Pilot Projects in Water Management

Practicing Change and Changing Practice

Pilot Projects in Water Management

Practicing Change and Changing Practice

Proefschrift

ter verkrijging van de graad van doctor
aan de Technische Universiteit Delft,
op gezag van de Rector Magnificus prof. ir. K.C.A.M. Luyben,
voorzitter van het College voor Promoties,

in het openbaar te verdedigen
op donderdag 2 december 2010 om 10.00 uur

door

Heleentje Sarah Isis VREUGDENHIL

Technisch Bestuurskundig ingenieur
geboren te Amersfoort

Dit proefschrift is goedgekeurd door de promotor:
Prof.dr.ir. W.A.H. Thissen

Copromotor:
Dr. J.H. Slinger

Samenstelling Promotiecommissie:

Rector Magnificus	voorzitter
Prof.dr.ir. W.A.H. Thissen	Technische Universiteit Delft, promotor
Dr. J.H. Slinger	Technische Universiteit Delft, copromotor
Prof.dr. J. Grin	Universiteit van Amsterdam
Prof.mr.dr. E.F. ten Heuvelhof	Technische Universiteit Delft
Prof.dr. A.J.M. Smits	Radboud Universiteit Nijmegen
Prof.dr. P. van der Zaag	UNESCO-IHE, Delft

Publisher:
VSSD
Leeghwaterstraat 42
2628 CA Delft
The Netherlands
+31 15 278 2050
balie@vssd.nl
www.vssd.nl/hlf

ISBN 978-90-6562-257-0

Cover design ‘The Rhine from source to sink’ by Jeroen van der Heijden

PRINTED IN THE NETHERLANDS

Acknowledgements

Rivers are highly important for societies in several ways. During my training as an engineer in Systems Engineering, Policy Analysis and Management, I became interested in the policy and management of rivers and particularly in the role that nature restoration can play in achieving flood defence, environmental- and economic goals. In many places nature restoration initiatives in river management are not yet common practice, but are implemented in the form of pilot projects. In these pilot projects multi-actor challenges and creativity come to the forefront, what has triggered my interest for pilot projects. I asked myself questions like 'how comparable are pilot projects', 'who uses pilot projects and for which purposes', 'what are the outcomes of the pilot project' and 'do these meet the expectations of the initiators and if not, why not'? In studying these and related questions for this doctoral thesis, I had the help of many people. I'd like to take the opportunity to thank them for their contributions.

First, I'd like to thank my promotors and good colleagues Wil Thissen and Jill Slinger, who provided me with the opportunity to undertake a PhD and gave me the freedom to develop my skills and thoughts as a scientist. I appreciate all the time and effort they took in discussing ideas with me and in encouraging me to take the work one step further than I thought I could. You are a good team. Particular thanks Jill for all the English editing. I'd also like to thank my thesis committee members John Grin, Ernst ten Heuvelhof, Toine Smits and Pieter van der Zaag for commenting insightfully on my work and for their presence on the day of the defence.

This thesis was conducted under the auspices of the Water Research Centre Delft, with funding from the Multi-Actor Systems Research initiative of the TU Delft, the EU Interreg IIIb "Freude am Fluss" project and with some support from Deltares. I'd like to thank the people who directly or indirectly contributed to this thesis with their comments on draft chapters or related journal articles, including Kevin Collins, Helen Ingram, Niki Frantzeskaki, Jeroen van der Heijden, Dave Huitema, Emiel Kater, Philippe Ker Rault, Simone Ledermann, Jens Newig, Claudia Pahl-Wostl, Daniël Rüetschi and Marcel Stive.

I'm much indebted to the people in water and nature management with whom I established contact via Daan Vreugdenhil. These people were prepared to share their experience with, and knowledge of developments in water management with me. They were very important in deepening my understanding of river systems and the developments in river management and policy, both in discussions and in taking me out into the field. They confirmed the challenges, questions and relevance of my research on pilot projects in water management. I'd specifically like to mention Henk Saeijs and Dick de Bruin who both played a significant role in changing water management in the Netherlands, as water director of the Delta area and as driving

force behind Plan Ooievaar, respectively, as well as Pieter Huisman and Ben van de Wetering from the ICPR.

For this thesis I studied three pilot projects on floodplain management in the Rhine Basin and a number of pilot projects in the innovation program of the Dutch Rijkswaterstaat. I'm much indebted to the people in the case studies who shared their experience and views with me and took me out into the field. Sincere thanks to all of you. It is a crucial in policy studies like this to hear different perceptions of the same project. Although I would like to, I cannot mention all of your names individually. However, a few people deserve specific mention. In the Dutch case study Emiel Kater was a particular help to me, in Germany Jost Armbruster fulfilled this role and in Switzerland it was Daniël Rüetschi who made the Swiss case study possible. They each helped me to understand the project, to contact other involved actors and were always available to discuss and verify information. Your passion for nature restoration and yet your abilities to reflect critically on the pilot projects were very valuable in many ways. For the Dutch case study, which motivated me to start a PhD in the first place, I'd like to thank the people of the Radboud University as well as Johan Bekhuis, Joep Mannaerts and Bart Peters. Specifically, the field trip to the Allier River in France in which you explained and illustrated the dynamics natural to a river system served as an eye-opener to me. Toine, you showed that with ongoing enthusiasm one can make great strides, even when your plans do not fit in with mainstream thinking. A very nice detail is that during the printing of this thesis the excavation works on Plaat Ewijk are taking place! Lastly, I also used empirical material from the WINN pilot projects conducted by Deltares and RWS. Many people involved in the WINN projects were prepared to share their experiences with me and I was invited to participate in meetings and workshops. I'd like to thank Sonja Karstens and Maya Sule for their support with the WINN project.

Essential to enjoying any type of job, including a PhD, are one's colleagues. I had the privilege of being surrounded by nice colleagues. People in the Policy Analysis group are kind, willing to help, constructive, good partners with whom to discuss issues both in science and daily life, and are good in their academic field. Some of you have become really good friends! I'd like to thank Gonny and Monique for their reliability in making arrangements even when I was late. Maaike, WG, Stephanie and Miriam shared an office, and so many hours of their life, with me. Miriam: Max Weber and Marie Curie are the ultimate proof that you are a true academic. Alexander, it was good to discuss ethical questions about the relations between humans and animals, in the zoo with you. Let's hope we get another cold winter so that we can go ice-skating again over the Dutch lakes. To the beach-volley team, Erik, Niki, Gonenc, it was always lots of fun even though our thesis work and other obligations took away much of our playing time last summer. Thank you Bert, Jan, Els, and also Susan Taljaard, even though you live abroad. Despite the big barrier, people along the corridor 'on the other side of the door' are also very nice. Hester, you're an excellent plant keeper. Jeroen, thank you for designing the cover. I'm sure you will find a new friend to cycle through Midden-Delfland with and to join you in thinking about science, scientists and universities. Carla, Bauke and Catherine, thank you for your

help in reflecting on my work and on being a PhD researcher in general. Furthermore, thank you Menno for designing the Nonagon, Jessica for helping me out with the German and Werner for keeping the building open.

Philippe, through all the discussions we had you have made very important contributions to this thesis. Thank you for your support and you're a good horseman: I'm looking forward to see you working with Jolly Jumper! A special word to Jill: you were more than a supervisor. With your creativity, lasting enthusiasm and knowledge of people and water systems, you made the PhD process very inspiring. I will miss you popping into my office to discuss small and large things. I think I have been very lucky to work so closely with you. I hope that in the future we will have many opportunities to work together again.

The people not yet mentioned, but also very important, if only for understanding that in the many tradeoffs I made between you and my work, I often chose the latter. Thank you for your trust and for being pleasant companions, Ien and Flip, Willemijn and Mariken, Karin, Monica, Niki, Petra, Pauline, Jessica, D2 and Marco. Thank you Amanda and Corine for taking care of Royal so many times. Lastly, I'd like to thank Petra and Mariken for acting as my paranymphs during the defence.

The book lying in front of you represents the culmination of my PhD research at Delft University of Technology. Its completion was only made possible by your support. I hope you will enjoy reading it!

Heleen Vreugdenhil

December 2010

Summary

Why study pilot projects in water management?

Pilot projects are popular instruments in water management. Many water managers, policy-makers, companies, NGOs and scientists initiate or participate in pilot projects. The Water Framework Directive of the European Union and diverse national policies in Europe specifically encourage the use of pilot projects. Pilot projects align with the desire for controlled innovation in complex social-ecological systems with high uncertainty and dynamics. The innovations applied in pilot projects can be diverse, and include new technologies, new river management approaches and new governance styles. Pilot projects are expected to provide the space to practice change without having major negative impacts societally or professionally. Additionally, they are expected to deliver the knowledge to make grounded decisions regarding the use, adoption, adaptation or rejection of innovations. However, in practice, insights developed in a pilot project are often ignored, do not reach the right audience, may be considered irrelevant, or are opposed. Consequently, the influence of pilot projects in changing established practices is often considered disappointing.

The increasing use of pilot projects, the disappointments in their influence on policy and practice, and the limited attention paid to pilot projects in scientific literature provide the motivations for this research. The aim of the research is to deepen the understanding of the phenomenon 'pilot project' and to elicit possibilities to increase the influence of pilot projects in policy and management. Accordingly, the main research question addressed is '*How do pilot projects in Integrated Water Management contribute to policy and practice and how can their contribution be strengthened?'*

Research approach

For this research, a staged approach was adopted. This implies that insights and questions obtained from early data collection and analysis provide the basis for later research stages. Three main stages are distinguished: a primary analysis, a case study research and a reflection. Data are obtained through interviews, document study and participation in meetings and workshops.

In the primary analysis, the phenomenon 'pilot project' is explored. Pilot project uses, characteristics, contexts and the effects on policy-making and management are explored and conceptualized in a framework of analysis (see Figure 1 for an overview). The input for the primary analysis derived from interviews with experienced water managers and sixteen WINN pilot projects. WINN is the water innovation program of Rijkswaterstaat in the Netherlands. Additionally, a literature review regarding the roles that different policy development theories ascribe to pilot projects is performed.

In the second stage of the research, the case study research, the framework of analysis is applied to three case studies along the river Rhine. The case studies deal with Cyclic Floodplain Rejuvenation in the floodplains of Beuningen (the Netherlands), Ecological Floods in Polder Altenheim (Germany) and Floodplain Revitalisation in a drinking water production area in Basel (Switzerland). All case studies focus on floodplain revitalisation, but were initiated by different types of actors, for different purposes and had different effects on policy-making and management. The Beuningen pilot project demonstrates possibilities for the diffusion of an innovation even though the pilot has not yet been implemented. The Altenheim case provides an example of a longer post-pilot implementation period and illuminates the different mechanisms of diffusion in policies and in practice. The Basel case study provides an example of a pilot project in which 'evidence' was disputed, leading to conflict.

As a third and last stage in the analysis, insights from both the primary analysis and the case study research are reflected upon and validated using further interviews and literature. The piloting process is analysed and factors influencing the diffusion of pilot projects are identified. This provides the input for the development of recommendations aiming at strengthening the influence of pilot projects on policy and management. Additionally, the contributions of this thesis to the policy literature are reflected upon. The identified limitations led to the development of a research agenda.

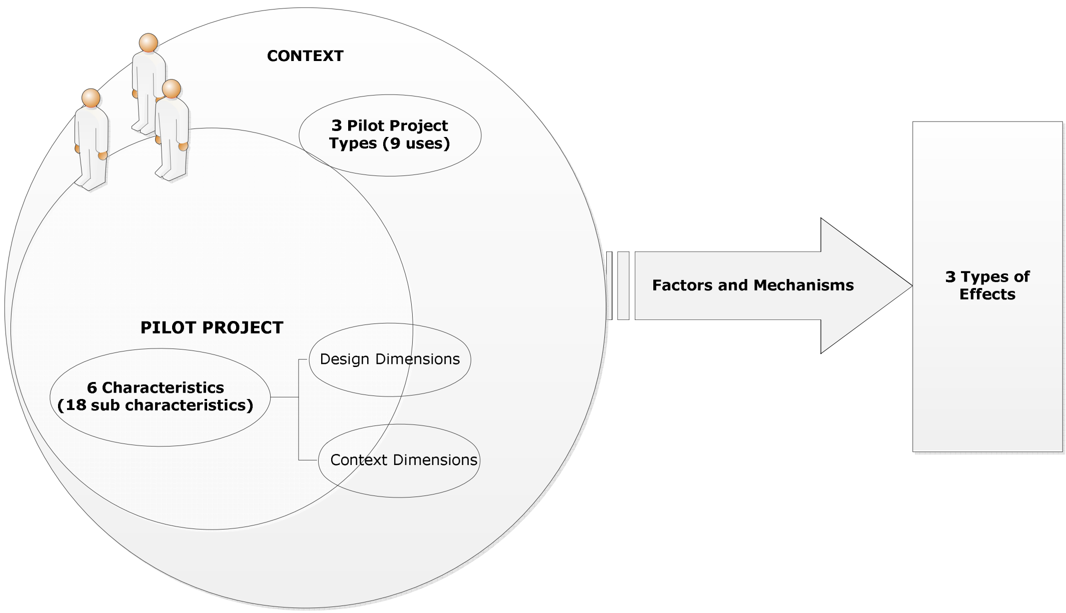


Figure 1. Overview of the different aspects of pilot projects and their relation studied in this thesis

What are pilot projects?
'Pilot project' appears to be an ambiguous concept. Different meanings are assigned to the concept, actors can use an individual pilot project for multiple purposes and they can have different appearances. I define pilot projects as '*projects in which innovative approaches or technologies are applied at a small-scale field setting in order to gain broad insight in the functioning of the innovation in praxis. Knowledge is possibly diffused into policy-making and management'*. Pilot projects can be distinguished from laboratory experiments by their field application and from routine water management projects by the application of innovations and the focus on knowledge creation and learning.

I identify three different types of pilot projects: *Research, Managerial* and *Political-Entrepreneurial* pilot projects. More specifically, pilot projects can be used for *Evaluation, Exploration, Communication, Policy Implementation, Problem Mitigation, Insurance, Incentive, Political Game* and *Advocacy* purposes. The multiplicity of uses of a pilot project can be mapped using the Pilot Nonagon developed in this research. Further, an individual pilot project can be described based on six characteristics (i.e. *Relation to Policy and Local Context, Scale, Innovation, Knowledge Orientation, Special Status* and *Actor Network*, subdivided into 18 sub-characteristics). The characteristics can take on a broad range of values indicating the diversity in pilot projects. For example, the level of innovation can vary from radical to incremental, and the quality and intensity of the knowledge program can be highly variable despite the knowledge generation claim of pilot projects. The (sub-)characteristics for which a pilot initiator can actively make design decisions are termed the 'design dimensions' (e.g. which scale, level of innovation, which knowledge program), whereas the contextually determined (sub-) characteristics are termed the 'contextual dimensions' (e.g. is a pilot project supply or demand driven, which actors participate). Note that the design and contextual dimensions can differ from pilot project to pilot project. For example, one pilot project initiator could choose to design a pilot project near the policy core to gain policy attention. However, another pilot project initiator might be forced to position the pilot near the policy core, owing to financial dependency.

Contributions of pilot projects to policy and practice
Pilot projects exert three types of effects either directly on the pilot area and its actors, or more broadly on policy and management. The effects can be classified as:

- Systems' Response
- Knowledge Development
- Diffusion

The systems' response is the most direct effect of a pilot project on its biophysical- and actor-network context. An intervention changes the area and new ecological processes may take place. Additionally, the actor-network structure changes in reaction to the initiation of the pilot and the developments taking place. For instance, actors who have not cooperated before now do so and new relationships develop. The systems' response can be the primary purpose of a pilot, but also provides the basis for knowledge development.

Knowledge development includes knowledge creation and learning. I describe the created knowledge along three dimensions. The first is the degree to which the knowledge is substantive (e.g. on ecology or technology) or process-related (e.g. on permits or roles of actors). The second is the degree to which the knowledge is context-dependent or generic, whereby generic is a relative notion (e.g. generic to a floodplain, river, across sectors). The third dimension is the distinction between hard and soft knowledge. Hard knowledge can be explicated easily, whereas soft knowledge is difficult to share and is embedded in or between individuals. Examples are skills, relationships, experience, shared values and intuition. The pilot projects studied were generally initiated to develop hard substantive knowledge about the innovation itself. However, the research shows that all types of knowledge can be created in a pilot project. Pilot projects are particularly strong in the development of unique context-dependent and soft knowledge. Who learns is highly dependent on the actor participation, owing to the importance of experiencing in learning. Additionally, the interpretation of knowledge is subject to perceptions. For one actor, a pilot provides the evidence necessary to continue and expand, and for another the interpretation of the same knowledge is the reason to give up on the innovation. Moreover, 'evidence' appears to not be necessary to support diffusion: anticipated evidence can already be sufficient. Additionally, the study demonstrates that 'social learning' that takes place, can be both of a constructive and a destructive nature. As a consequence actors can both intensify or avoid further cooperation.

The last type of effect is the diffusion of pilot projects into policy and management. Diffusion is described in terms of its patterns, nature and channels. Patterns of diffusion include dissemination and scaling up. Dissemination refers to the spread at the operational level such as the initiation of new (pilot) projects and the refinement or adjustment of the existing pilot project. Scaling up refers to the expansion of the scale of the pilot project in space and times and to the inclusion of the pilot project in institutions, for instance in a policy or in the formalisation of a cooperation structure. The majority of diffusion patterns relate to the pilot design (e.g. from regional to regional). The nature of the diffusion can be narrow or broad. Narrow diffusion means that the innovation itself is replicated. Broad diffusion goes beyond the replication of the innovation alone and can include the use of methods, supporting technologies, cooperation structures and skills. In water management, the diffusion of pilot projects is usually of a broad nature. Channels of diffusion can be internal, external or mixed. The majority of diffusion in the studied pilot projects takes place through internal or mixed channels. The dependence on initiators and other participants for diffusion is therefore large. This is not surprising as these are the actors who have learned the most and are the most attached to the pilot.

Pilot project dynamics

Different activities are undertaken in a pilot project. Following the initiation, these include *the process design, design of the intervention, implementation of the intervention, monitoring and analysis* and *diffusion*. Expectations of pilot projects can be inferred on the basis of which activities are present in the pilot project. I identify first a narrow 'routine project view' in which the focus is on intervention design and implementation. The pilot is primarily an end in itself. Second, I identify the 'archetypical pilot project view' in which the process is expanded with monitoring and analysis. Third, in an 'inclusive pilot project view' all activities are undertaken, including the facilitation of diffusion. Major factors that influence pilot dynamics and so the diffusion into policy and management include:

- **Pilot characteristics:** Some characteristics, particularly the special status and confined scale, enable the participation of actors. Actor involvement influences both whose knowledge is available for the pilot and who will learn. Demand-driven pilot projects more naturally involve future users and meet their demands, but supply-driven pilots at the policy periphery have more room for more radical innovation. Involvement of current critical actors is needed to initiate the pilot. Involvement of future critical actors is needed to diffuse the pilot.
- **Perceptions:** Perceptions and underlying value systems guide the pilot design, including the focus of knowledge creation, the interpretation of the pilot (what is the nature of the 'evidence'?) and the further use of the knowledge. In return, perceptions of the problem, the innovation and of each other can be influenced by the pilot design and in particular by the perceived governance style and actor involvement.
- **Intensity and timing of diffusion activities**: It is a common pitfall to exercise a narrow view by focusing on the implementation and development of hard knowledge alone and either expecting diffusion to occur autonomously or only focusing on diffusion later. When initiators act as pilot project ambassadors diffusion may increase.

Pilot Design: Strategies and Dilemmas

Due to the complexity of pilot projects, simple cause and effect relations and therefore blueprints for pilot design cannot be provided. Nevertheless, the study reveals some strategies for, and dilemmas of, pilot project design. The recommendations for strategies apply to pilot project initiators aiming for diffusion. The strategies relate to the design dimensions through which the initiator has the possibility to influence the pilot project. In essence, encouraging diffusion encompasses facilitating learning of both hard and soft knowledge by critical actors. Strategies include:

- Formulating flexible diffusion activities in the pilot plan and reserving resources. Initiators should take the responsibility to drive diffusion
- Identifying current and future critical actors and application areas

- Exercising open governance styles to facilitate constructive social learning

A major design dilemma is the representativeness of the pilot versus the ease of implementation. Due to the pilot status, its location and scale choice, the pilot provides favourable conditions for actors to participate and learn, to maintain implementation speed and to isolate specific research aspects. However, at the same time it reduces the representativeness of the developed knowledge for larger scale application in other areas. Actors may have little trust in results. They can even use this design option for opportunistic reasons. By specifically designing the pilot to be non-representative for other areas, the results of the pilot project can be set aside easily. Another dilemma relates to institutionalization. Institutionalization can ensure long-lasting support for diffusion of the pilot. However, it also reduces the flexibility of the innovation to adjust to new circumstances, and can form a barrier for future innovation. Moreover, it provides no guarantee of implementation. Due to the involvement of new actors, diffusion at the operational level usually requires new initiatives, such as pilot projects, to develop shared experience.

Concluding remarks

In this thesis, I demonstrate that the added value of pilot projects lies in their potential to establish cooperation within unconventional actor coalitions and in the development of context-dependent hard and soft knowledge. Pilot projects enable policy-makers, managers and researchers to practice changes and so to potentially change practices.

Samenvatting

Waarom is het bestuderen van pilot projecten in het waterbeheer belangrijk?
Pilot projecten zijn veelgebruikte instrumenten in het waterbeheer. Vele waterbeheerders, beleidsmakers, bedrijven, maatschappelijke organisaties en wetenschappers starten een pilot project of doen eraan mee. De Kaderrichtlijn Water van de Europese Unie en diverse nationale beleidsprogramma's in Europa moedigen zelfs het gebruik van pilot projecten specifiek aan. Pilot projecten sluiten aan bij de wens om gecontroleerd te innoveren in complexe sociaal-ecologische systemen, die zich laten kenmerken door onzekerheid en dynamiek. De innovaties toegepast in de pilot projecten kunnen van verschillende aard zijn, zoals nieuwe technologieën, nieuwe benaderingen voor rivierbeheer, of nieuwe governance stijlen. Men verwacht daarbij dat pilot projecten de ruimte bieden om te kunnen oefenen met veranderingen zonder dat er grote negatieve maatschappelijke of beroepsmatige gevolgen zijn. Bovendien verwacht men dat ze kennis opleveren op basis waarvan gegronde beslissingen kunnen worden genomen met betrekking tot het gebruik, aanpassing of afwijzing van de innovaties. In de praktijk echter, worden de inzichten die in het pilot project worden ontwikkeld vaak genegeerd, ze bereiken niet de juiste mensen, ze worden als irrelevant beschouwd of ze worden tegengesproken. De mate waarin pilot projecten invloed hebben op het veranderen van bestaande praktijken wordt vaak als teleurstellend ervaren.

De toename in het gebruik van pilot projecten, de teleurstelling over hun invloed op beleidsontwikkeling en uitvoering en de beperkte aandacht die is besteed aan pilot projecten in wetenschappelijke literatuur vormen samen de motivatie voor dit onderzoek. Het doel van het onderzoek is enerzijds het vergroten van het begrip van het fenomeen 'pilot project' en anderzijds het vinden van mogelijkheden om de invloed van pilot projecten op beleidsontwikkeling en uitvoering te vergroten. De hoofdonderzoeksvraag is *'Hoe dragen pilot projecten in Integraal Waterbeheer bij aan beleidsontwikkeling en uitvoering en hoe kan hun bijdrage worden versterkt?'*

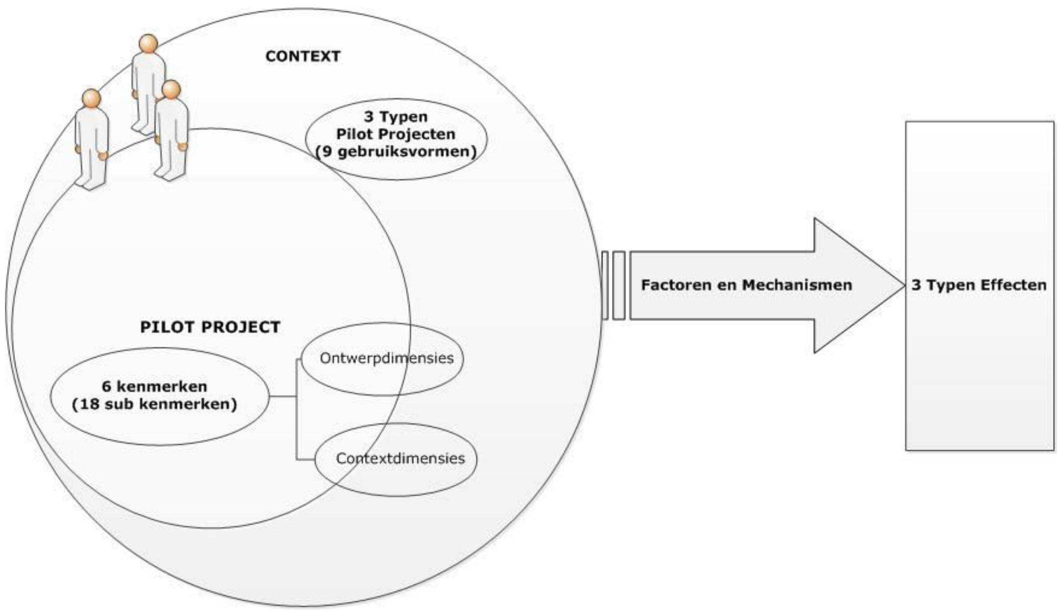
Onderzoeksaanpak
Voor dit onderzoek is een gelaagde aanpak gebruikt. Dit betekent dat inzichten en vragen uit eerdere data verzamelings- en analyse activiteiten de basis vormen voor latere onderzoeksfasen. De drie belangrijkste fasen zijn een primaire analyse, casus onderzoek en een reflectie. Gegevens worden verzameld door middel van interviews, documenten studie en deelname aan vergaderingen en workshops.

In het eerste deel van het proefschrift, de primaire analyse, wordt het fenomeen 'pilot project' verkend. Het gebruik van pilot projecten, hun kenmerken, de context en hun effecten op beleidsontwikkeling en beheer worden verkend en geconceptualiseerd in een analysekader (zie Figuur 1). De input voor de primaire analyse komt van interviews met ervaren waterbeheerders en zestien WINN pilot projecten. WINN is het waterinnovatie programma van Rijkswaterstaat in Nederland.

Daarnaast wordt er een literatuurstudie gedaan naar de rollen die verschillende beleidsontwikkelingstheorieën toeschrijven aan pilot projecten.

In het tweede deel van het proefschrift, het casusonderzoek, wordt het analysekader toegepast op drie casussen langs de Rijn. De casussen gaan over 'Cyclisch Verjongen' van uiterwaarden in de Beuningse uiterwaard (Nederland), 'Ecologische Overstromingen' in Polder Altenheim (Duitsland) en 'Uiterwaardherstel in een drinkwaterproductiegebied' in Basel (Zwitserland). Alle casussen gaan over het revitaliseren van uiterwaarden, maar werden geïnitieerd door verschillende typen actoren, voor verschillende doeleinden en hadden verschillende type effecten op beleidsontwikkeling en beheer. De Beuningen casus laat de mogelijkheden voor de diffusie van een innovatie zien door middel van een pilot project, zelfs als de pilot nog niet is uitgevoerd. De Altenheim casus is een pilot project met een lang traject na de uitvoering van het pilot project en geeft inzicht in verschillende diffusie-mechanismen tussen institutionalisering en uitvoering van pilot projects. De Basel casus is een voorbeeld van een pilot project waarin 'bewijs' afkomstig van de pilot ter discussie werd gesteld en tot conflict leidde.

In het derde en laatste deel van het proefschrift wordt gereflecteerd op inzichten van zowel de primaire analyse als het casusonderzoek. Verworven inzichten worden gevalideerd door verdere interviews en literatuurstudie. Het pilot proces en bijbehorende mechanismen wordt geanalyseerd en factoren die het diffusieproces van pilot projecten beïnvloeden geïdentificeerd. Op basis van deze analyse worden aanbevelingen ontwikkeld gericht op het vergroten van de invloed van pilot projecten op beleid en uitvoering. Daarnaast wordt op de bijdrage van dit proefschrift op beleidsliteratuur gereflecteerd. De identificatie van beperkingen leidt tot het opstellen van een agenda voor vervolgonderzoek.



Figuur 1. Overzicht van de verschillende aspecten van pilot projecten en hun relatie bestudeerd in dit proefschrift.

Wat zijn pilot projecten?
Het concept 'pilot project' blijkt een ambigu concept te zijn. Er worden verschillende betekenissen gegeven aan het concept, actoren kunnen een individueel pilot project voor meerdere doeleinden gebruiken en een pilot kan diverse verschijningsvormen hebben. Ik definieer pilot projecten als *'projecten waarin innovatieve benaderingen of technologieën worden toegepast in een kleinschalige veldopstelling om zo een breed inzicht te verkrijgen in het functioneren van de innovatie in de praktijk. De verworven kennis wordt mogelijk verspreid naar beleid en beheer.* Pilot projecten onderscheiden zich van laboratoriumexperimenten door de praktijktoepassing van een innovatie en van routine water management projecten door het gebruik van innovaties en de focus op kennisontwikkeling en leren.

Ik identificeer drie verschillende type pilot projecten: *Onderzoeks-* en *Management* pilot projecten en pilot projecten met een *Strategisch-Ondernemend* karakter. Specifieker, pilot projecten kunnen worden gebruikt voor *Evaluatie, Verkenning, Communicatie, Beleidsimplementatie, Probleem oplossen, Verzekering, Prikkel, Politiek Spel* en *Advocatie.* Het meervoudig gebruik van pilot projecten kan weergegeven worden in de Pilot Nonagon die daarvoor ontwikkeld is in dit proefschrift. Verder kan een individueel pilot project beschreven worden op basis van zes kenmerken, te weten *Relatie tot Beleid en Lokale Context, Schaal, Innovatie, Kennis Oriëntatie, Speciale Status* en *Actor Network.* Deze zijn weer onderverdeeld in 18 sub-kenmerken. De waarden die deze hebben kunnen erg verschillend zijn, wat de verscheidenheid van pilot projecten weergeeft. Bijvoorbeeld, het innovatieniveau kan variëren tussen radicaal en incrementeel en de kwaliteit en intensiteit van het kennisprogramma kan sterk variëren ondanks het doel van pilot projecten om kennis te ontwikkelen. De (sub) kenmerken waarop een initiatiefnemer actief ontwerpbeslissingen kan nemen zijn de 'ontwerpdimensies' (bijv. welke schaal, welk innovatieniveau, welk kennisprogramma), terwijl de (sub) kenmerken die door de context bepaald worden 'omgevingsdimensies' genoemd worden (bijv. is een pilot aanbod- of vraag gestuurd, welke actoren doen mee). Er moet daarbij opgemerkt worden dat de ontwerp- en omgevingsdimensies per pilot project kunnen verschillen. Zo kan een initiatiefnemer besluiten een pilot in het hart van een beleidsveld te positioneren om zo beleidsaandacht te krijgen, terwijl een andere initiatiefnemer gedwongen wordt om de pilot dichtbij het hart van het beleid te positioneren vanwege financiële afhankelijkheid.

Bijdragen van pilot projecten aan beleid en praktijk
Pilot projecten vertonen drie type effecten op het pilot gebied en/of haar actoren, en in bredere zin op beleid en beheer. De effecten zijn geclassificeerd als:

- Systeemreactie
- Kennisontwikkeling
- Diffusie

De systeemreactie is het meest directe effect van een pilot project op haar (bio)fysieke en sociale actor-netwerk omgeving. Als gevolg van een interventie verandert het gebied en kunnen nieuwe ecologische processen opkomen. Daarnaast verandert de actor-netwerk structuur in reactie op zowel het initiëren van de pilot als op de ontwikkelingen die als gevolg daarvan plaatsvinden. Bijvoorbeeld, actoren die eerder nog niet hebben samengewerkt, werken nu samen en nieuwe relaties ontwikkelen zich. Een systeemreactie kan het primaire doel zijn van een pilot, maar ze biedt ook de basis voor kennisontwikkeling.

Kennisontwikkeling omvat zowel het creëren van nieuwe kennis als leren. Ik beschrijf de gecreëerde kennis aan de hand van drie dimensies. De eerste is de mate waarin kennis substantief (bijv. over ecologie of technologie) of proces-gerelateerd (bijv. over vergunningen en rollen van actoren) is. De tweede is de mate waarin kennis context-afhankelijk of generiek is, waarbij generiek een relatieve notie is (bijv. generiek voor een uiterwaard, rivier of tussen sectoren). De derde dimensie is het onderscheid tussen harde en zachte kennis. Harde kennis kan eenvoudig worden geëxpliciteerd, terwijl zachte kennis moeilijk te delen is. Het zit ingebed in individuen of in een relatie tussen individuen. Voorbeelden hiervan zijn vaardigheden, relaties, ervaring, gedeelde waarden en intuïtie. De bestudeerde pilot projecten waren over het algemeen ingezet om harde, substantieve kennis te ontwikkelen over de innovatie zelf. Het onderzoek toon echter aan dat in een pilot project niet alleen alle typen kennis ontwikkeld kunnen worden, maar ook dat ze vooral sterk zijn in de ontwikkeling van unieke context-afhankelijke en zachte kennis. Wie leert is sterk afhankelijk van de actorparticipatie, vanwege het belang van leren door ervaring. Daarnaast geldt dat de interpretatie van kennis afhankelijk is van percepties. Voor de ene actor biedt een pilot het bewijs dat het nodig is om ermee door te gaan of zelfs uit te breiden, terwijl voor een andere actor de interpretatie van dezelfde kennis de reden is om de innovatie op te geven. 'Bewijs' afkomstig van de pilot blijkt ook niet nodig te zijn om diffusie te steunen: 'verwacht bewijs' kan al voldoende zijn. Verder laat de studie zien dat het 'sociaal leren' dat plaatsvindt zowel constructief als destructief kan zijn. Als gevolg daarvan kunnen actoren hun samenwerking verder versterken of juist vermijden.

Het laatste type effect is de diffusie van pilot projecten in beleidsontwikkeling en uitvoering. Diffusie wordt beschreven aan de hand van patronen, aard en kanalen. Diffusiepatronen zijn disseminatie en opschaling. Disseminatie verwijst naar de verspreiding op het operationeel niveau zoals het opstarten van nieuwe (pilot) projecten en het verfijnen of aanpassen van het oorspronkelijke pilot project. Opschalen verwijst naar de expansie van de pilotschaal in ruimte en tijd en de opname van het pilot project in instituties, bijvoorbeeld door opname in een beleidsprogramma of door het formaliseren van samenwerkingsstructuren. De meerderheid van diffusiepatronen zijn gerelateerd aan het pilotontwerp (bijvoorbeeld van regionaal naar regionaal). De aard van diffusie kan zowel smal als breed zijn. Smalle diffusie houdt in dat de innovatie elders opnieuw wordt toegepast. Brede diffusie gaat voorbij de herhaling van de innovatie alleen en kan het gebruik van methoden, ondersteunende technologieën, samenwerkingsverbanden en vaardigheden omvatten. Diffusie in het waterbeheer is meestal van een brede aard. Diffusiekanalen tenslotte, kunnen intern, extern of gemengd zijn. De meerderheid van de diffusie in de bestudeerde projecten vindt plaats door interne of gemengde kanalen. De mate van diffusie is sterk afhankelijk van de acties van initiatiefnemers en andere deelnemers. Dit is niet verassend aangezien zij de degenen zijn die het meest geleerd hebben en het meest gehecht zijn aan de pilot.

De dynamiek van pilot projecten

In een pilot project worden verschillende activiteiten ondernomen. Deze activiteiten zijn, na de initiatie, *het proces ontwerp, het ontwerp van de interventie, implementatie van de interventie, monitoring en analyse* en *diffusie.* Uit de aanwezigheid van de verschillende activiteiten in een pilot project kunnen verwachtingen erover afgeleid worden. Ik onderscheid eerst het smalle 'routine project perspectief' waarin de focus is op het ontwerp van de interventie en de implementatie ervan. De pilot is voornamelijk een doel op zich. Een tweede onderscheid is het 'typische pilot project perspectief', waarin het proces wordt uitgebreid met monitorings en analyse activiteiten. Ten derde onderscheid ik het 'omvattende pilot project perspectief', waarin alle activiteiten worden ondernomen, inclusief het faciliteren van diffusie. Hoofdfactoren die de pilotdynamiek beïnvloeden en op die manier de diffusie in beleid en uitvoering aansturen zijn:

- **Pilotkenmerken:** Sommige kenmerken, en dan vooral de speciale status en de beperkte schaal, maken de participatie van actoren mogelijk. Actordeelname beïnvloedt zowel wiens kennis beschikbaar is voor de pilot als wie leert. Vraaggestuurde pilot projecten betrekken toekomstige gebruikers vanzelfsprekender en komen ook eenvoudiger tegemoet aan hun behoeften. Aanbodgestuurde pilot projecten daarentegen hebben meer ruimte voor radicalere innovatie. Het betrekken van huidige kritieke actoren is nodig om de pilot te initiëren. Het betrekken van toekomstige kritieke actoren is nodig voor de diffusie van de pilot.
- **Percepties:** Percepties en de onderliggende waardensystemen zijn leidend voor het pilot ontwerp, inclusief de focus op het creëren van kennis, de interpretatie van de pilot (wat is de aard van het ontwikkelde 'bewijs') en het verdere gebruik van de kennis. Percepties op zowel het probleem, de innovatie als op elkaar, kunnen dan weer beïnvloed worden door het ontwerp van de pilot en vooral door hoe de governance stijl en de actorparticipatie worden ervaren.
- **Intensiteit en timing van diffusie activiteiten:** Een valkuil van pilot projecten is het uitoefenen van een smalle perceptie door zich alleen te richten op de implementatie en ontwikkeling van kennis. Er wordt verwacht dat diffusie vanzelf gaat of men richt zich pas veel later op diffusie. Door het optreden als ambassadeur kunnen pilot project initiatiefnemers de diffusie mogelijk laten toenemen.

Pilotontwerp: Strategieën en Dilemma's

Vanwege de complexiteit van pilot projecten, kunnen eenvoudige oorzaak-gevolg relaties en daarom standaard pilot-ontwerpen niet geboden worden. Desalniettemin onthult de studie wel een aantal strategieën en dilemma's voor pilotontwerp. De aanbevelingen voor strategieën zijn relevant voor initiatiefnemers van pilot projecten die zich richten op diffusie. De strategieën zijn gerelateerd aan de ontwerpdimensies waarmee de initiatiefnemer de mogelijkheid heeft de pilot te beïnvloeden. De essentie van het versterken van de diffusie ligt in het faciliteren van leren van zowel harde als zachte kennis door kritieke actoren. Strategieën zijn:

- Het formuleren van flexibele diffusie activiteiten in het pilot plan en het reserveren van hulpmiddelen. Initiatiefnemers zouden de verantwoordelijkheid moeten nemen om diffusie te stimuleren
- Het identificeren van huidige en toekomstige kritieke actoren en toepassingsgebieden
- Het toepassen van open governance stijlen om constructief sociaal leren te faciliteren

Een groot ontwerpdilemma is de representativiteit van de pilot versus het gemak van uitvoering. De pilot status, locatie en schaalkeuzen bieden aantrekkelijke omstandigheden voor actoren om te participeren in de pilot en te leren, het vasthouden van uitvoeringssnelheid en het isoleren van specifieke onderzoeksvragen. Echter, diezelfde omstandigheden zorgen ervoor dat de representativiteit van de ontwikkelde kennis voor toepassing in andere gebieden op groter schaalniveau omlaag gaat. Het vertrouwen van actoren in de resultaten gaat omlaag. Ze kunnen deze ontwerpoptie zelfs strategisch gebruiken. Door de pilot zodanig te ontwerpen dat deze niet representatief is voor andere gebieden, kunnen de resultaten relatief eenvoudig aan de kant gezet worden. Een ander dilemma is gerelateerd aan institutionalisering. Door institutionalisering wordt de lange termijn ondersteuningen voor de pilot verzekerd. Echter, het verkleint ook de flexibiliteit van de innovatie om zich aan te passen aan nieuwe omstandigheden en kan een barrière vormen voor toekomstige innovaties. Daarnaast biedt het geen garanties voor uitvoering. Vanwege de betrokkenheid van nieuwe actoren vereist diffusie op het operationele niveau vaak nieuwe initiatieven, zoals pilot projecten, om nieuwe gedeelde ervaring te ontwikkelen.

Tot slot

In dit proefschrift laat ik zien dat de toegevoegde waarde van pilot projecten ligt in het opzetten van samenwerking in ongebruikelijke actor coalities en in de ontwikkeling van context-afhankelijke zachte en harde kennis. Pilot projecten geven beleidsmakers, beheerders en onderzoekers de ruimte om veranderingen relatief veilig uit te proberen en zo mogelijk bestaande praktijken te veranderen.

List of Tables

List of Figures

Contents

Part I: Primary Analysis

1.

Introduction

1.1 Pilot projects in IWM

Pilot projects are commonly applied in diverse policy domains, including Integrated Water Management (IWM). In the EU Water Framework Directive for example, pilot projects aiming to explore the development of river basin plans, the shaping of participation processes and the implementation of the WFD at the local level are widely present (EC 2002, CIS 2003, Quevauviller *et al.* 2005, Carter and Howe 2006, EC 2007, Querner and Mulder 2007). In many other instances not directly in the realm of a policy or directive, pilot projects are also applied. Examples thereof are pilot projects addressing innovative dike re-inforcement technologies and river management approaches focussing on integrating nature and flood defence (De Bruin *et al.* 1989, Baptist *et al.* 2004, Sule and Casteren van Cattenburch 2009).

Pilot projects are popular policy instruments, because they enable decision-makers and innovators to try out new things under conditions of reduced or eliminated risk (Cabinet Office 2003). Particularly in an era when societies face the challenges arising from climate change, demographic developments, economic growth and changing values on democracy, new water management approaches need to be developed (Cosgrove and Rijsberman 2000, Olsson *et al.* 2004, Dehnhardt and Petschow 2008, Termeer and Meijerink 2008). New approaches can help societies to mitigate negative effects, to adapt to new circumstances and to grasp opportunities that arise. The refinement and testing of the new approaches and even their gradual implementation can take place in pilot projects. However, the popularity of pilot projects is not fully explained by their contribution to new approaches. They are also popular with decision makers because they provide an elegant means of sliding out of a policy process. By participating in a pilot project one may demonstrate goodwill, but one does not have to be fully committed to the innovation or the process.

Definitions of a pilot project as *something done or produced as an experiment or test before wider introduction* (Compact Oxford Dictionary of English 2008), *a seed for societal change* (Van Mierlo 2002) and *a stepping stone for societal change* (Van Sandinck and Weterings 2008) indicate the high expectations placed on pilot projects as starting points for large-scale societal changes or policy innovations. In the space they provide new ideas can be implemented on a small scale as a preparatory exercise before being rolled out fully. Furthermore, they place innovations in the spotlight, enable the development of knowledge on policy impacts and encourage participation. The participants gain experience in applying the innovation and cooperating with other actors. Through the encouragement of policy- or societal discussions within a pilot project and changed behaviours, pilot projects contribute to IWM policy processes (GWP 2000, Pahl-Wostl 2006, Campbell 1967, Pawson and Tilley 1997). In other words: pilot projects enable the practice of change and the change of existing practices.

However, despite the potential of pilot projects, initiators and evaluators are often disappointed about the results. Often, the pilot project remained an event that did not bring the anticipated broad application of the innovation. For example, technologies tested in a pilot project to strengthen dikes from inside were, at the moment of study in 2009, not used any further after the pilot period. The technologies were considered immature. In a pilot project on interactive designing of a multi-functional dike, plans were drawn, but it never came to implementation. In a pilot project on floodplain rehabilitation, the concept was not included in regional or national policies after the pilot, despite that it proved added value, according to participants. Complaints are that policy-makers are not open to learning, that subsidies for further study are lacking, that participants go back to 'business as usual', or that conflicts arise during the pilot project are legion (e.g. Sanderson 2002, De Groen *et al.* 2004, Wüthrich and Geissbühler 2002, Bennett and Howlett 1992, Birckmayer and Weiss 2000, pers. comm. pilot initiators).

Despite the disappointments in the seemingly limited effects of pilot projects on policy change, the underlying reasons of these disappointments are unclear. One could wonder how the judgments of pilot projects are made. Of course, it may well be that the innovation simply has not worked as expected and has demonstrated limited added value. But there may be a variety of other reasons for limited impact and follow-up of pilots. Are initiators caught in a 'pro-innovation bias' (Rogers 1995) and therefore have unrealistic expectations? Does the innovation have added value indeed? Possibly the innovation simply does not work yet as expected. Do evaluators have knowledge and tools at their disposal to recognize a broad array of pilot project effects? Which evaluation periods have been used? Then, under which conditions do pilot projects achieve certain effects? How are lessons included in management and why do policy-makers not adjust their policies? Do they not recognize and value effects of pilot projects appropriately? Were the policy-makers interested in change, or did they have other reasons to support the pilot project? And, did pilot project initiators pro-actively encourage the achievement of certain effects beyond the pilot project, or did they wait for others to pick up the innovation and continue? Maybe their interests were in the pilot itself, rather than in the inclusion of the innovation in policy-making and management. Which hurdles need to be taken to achieve a certain effect and which possibilities do initiators have to enhance the influence of a pilot project on policy making?

This study was initiated to deepen the understanding of pilot projects and so to generate insights useful for pilot project initiators to increase effectiveness of a pilot project. Despite their wide use by policy makers, researchers and the market, pilot projects have rarely been an object of study themselves, particularly in water management (Greenberg and Shröder 2004, Huitema *et al.* 2009). Consequently, few empirically grounded insights and recommendations regarding pilot projects are available. A possible reason is that water management has a strong engineering tradition. In engineering disciplines the focus is generally on (technological) knowledge that can be developed within a pilot project, rather than on the instrument itself. Theory on pilot projects that is present primarily derives from evaluations on pilot projects in other domains, such as social- or health care policies (e.g. Martin and Sanderson 1999, Sanderson 2002, Cabinet Office 2003, Greenberg and Shröder 2004). Few studies in related domains or more generically on policy evaluation do conceptualize relevant mechanisms such as learning and provide insights in the added value of pilot projects. However, also here overview is lacking on pilot project use, effects and dynamics and conclusions are sometimes more based on expectations than on empirical results (e.g. Pawson and Tilley 1997, Lee 1999, Pahl-Wostl 2006, Huitema *et al.* 2009, Raven 2006).

This thesis focuses on the motivations for the initiation of pilot projects, their different designs or appearances, the contributions they make to IWM policy and management and on factors influencing the pilot project. Based on the developed insights, I suggest strategies with which pilot project initiators can influence the pilot project and enhance its role in IWM. Accordingly, the study can contribute to reducing the gap between expectations of pilot projects and their outcomes.

In this introductory chapter, I first provide the working definition of pilot projects that I used as the starting point of the thesis. Then, I introduce IWM, the application domain of this thesis, address the objectives and challenges of this study and present the research questions. This is followed by the structure of the thesis and the research philosophy, in which research choices and researcher's stance are discussed.

1.2 A working definition of pilot projects

In order to enable the development of a comprehensive understanding of pilot projects, I choose to take projects into account that are labelled by their initiators as pilot projects or any similar term (e.g. experiment, social experiment, quasi-experiment, trial-and-error experiment, demonstration project, '*proeftuin*' (experimental garden), and front runner project). Exercising the open view implies that I will use a broad definition as a starting point for this research. I may take projects into account that others will not consider as 'true' pilot projects (cf. Campbell 1975).

In early work, Weiss (1975, 1977) already coins the potential of pilot projects. In her view pilot projects can be used to evaluate new programs at a controlled small-scale before the major program is launched. They are conducted in a spirit of experimentation and good measures of the consequences of the program can be gained. As such, policy decisions can be more evidence-based (Pawson and Tilley 1997). More recently, pilot projects gained much attention in so-called 'Transition Management' (Rotmans *et al.* 2001). Authors in this field (e.g. Van Sandinck and Weterings 2008, Van den Bosch and Rotmans 2008) focus at those pilot projects that intend to achieve societal change. In their view, pilot projects deal with the introduction of an innovation in a confined or even protected setting in which a large variety of actors participates. Actor-learning has high priority in these pilot projects. With the focus on societal change, these authors exclude pilot projects used for other purposes or that have different designs.

In the above views, common aspects of pilot projects are the 1) innovation, 2) small scale, 3) field setting, 4) focus on knowledge and learning, and 5) intended impact on policy or society. Therefore pilot projects could be defined as '*projects in which innovative approaches or technologies are applied at a small-scale field setting in order to gain broad insight in the functioning of the innovation in praxis. Knowledge is possibly diffused into policy-making and management'*. In an open view, all of these aspects can be challenged or tested to see whether they are characteristic to pilot projects and if so, in which form they appear. For example, one could question 'how innovative is the pilot project?' or, 'which type of innovation is applied in the pilot project?', 'what does small-scale mean in practice?', 'how much focus is there on knowledge development or is the knowledge focus just a cover?', 'who learns?', 'how effective are pilot projects in their diffusion?', and, 'what is subject to diffusion, the knowledge or the innovation?'.

In selecting pilot projects for this study I specifically focus on the field application of the project and the (seemingly) presence of a 'spirit of experimentation'. This means that participants are willing to discover and learn from the test application, even though the overt attitude may differ from the covert purposes. Indeed, I distinguish between pilot projects, laboratory experiments and routine water management projects (for a more refined comparison see chapter 2). The consequent selection of pilot projects enables me to demonstrate a wide array of pilot projects, and to find both substantive and behavioural reasons for the achieved effectiveness. Moreover, the meaning of characteristics such as 'scale' and 'knowledge development' can be tested.

1.3 Integrated Water Management and the role of pilot projects therein

The application domain of the pilot projects in this thesis is Integrated Water Management (IWM). The pilot projects studied deal with IWM in different ways. In the first part of the thesis I explore a broad range of pilot projects including coastal protection technologies, integrated dike designs and energy generation in tidal areas.

In the second part of the thesis, I study three pilot projects along the Rhine River in the Netherlands, Germany and Switzerland in detail. These projects focus on floodplain rehabilitation in combination with other goals such as flood defence, drinking water production and recreation.

IWM emerged from the call to integrate the management of land, water and living resources to promote conservation and sustainable use in an equitable way (Convention on Biological Diversity 1992, Mitchell 2005)[1]. IWM should lead to healthier river systems, which are necessary for the long-term preservation of biodiversity and consequently for the continued provision of services to society. Such services include enabling navigation, the discharge of water and waste, as well as less tangible services contributing to human health, and seemingly indirect services such as the transportation of seeds and the provision of habitats (Likens 1992, Forget and Lebel 2001, Norris and Thoms 2001). The extent of river regulation and pollution are primary factors influencing river health. Since the Sandoz disaster in 1986, the importance of ecosystems' health and the relation with human health have been acknowledged in the Rhine River. Integrated Water Management is increasingly promoted as an approach for managing water in a complex social-ecological system where economic, environmental and social elements are interconnected and in which different interests need to be balanced. IWM has been defined by the Global Water Partnership (GWP) as a "*process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems*" (GWP 2000, 2004). The IWM approach involves applying knowledge from diverse disciplines and involving stakeholders. Overarching criteria to be addressed by IWM have been defined by the GWP (2004) as 'economic efficiency', 'ethical sustainability' and 'environmental sustainability'. Through this holistic approach the water system can continue to function and yet meet societal demands in the long term.

IWM has become the dominant paradigm in water policy (Viessmann 1997, Saeijs 2006). This is clearly reflected by its wide use in the policy documents of international, national and regional organizations, but also in formal education since the 1980's. Examples include the EU Water Framework Directive, the Rhine 2020 plan of the International Committee for the Protection of the Rhine, the Integrated Rhine Program of the German State of Baden-Wuerttemberg, the policy document 'dealing with water' in the Netherlands, and diverse provincial water policy plans (Ministry of VWS 1985, Huisman 1998, Ten Brinke 2004). In the Netherlands, the installation of a 'Committee Integrated Water Management' that aims to connect policy and the implementation of IWM, and the presence of specific IWM units in water boards reveal the importance ascribed to IWM.

[1] Note that many authors, including the GWP, speak of Integrated Water *Resources* Management (IWRM). In this thesis I use the term IWM. IWRM implies a distinction between water resources and water services, while both aspects must be taken into consideration for *integrated* water management (Ker Rault 2008).

However, IWM is not uncontested. Particularly the implementation of plans at the operational level remains difficult. It is here where several interests meet and trade-offs need to be made, while uncertainties, dynamics and controversies are high (Collins *et al.* 2007). Actors attempt to safeguard their interest in the scarce resource, water (Leeuwis 2000). Management actions are therefore not easily agreed upon and the consequences thereof are often not fully known in advance. More strongly, Biswas (2004) argues that no one really knows what the concept IWM means in operational terms and that it is non-implementable. A last criticism is that IWM is often more advocated than needed (Hooper *et al.* 1999). In doing so, policy makers may make straightforward problems more complicated and their handling more expensive than necessary.

Despite the difficulties, actors search for strategies to overcome the controversies and to facilitate IWM. A commonly applied strategy is to strive for consensus. However, a risk of consensus building and balancing between ecological, economic and social aspects is that the full potential of the ecosystem is not restored, realized or experimented with. In consequence, ecosystem health advocates may lose commitment to projects that have a limited ambition level (Sendzimir *et al.* 2007). A second common strategy is to connect IWM plans to other problems and domains, such as agriculture and land-use planning that have a strong statutory basis to give it more credibility (Mitchell 2005). A third strategy focuses on education and stakeholder interaction, starting with schools. Field visits are particularly powerful for this strategy. Fourth, new technologies or concepts are developed that address new issues or find solutions for existing controversies. These approaches attempt to combine different water management goals by taking the natural river dynamics as a guideline.

Pilot projects can be used to support these strategies and are valuable in the practical application of the IWM approach. In pilot projects, a broad range of actors can collaborate and establish relationships, learn about interdependencies between social and ecological aspects, gain practical experience and overcome their fear of change. At the same time, negative societal and political impacts remain limited should the approach not work. However, pilot projects can only fulfil this promise if actors reflect upon what they have learned and use the developed knowledge. This implies that the knowledge does not get lost with the termination of the project. Whether and how pilot projects contribute to the development of IWM through such knowledge development is unclear. This thesis addresses questions related to how pilot projects contribute to policy-making and management and under which conditions these effects come about. I focus thereby more on the concept, pilot project designs, how participants perceive the developed knowledge and how diffusion processes take place, than on the development of knowledge to improve the innovation per se.

1.4 Objectives of the thesis

The research objectives of this study are to deepen the understanding of pilot projects in IWM and to support pilot project management. For this purpose, the concept pilot projects, their effects and accompanying dynamics are explored. Consequently, knowledge of i) pilot project use and actor interests in pilot projects, ii) pilot project characteristics and the dimensions within which pilot project initiators can design and influence pilot projects, and iii) how pilot projects contribute to water management and policy-making, is deepened. Subsequently, strategies to support pilot project initiators in the development and diffusion of knowledge are suggested.

1.5 Research Questions

The research objectives, challenges and interest discussed in this chapter lead to the following research question:

How do pilot projects in Integrated Water Management contribute to policy and practice and how can their contribution be strengthened?

To answer this question, sub questions are formulated to explore and explain pilot projects and their dynamics. The first two questions are pure research questions, while the third question is more a design question. The sub questions are:

1. What is the nature of pilot projects in Integrated Water Management?
    a. For which purposes are pilot projects used?
    b. How can pilot projects in Integrated Water Management be characterized?

2. How do pilot projects contribute to policy and practice in Integrated Water Management?
    a. What effects do pilot projects have on water management practice and policy?
    b. What are the mechanisms through which effects on water management practice and policy occur?
    c. Which factors inhibit the influence of a pilot project on water management practice and policy?

3. How can the contribution of pilot projects to policy and practice be strengthened?

1.6 Research Philosophy: Paradigm, Position and Strategy

In understanding how results are developed in this thesis and should be interpreted, I first explain the research paradigm and strategy as part of the research philosphy before I discuss the research approach and the structure of this thesis in the next section. Essential in understanding this research is that it is a study of a social system. This implies that results are value-laden and that the researcher influences what is being studied and how data are interpreted and presented (Searle 1995, Bergman and Coxon 2006, Blaike 2007).

Research Paradigm
Since pilot projects in water management are social constructs, different meanings are given to the concept, actors have different reasons to initiate a pilot project, and they can design and manage the pilot projects in different ways (cf. Schön and Rein 1994, Bergman and Coxon 2006). The view that 'there exists a single, freestanding reality that waits to be discovered' does thus not apply to this research (Patterson and Williams 1998). Instead, I follow Blaikie's (2007) idea that 'reality is what human beings construct' and that 'many interpretations of reality can co-exist'. I study perceptions of pilot projects, based on which I develop new insights on the construct. In essence, I adopt the paradigm of double hermeneutics (Giddens 1984) and thus interpret interpretations.

The double hermeneutics paradigm is embedded in postmodernism and constructionism. Postmodernism contrasts itself to the positivistic tradition. Positivism suggests that objective and universally valid facts can be discovered by following clear procedures and rules. The interpretation of the researcher is not taken into account (Bergman and Coxon 2006). Studies following the double hermeneutics paradigm do not attempt to develop 'universal explanations' or 'objective reality' (Flyvbjerg 2001, Functowitz and Ravetz 1993, Nowotny *et al.* 2006). Rather, the value of contextual dependency is acknowledged. Tentative explanations are sought for small-scale situations in particular contexts.

Essential to the double hermeneutics paradigm is the understanding that researchers influence the course and conclusions of the research by their interpretation, which in its turn is fed by their cultural background and education. Reality is thus not only socially constructed at the social actors level, but also at the research level. (Blaikie 2007, 22-23). Objectivity in gathering, analysing and understanding data and producing knowledge is rejected (Denzin and Lincoln 2005). As a result of the interpretative nature of this research, a definitive answer to the research questions cannot be formulated, but only a particular interpretation. This interpretation is itself open to criticism and new insights, so allowing discussions on the subject to continue. However, the interpretation is grounded in a broad range of empirical and theoretical material. Consequently, the conclusions are justifiable and provide a grounded perspective upon the problem.

Research Position
The research position that I exercised to enable the double hermeneutics paradigm is primarily external and as a mixed learner-expert. The external position implied that I read project documentation, questioned actors involved in the projects and observed meetings and workshops of projects still running (this include the WINN projects and the Dutch case study). In two case studies data were collected several years after the pilot project was completed (11 years for the German and 7 years for the Swiss

case). In the third case study (the Dutch one), I collected data both during and after the pilot project. Moreover, I participated actively in early stages of the Dutch pilot project as a researcher. I provided insights on the hydraulic effectiveness of interventions, on the implications of scale choices, and the barriers to concept implementation provided by institutional arrangements. However, I did not participate as a stakeholder and remained primarily an observer. Nevertheless, I could make very direct internal observations of issues playing at that time that I could not have made otherwise. I could actively observe what was going on, in addition to learning from participants during or after the project. The mixed learner-expert aspect of my research position implied that I approached the research with existing knowledge on pilot projects and IWM, and helped pilot participants to reveal how they understand pilot projects. Emerging concepts were then validated with additional empirical material and literature on related phenomena such as innovation, policy change and learning. Answers to the research questions emerged from this process, rather than from literature alone.

Research Strategy

The research strategy related to the double hermeneutics paradigm and the research position is abduction (Blaikie 2007). Abductive research is a process of inference through which theory is developed that is grounded in the meanings of actors (Strauss and Corbin 1998) and enriched with theoretical ideas. Hence, theory generation in an abductive strategy is an evolving process whereby data and theoretical ideas interact (Blaikie 2007). The meaning actors give to pilot projects, their motivations and the activities they undertake, can all be categorized and conceptualized. Consequently, an insider view of pilot projects can be developed (Menzies 1996). The bottom-up nature of the abductive strategy contributes to the relevance of results and provides the ability to explain pilot project dynamics (cf. Glaser and Strauss 1968, Menzies 1996). In the following section I discuss how the research philosophy is reflected in a staged approach.

1.7 Research approach and structure of the thesis

An important aspect of the research philosophy is the choice to develop theory in an incremental manner and to place large emphasis on empirical data (e.g. Braun and Clarke 2006, Miles and Huberman 1994, Charmaz 2006, Strauss and Corbin 1998). Reasons are the assumption that pilot projects are social constructs that exist because people give meaning to it (e.g. Searle 1995) and that theoretical insights on pilot projects are limited available. This aspect of the research philosophy is reflected in the research approach and structure of the thesis. Two major implications are the staged research approach and the use of mixed methods, because it is the interplay between different methods that fosters the development of new theory (Strauss and Corbin 1998).

The staged research approach means in practice that one starts to collect diverse data on experiences with pilot projects from an early research stage on and simultaneously start analysing these data (Charmaz 2006). Early insights provide the building blocks for refined research in which empirical material is again of large importance. In other words, different research steps are taken whereby the next step follows the previous step. In this way, a consistent and insightful line of argument is built to answer the research questions.

The mixed methods approach is reflected in the diversity of methods for data collection and analysis used during the research. The applied methods are primarily of a qualitative nature and enable to find out about peoples' ideas and experiences in the field, to explore actor behaviour and interactions and motivations thereof, and societal- and policy developments. By organizing the data in explanatory schemes, concepts and relationships can be revealed (Strauss and Corbin 1998).

The research steps illustrate how the study is constructed and the diversity in the methods of data collection and analysis adopted. The three steps include Primary Analysis, Case Study Research and Reflection (Figure 1.1). In each of these steps different activities are undertaken that fit with an abductive strategy and give an important position to empirical studies.

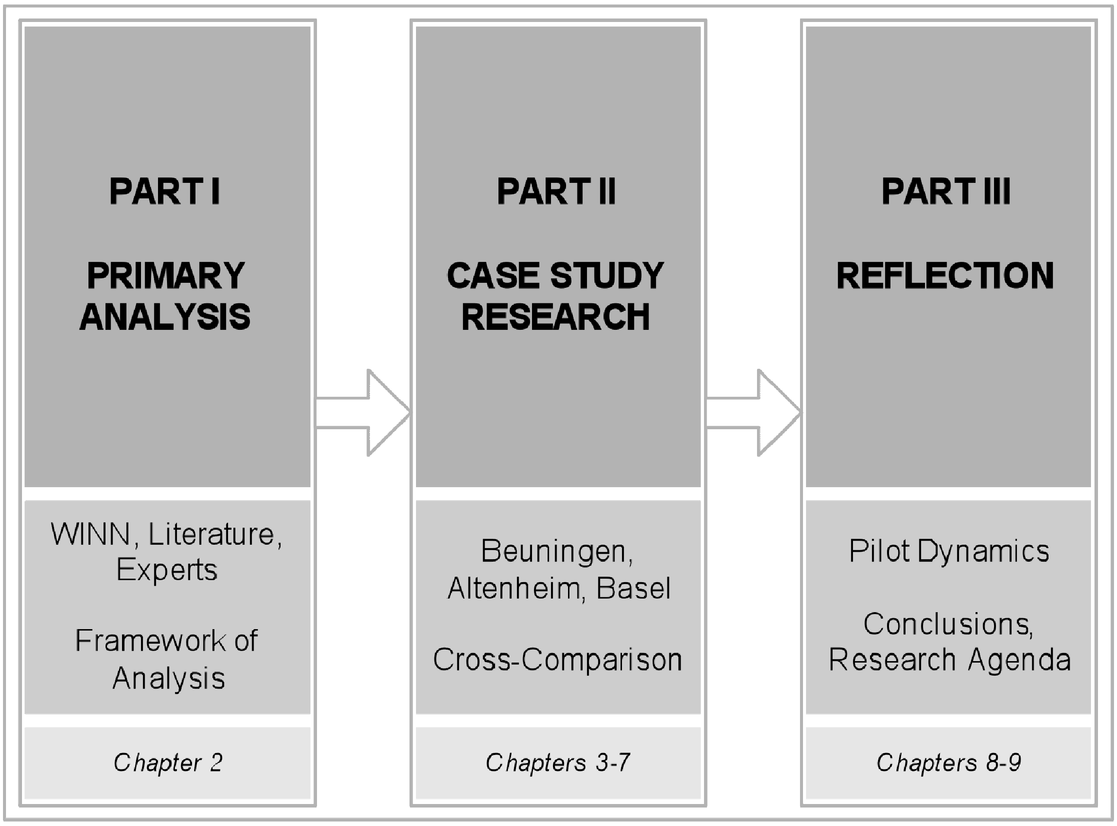


Figure 1.1: Thesis structure

In the first step, the Primary Analysis, the concept 'pilot projects' is explored. Purposes for which pilot projects are initiated, pilot project characteristics and effects to water management and policy are identified. The exploration is based on information from a) explorative open interviews with former and current water managers and scientists, b) 'WINN' pilot projects conducted by the Dutch Ministry of Transport, Public Works, and Water Management and c) a theoretical, literature-based, exploration of policy development concepts including analytical, political and holistic models. The exploration results in the development of a framework of analysis (chapter 2).

The second step is the Case Study Research. In-depth case study research enables the systemic production of exemplars and the identification of mechanisms related to pilot projects in specific situations (cf. Flyvbjerg 2006). In chapter 3, case study research is explained and the application of the framework discussed. Next, the developed framework is applied and tested in three individual case studies. The framework provides a lens through which the cases are viewed and elements are highlighted. The three case studies are on floodplain rehabilitation pilot projects in the river Rhine in Beuningen in the Netherlands (chapter 4), Altenheim in Germany (chapter 5) and Basel in Switzerland (chapter 6). For the case study research, more focussed interviews are conducted and documents are studied. In the Beuninge case study I had a participatory role. The in-depth analysis of the use, character and effects of individual pilot projects is followed by a cross-comparison (chapter 7), which is enabled by the use of the framework. The cross-comparison results in a better understanding of the individual pilot projects and facilitates the identification of regularities and differences in the nature and effects of the pilot projects.

Lastly, in the Reflection, the dynamics of pilot projects as identified in the case studies are discussed and verified through additional interviews. This leads to the development of a model that explains different views of pilot projects and to the identification of factors that influence the evolution of pilot projects (chapter 8). The deeper understanding of pilot project dynamics provides the input for the suggestions of strategies for pilot project initiators to enhance pilot effectiveness in terms of diffusion of knowledge into policy and management. The thesis finalizes with a concluding chapter in which the research questions are answered (chapter 9). Additionally, I discuss both the contributions of the thesis to science and practice and the limitations of the research. The latter provide input for a research agenda.

2.

A primary analysis of pilot projects

In this chapter, a primary analysis -or exploration- of pilot projects is performed. The purposes for which pilot projects are used and their characteristics are identified. Effects and contexts are conceptualized. The analysis is based on a literature review of policy development- and socio-ecological literature, together with a review of WINN pilot projects and interviews with past and present representativeness of Rijkswaterstaat, the Dutch Ministry of Agriculture, Nature and Food Quality, WWF, Wageningen University and the International Committee for the Protection of the Rhine. The analysis results in the development of a framework that will serve as the basis for the next part of the research.

2.1 Method for the primary analysis

In this primary analysis, the construct pilot project is explored more thoroughly. Based on literature and empirical data, pilot projects can be explored from different angles. I use 'pilot project' as an umbrella term for projects that are undertaken in the real world in 'the spirit of experimentation' (Lee 1999, Weiss 1975) or at least claimed to be. Consequently, a broad array of projects can be explored. The main approach is to identify themes relevant to pilot projects and to structure and refine these. The themes will provide the basic elements for the framework. Themes can be identified through coding and categorizing data (Braun and Clarke 2006, Miles and Huberman 1994). I first introduce the three main data sources after which I introduce the themes identified for this study.

Literature Review

The first activity is a literature review in which I perform a socio-political analysis of how pilot projects are applied and integrated within policy development. Literature derives from public administration and governance in western democracies (e.g. Bovens *et al.* 2001, Sabatier 2007, Hoogerwerf 1998), pilot project evaluations (e.g. Cabinet Office 2003, Sanderson 2002), pilot project use (e.g. Huitema *et al.* 2009, Lee 1993, Hoogma *et al.* 2002), policy learning and evaluation (e.g. Weiss 1975, Campbell 1975, Bennett and Howlett 1992), evidence based policy making (e.g. Pawson and Tilley 1997), diffusion of innovation (e.g. Douthwaite *et al.* 2003, Rogers 1995), Transitions management (e.g. Rotmans *et al.* 2001, Loorbach 2007), IWM (e.g. Mitchell 2005, Meijer 2007, GWP 2004) and Adaptive management (e.g. Lee 1999, Walters 1997, Pahl-Wostl 2008).

On the basis of the literature review, I identify three streams of policy development models within public administration and governance. In each of these models a different view and expectation of pilot projects and their role in policy-making, decision-making and problem solving is exercised. Additionally, the context of pilot projects in IWM and the Rhine basin specifically is reflected upon.

Data collection

<u>WINN</u>
WaterINNovatie (WINN) represents an innovation program of Rijkswaterstaat, an operational arm of the Dutch Ministry of Transport, Public Works and Water Management. Several pilot projects were conducted within WINN in the study period (2002-2007). In October 2008, twenty seven pilot projects were presented on the website[2]. Sixteen out of these were selected as input for this study. Projects with minimal information on the website and laboratory experiments (projects in non-field settings to learn about innovation itself) were excluded. The types of project range from coastal eco-engineering ('bio-bouwers') to dealing with re-establishing estuarine dynamics ('van zoutbestrijden naar zoutbegeleiden') and the use of digital tools in multi-stakeholder design processes ('digitale ontwerptafel'). The quality of the data is highly variable; some projects include extensive descriptions of activities and measures, illustrations, methods and results, while others are limited to a one paragraph project goal description.

In addition the written documents of WINN, a WINN workshop held in December 2008 was attended. Circa 50 participants in the WINN projects were present. In this workshop three projects (INSIDE, Rijke Dijk/Biobouwers, Zandmotor) were discussed extensively. Next to the design and course of the project, the existence of barriers to the diffusion of the pilot and strategies to overcome these were discussed.

<u>Interviews</u>
Sixteen open semi-structured interviews were conducted in 2007 with past and present representatives from various departments of the Dutch Ministry of Transport, Public Works and Water Management, the Ministry of Agriculture, Nature and Food Quality, the World Wildlife Fund, Wageningen University and the secretariat of the International Commission of the Protection of the Rhine (see Appendix 1 for a list of

[2] www.waterinnovatiebron.nl. The webpage has changed since then, and the majority of project descriptions have since been removed. The original texts are however available upon request.

interviewees). The interviews were used to reflect upon developments and personal experience in water management and policy in the Netherlands and North-West Europe over the past decades and the role of pilot projects therein. Interviewees described and reflected upon the pilot projects they had been, or were, involved in and related these to broader water management developments at local, national and international level. Additionally, more generic mechanisms and factors related to pilot projects such as learning and the role of key individuals in policy change were discussed (see Appendix 2 for interview guide). The duration of the interviews ranged between 1.5 hrs and a full day.

The themes of analysis

Based on the project descriptions, interviews and literature, a database has been developed based on the logic of structuring and categorizing data as extensively explained by Miles and Huberman (1994) and Braun and Clarke (2006).

For the analysis, first a list attributes that were encountered when reflecting upon the material (e.g. type of innovation, actor involvement, duration, water management policies) could be developed. On the basis of the initial of attributes the WINN pilot projects were assessed. New insights were used to refine and adjust the list. As such, a database of pilot projects was built showing a colourful palette of pilot attributes. Grouping and regrouping of these lead to the development of themes. For example, the analysis has lead to the identification of three main pilot uses (research, managerial and political-entrepreneurial) and six different characteristics. To illustrate the characters of pilot projects, they were contrasted to laboratory experiments and routine projects. Next, three types of effects that can be established by pilot projects have been identified, including changes in the biophysical and actor system, knowledge development and diffusion. Diffusion is subsequently further conceptualized in patterns, channels and nature of diffusion. Lastly, the institutional, biophysical and socio-economical context of pilot projects was explicated. The use of a context chart (Miles and Huberman 1994) provides additional structuring within this theme. The relation between contextual elements and the pilot provides a basis for the understanding of the theme pilot dynamics and accompanying hurdles for diffusion that is discussed in the reflection part of this thesis. Most of the themes are not a specific topic in the studied literature, but elements thereof where discussed in various places. In summary, the initial themes include:

- Purposes for which pilot projects are used (‘use’)
- Pilot characteristics
- Context of the pilot
- Effects to policy and management (particularly diffusion)

Figure 2.1 provides an overview of the different themes (aspects of pilot projects) studied. To enable a description of an individual pilot project, different pilot project characteristics will be identified (see 2.3). These can be further subdivided in design dimensions and contextual dimensions. One can see that the pilot project is located in a context. Actors, both as part of the pilot and of the context use the pilot project in a certain way. Based on the uses, 3 pilot project types will be identified and their characteristics described (see 2.4). To understand a pilot's context, different aspects of the context are identified in 2.5. Next, three types of effects are identified in section 2.6.

In the reflection of this thesis (part 3) 'design' and 'pilot dynamics' are more focused upon as themes. In this discussion, factors and mechanisms are identified that connect the pilot including its design and context with the effects. This discussion will also provide the basis for developing design recommendations for pilot project initiators.

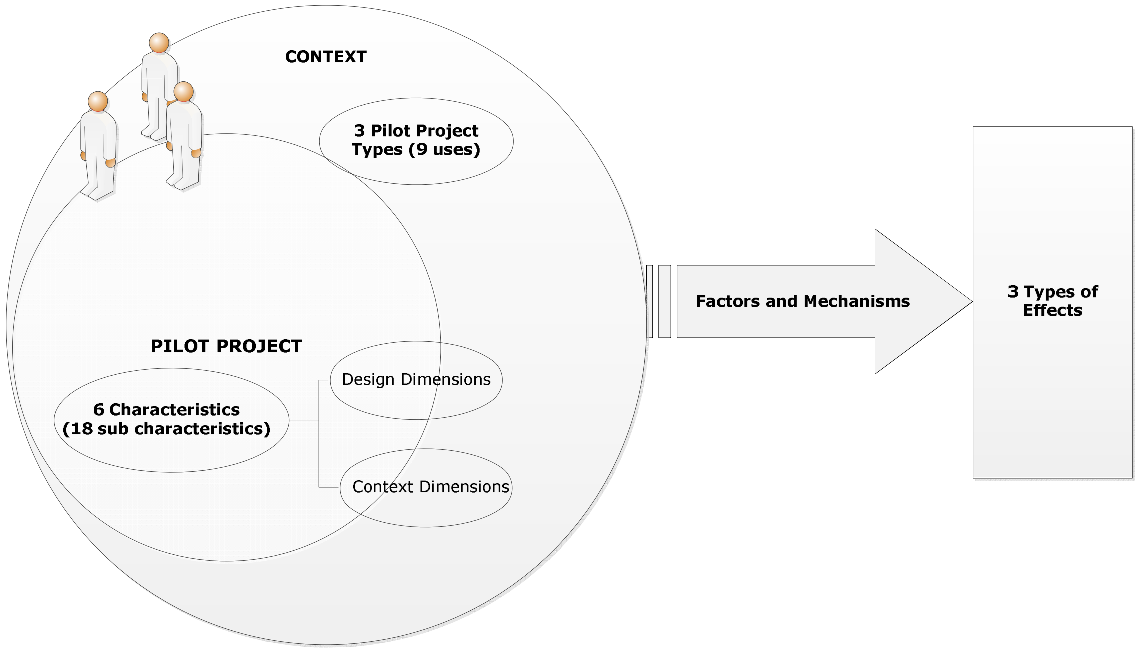


Figure 2.1. Overview of the different aspects of pilot projects and their relation studied as themes in this thesis

2.2 Pilot Projects in Policy Development Theories[3]

2.2.1 Analytical, Political and Holistic views on policy development

Within public administration in general and in water management specifically, different perspectives exist upon policy development- and decision-making processes. There are many models describing these processes. They implicitly or explicitly assign a role to pilot projects. In this section, I distinguish three categories

[3] Sections 2.2 to 2.4 are based on Vreugdenhil *et al*. (2010b): Pilot Projects in Water Management. Ecology and Society (16):1

of policy development models in public administration on the basis of the view they hold of policy development. For each of these model categories I discuss the roles given to and expectations associated with pilot projects. I first follow established practices in differentiating between *Analytical Models* and *Political Models* (Bovens *et al.* 2001). Next, I identify another category of models that I define as *Holistic Models*. An overview of the three categories and the accompanying models, is provided in the first two columns of Figure 2.1. The different categories of models are not necessarily exclusive, but can be used alongside and in addition to each other.

The Analytical Models prescribe distinguishable, often rational, activities to resolve problems that are undertaken one after another or contemporaneously (e.g. Simon 1977, Hoogerwerf 1998, Miser and Quade 1985). The underlying paradigm is that of informed decision making. Decisions are made based on analyses and evaluated in terms of effectiveness. Examples of Analytical Models are the 'Phase Model' (Simon 1977) and the 'Parallel Model' (Geldof 2005).

The Political Models describe policy making as a complex and seemingly chaotic and incremental process. In the process, different discussion rounds, for instance, provide space to formulate agendas and windows of opportunity can arise (e.g. Teisman 1995, Kingdon 1995, Lindblom 1993, Wildavsky 1973). The underlying paradigm in the Political Models is that of opportunism and capricious chance. The political discussion continues during implementation of policies and results are politicised. The focus of the models is on political and strategic levels where the debates take place. The biophysical system itself is less directly of interest. Policy development is considered a process in which many actors are interrelated and systems are interconnected. The models stress the differences, conflicts and competition amongst actors, but also the emergence of opportunities to cooperate (De Bruijn and ten Heuvelhof 2008). Examples of the Political Models are the 'Rounds Models' (Teisman 1995) and 'Streams Models' (Kingdon 1995).

The Holistic Models view the policy development process within a broader societal context of interacting institutional, societal and biophysical systems and recognise systemic uncertainties. Their view is holistic when describing large societal changes, but becomes pragmatic when seeking the means of inducing changes at the micro-level through pilot projects. The holistic models attempt to deal with criticism of the limited impact of policy evaluation on policy-making (Bennett and Howlett, 1992; Argyris and Schön, 1996; Birckmayer and Weiss, 2000; Schwandt, 2003) and the increased recognition of the complexity of social-ecological systems (Scheffer *et al.* 2001, Carpenter *et al*. 2001). They attempt to both rationalize the policy development process and create space for dealing with complexity, for example through participation. Examples of the Holistic Models are 'Adaptive Management' (Holling 1978, Lee 1993, Gunderson 1999, Pahl-Wostl 2008), 'Adaptive Co-management' (Olsson *et al.* 2004), 'Transition Management' (Rotmans et *al.* 2001, Van de Poel 2003) and 'Integrated Water Management' (Mitchell 1990).

2.2.2 Contrasting the policy development models

In addition to general differences in their perspectives upon policy process, the three categories of policy models differ in the explicit presence and roles they ascribe to pilot projects. In this section, I contrast the three model categories on the basis of their views on the use of pilot projects, the inclusion of the complexity of the (social-ecological) systems, the expected contribution to policy, and the governance style (the process of exercising authority) they consider appropriate, whereby governance styles range from authoritative (i.e. a closed process), via consultative and cooperative towards facilitative (Ker Rault 2008). An overview of the discussion of this section is provided in the last two columns of Figure 2.1.

The primary purposes of pilot projects in the Analytical Models are to test and apply (technological) innovations in particular contexts and to mitigate well-defined issues in the biophysical system. Pilots are used to streamline and to collect resources, such as money, knowledge and the commitment of other actors. The knowledge developed in the evaluation stage ought to flow back into the problem-solving and decision-making process. Learning, gaining experience and dealing with (biophysical) risks are considered major contributions of the pilot project to the problem-solving process. However, the main focus is on testing a particular innovation (often an artefact or technology). The users of such pilot projects are often single actors such as experts (Van den Bosch and Rotmans 2008). An authoritative governance style is common because interdependencies of systems, interactions of actors and uncertainties are not recognized or are excluded from the process. Indeed, the authority defines the problem and makes decisions in relative isolation.

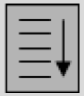
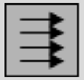
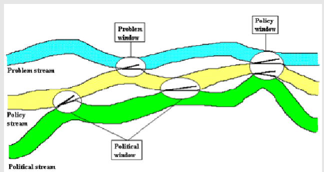
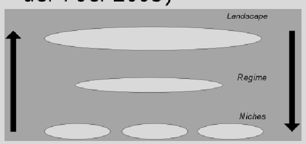
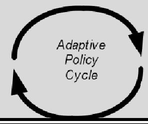
	Policy Development Models		**Role of Pilot Projects in Model**	
	Examples	*Basic Characteristics*	*Use*	*Potential Impact*
Analytical Models	- Phase Model (Simon 1977, Miser and Quade 1985, Hoogerwerf 1998) - Parallel Model (Geldof 2005)  	- Rationality - Single actor/ individual (Koppenjan 1993) - Experts and focus groups - Clear distinguished activities - Well defined (single) issue: strong focus - Prescriptive in nature	- Solution to practical problem - Developing and streamlining innovation to context - Streamlining resources - Knowledge development and feedback/ evaluation (Campbell 1975, Weisss 1975) - Technology testing - Authoritative governance style	- Gaining experience - Learning - Solving bio-physical issue - Spread of ideas and practices - Stimulating creativity and innovation - Stimulating interaction between innovation and social-, physical- and institutional context
Political Models	- Rounds/ Arena Model (Teisman 1995)  - Streams Model (Kingdon 1984/ 1995)  (Pauli 2001)	- Multi-actor groups (Koppenjan 1993); policy-makers and associated groups - Policy entrepreneurs - Complex systems - No procedures - No fixed hierarchies in goals and values - Capriciousness - Intermittent focus on biophysical issues - Descriptive in nature	- Strategic influence of actor relations, shift attention, convincing (process use) - Dealing with risks/ test before policy roll out (cabinet office 2003) - 'Abuse' - Consultative governance style	- Changed actor-network, actor interactions and interdependencies - Changed perceptions - Policy adaptations - Prevent (financial) failure - Giving direction and setting boundaries
Holistic Models	- Adaptive Management (Holling 1978, Lee 1993, Gunderson 1999, Pahl-Wostl 2008), Adaptive co-management (Olsson et al. 2004) - Transition Management (Rotmans et al. 2001, Van der Poel 2003) 	- Interconnectedness between policy levels - Recognition uncertainties - Experiments inherently part of the philosophies - Learning as a basis for progress - Pragmatic striving after policy change - Prescriptive in nature 	- Learning by doing - Dealing with uncertainty - Exploration - Initiating change - Recognition of importance of local context - Cooperative and Facilitative governance styles	- Social learning - Feedback in governance practices - Accumulating evidence - Accumulating of niche formation and regime change (Raven 2007, Van der Poel 2003) - Adaptations in practice and policies

Figure 2.2: The role of pilot projects in policy development theories: three models

In the Political Models, pilot projects are used by policy entrepreneurs to influence actor-networks. Here, actor-networks are explicitly present and are considered to be at the heart of policy development (Bovens *et al.* 2001). For instance, actors try to steer the policy development process by attracting or distracting attention. Pilot projects are recognized as a strategy to deal with risks and uncertainties, mainly those deriving from the societal system (e.g. actor behaviour). Another rationale for conducting pilot projects in this view is to test policies on a controlled scale to prevent larger financial and personal failures (Cabinet Office 2003). Adversely, pilots can be (ab)used to postpone policy decisions or as 'demonstration projects' (Sanderson 2002). These pilots lack learning and feedback to policy. The contributions of pilot projects are reflected in enhanced actor-interactions, changed actor perspectives, increased involvement of actors and policy adjustments. The governance style is usually cooperative, meaning that problem definitions and solutions are defined between the authority and other stakeholders, but power over the formal decision is not distributed. More authoritative styles can also be exercised. Given the interdependencies these are likely to lead to conflict.

In contrast to the Political and Analytical Models where the use of pilot projects remains implicit, the Holistic Models explicitly assign a role to pilot projects. Pilot projects are primarily meant for learning-by-doing and reflecting on practice or policy. Based on the pilot projects, practices and policies might be adjusted to changing circumstances. As such, pilot projects are considered a means of dealing with the uncertainties inherent to complex social-ecological systems. The pilots enable the incorporation of research findings, societal actors' interests and policy practitioners' ideas in the early stages of the policy cycle (Pahl-Wostl 2007, Carlsson and Berkes 2005, Olsson *et al.* 2004, Dietz *et al.* 2003). Furthermore, pilot projects are used for exploring options within local contemporary contexts, evaluating hypotheses, and as instruments to induce (long-term) societal changes, particularly when the effects of multiple pilots accumulate (Pahl-Wostl 2006, Raven 2007, Gunderson *et al.* 1995, Van Sandick and Weterings 2008, Van der Poel 2003). In their most far-reaching form, management and policy-making can themselves be considered as ongoing social-ecological experiments (Walters 1986, Campbell and Russo 1999). In these models a broad range of actors deriving from different policy- and societal levels is involved in the pilot projects. A multitude of mutual relationships and interdependencies arises. Consequently, the direct influence of the authority is limited and its role becomes cooperative and facilitative, even if they wish to be more authoritative (Vreugdenhil and Ker Rault 2009). The authority sets the boundaries within which actors share decision-making and implementation responsibilities.

In summary, three categories of policy development models have been distinguished on the basis of the views they hold of the policy development process and their expectations of pilot projects. This has led to the identification of a broad range of uses and effects.

2.2.3 Caveats of and Criticisms on Pilot Projects

Despite the expected contributions to policy-making, pilot projects are also regularly subject of criticism (Huitema *et al.* 2009). This section presents a few of the caveats and criticisms.

The main criticism is that pilot projects do not always deliver what they intended for or how they were expected to function (Fischer 1995, Sanderson 2002, Martin and Sanderson 2001, Weiss 1975). Pilot projects are expected generally to foster (policy) learning and policy change. Moreover, when starting a pilot project, these are generally the reasons explicated for its initiation (Greenberg *et al.* 2003). The pilots are supposed to generate directly applicable lessons or build up the body of knowledge relevant to policy making. A first reason of limited policy learning and change is that much of the developed knowledge is context-dependent (Pawson and Tilley 1997). Contextual knowledge is needed for policy-making, but the transferability is limited. When the pilot is initiated to evaluate and refine the policy, the developed knowledge is not necessarily useful for the policy. Second, the limited usefulness can also be a result of poor timing (Cabinet Office 2003). Problems to which pilot projects are applied change during the course of the pilot, or policy makers don't have the time to await the outcomes. Third, the information provided by the pilot projects is just one of the sources of information for policy makers. Decisions are made on more than solely information (e.g. which beliefs policy makers hold) (Weiss 1977). Fourth, pilot projects are often approached rationally, but the accompanying conditions are hardly ever met (Greenberg *et al.* 2003). Fifth, pilot projects can also be initiated without the intention to base policy on evidence. They rather serve to convince people through demonstration or to solve a local problem. Their role in policy making is then different. According to Sanderson (2002) a pilot then looses meaning. In this thesis these pilots are considered as specific types (see 2.3). Other criticisms include that pilot projects for social policy raises ethical questions, since some people receive 'treatments' while others do not (Greenberg and Shröder 2004) and that pilot projects are often used to test whether certain goals can be achieved by the innovation, while the goals themselves are hardly discussed (Fischer 1995).

In contrast to the criticisms of limited policy learning limited, other authors argue that practical cases or evaluations, and thus pilot projects, should be considered as opportunities to accumulate knowledge, enlightenment and to gain experience (Pawson and Tilley 1997, Weiss 1977, Flyvbjerg 2006).

2.2.4 Conclusions, choices and implications for this thesis

When comparing the different views on pilot projects in policy development, several conclusions can be drawn and choices can be made that have implications for this thesis. First, pilot projects are widely present and acknowledged in policy-making and management, but little clarity or agreement exists on their nature or how they should be used. This freedom in interpretation also leads to a large variation in their use and makes them applicable to many situations and purposes. Second, the choice to explore pilot projects broadly enables the identification of different pilot types and contributions to policy-making and management. Third, the review provides a basis for the identification of different characteristics and a distinction with laboratory experiments and routine water management projects. In section 2.3, the characteristics of pilot projects are refined with the help of WINN and the interviews. Fourth, three different pilot types can be distinguished, the research, managerial and political-entrepreneurial pilot project, each of which being used for different purposes. This is further elaborated upon in 2.4. Lastly, the review confirms the knowledge gap that exists with respect to pilot projects. Most of the insights are based on anticipated contributions of pilot projects, rather than empirical findings. The instances that pilot projects have been analysed (e.g. Greenberg and Shröder 2004, Cabinet Office 2003), the pilot projects concerned social policy (e.g. changes in tax schemes) more than management of social-ecological systems.

2.3 Characterizing Pilot Projects

In this section I characterize pilot projects. I identify project characteristics and describe pilot projects characters. This leads to the development of a framework that supports the identification of the character of an individual pilot. The primary input for this analysis derives from the literature survey. Insights are further validated and refined using insights from the interviews with water managers and the exploration of WINN pilot projects (see 2.1). To clarify pilot projects further, their characters are contrasted with laboratory experiments and routine water management projects. With laboratory experiment I mean experiments undertaken in non-field settings, intended to test hypotheses. By routine projects, I mean conventional projects and operational or daily management.

The six project characteristics to identify pilot characters are: i) Relation to policy and local context ii) Scale, iii) Innovation, iv) Knowledge Orientation, v) Special Status, and vi) Actor Network. In Table 2.1 I indicate how pilot projects, laboratory projects and routine water management projects differ on the basis of these characteristics. It is not my intention to claim that these characteristics provide a comprehensive description of all pilot projects in water management. Instead, they represent a grounded characterization of the pilot projects I encountered in the research.

Table 2.1: Pilot projects characterized and compared and contrasted with laboratory experiments and routine water management projects

Project Characteristics		***Laboratory Experiments***	***Pilot Projects***	***Routine Water Management Projects***
Relation to policy and local context	*Connection to policy*	In policy periphery	Either close to policy core or in periphery	In line with and following policies
	Local contextual dependency	Controlled contextual factors	High; interaction with local context	Moderate
	Incidence of occurrence	In series or single event	In series or single event	In series or single event
Scale	*Limitedness (space, time, problem scope)*	Confined	Confined in at least one dimension	Full scale
	Reversibility	n.a.	Variable: Sometimes reversible to biophysical reference situation	Permanent
Innovation	*Type of innovation*	Technological	Technological, Conceptual, Process	n.a.
	Driver of innovation	Supply driven	Demand or Supply driven	n.a.
	Level of innovation	High level	Variable level	Low level
Knowledge orientation	*Knowledge model*	Expert-driven	Expert-driven Communicative/ social-learning driven	Expert-driven
	Monitoring intensity and type	High intensity Controlled observation in controlled context (Lee 1999)	Variable intensity Systemic monitoring	Low intensity/ Absent (standard procedures) n.a.
	Type of knowledge	Hard, substantive, generic	Hard-soft, substantive-process, generic-contextual	n.a.
	Type of learning	Single loop	Single loop Double loop, Experience	Absent/ Experience
Special status	*Attitude*	Allowance for failure Creativity	Allowance for failure Creativity, No consequences expected	Everyday practice Conforming
	Flexibility	Flexible in design, not during course	High flexibility in design and course	Low Capped by standardisation and meeting policy goals
	Resource allocation	Variable	Relative easy and diverse	Fixed
Actor Network	*Initiator*	Researchers	Research, Government, Stakeholders, Commercial	Government agencies
	Participants	Single actor	Multi-actor	Variable
	Governance Style	n.a.	Facilitative, open styles	Traditionally closed styles

1. Relation to policy and local context

Projects are embedded within a particular biophysical, societal and institutional context. This embedding in policy and local context can be described in terms of connection to policy, local contextual dependence and incidence of occurrence.

First, projects are not independent entities conducted in policy isolation, but are connected to existing policies and projects in some way. They can be undertaken in the policy periphery or at the policy core. Pilot projects can be conducted as part of a policy program or replace a planned management project and so be in the core of policy, but they can also be conducted in the policy periphery. In the last situation they have more freedom than in the other situations, because they have been 'de-coupled' from policies (Van Eeten and Roe 2002). The pilot projects conducted under the WINN umbrella have been selected as potentially valuable by the Dutch Ministry of Transport, Public Works and Water Management. They thus have an explicit relation to policies. Nevertheless, some are more at the policy core than others. Laboratory experiments are in the policy periphery where they have more freedom to experiment and they don't necessarily have to account for policy implications. In contrast, in routine projects the link to policy is strong: they are conducted as a result of existing policy and do not deviate from this policy.

Second, local contextual dependency is an intrinsic part of the pilot process. Contextual factors can in a pilot setting only be controlled to a limited extent (Lee 1999). Biophysical and societal contextual factors interact with the pilot project: design and development are influenced by biophysical preconditions and involved actors who have local knowledge. These actors might in their turn be influenced by the pilot process (i.e. they may learn). The interaction between pilot and context also enable the development of context dependent knowledge (Flyvbjerg 2006). In contrast, a core characteristic of laboratory experiments is that contextual factors are controlled (Lee 1999). Laboratory experiments are therefore repeatable. Routine projects are moderately intertwined with the context. They are undertaken in a specific biophysical and societal context, but are often subject to standardisation in order to eliminate contextual uncertainty.

Third, the incidence of occurrence of pilot projects is that they can be part of a series or be undertaken as a single event. Since the same applies to the other two types, pilot projects cannot be distinguished in this respect.

2. Scale

The characteristic 'scale' can be described in terms of limitations and reversibility. Scale limitations refer to whether projects are confined in scale or applied at full scale. Scale dimensions include time and space (Karstens 2009, Sendzimir *et al.* 2007, Doutwaithe *et al.* 2003) and problem scope. Pilot projects are confined in at least one of these dimensions. Indicators of confined scales include budget constraints, limited timelines (e.g. 0.5 to 2 years), local implementation (e.g. a single dike or floodplain) and a limited number of issues and actors involved. Confining the scale of a pilot project acts to prevent large flaws and as a means of dealing with risks and uncertainty (Cabinet Office 2003). Laboratory experiments are confined in all dimensions, while routine projects are applied at full scale.

Reversibility describes the ability to return to the reference situation following the implementation of a project. In contrast to limitation that is design-oriented, reversibility is effect oriented. The reason to include reversibility also in the characteristic 'scale' is that the degree of reversibility is primarily influenced by the scale. For instance, a short project provides a means of discontinuing the project after that period and return to the reference situation. Reversibility of pilot projects is limited to the biophysical aspects and formal institutions, but is not achievable for softer aspects such as relations amongst involved actors and acquired experience. In the softer aspects, a pilot project does not differ from any other project. Routine projects are meant to be permanent (note that permanent and reversible are notions relative to the time period under consideration). Laboratory experiments are not applied in real-world settings and so the reversibility to the reference situation is not relevant.

3. Innovation

Testing of an innovation or stimulating innovation in general, are the reasons often given for conducting pilot projects in the first place. However, innovation is a relative notion, depending on what is known to which actors in particular areas within a certain time frame. For instance, within WINN a number of projects explicitly state that the technology had already been implemented in another context (e.g. the pilot 'ecobeach' in Denmark), but that it is innovative for the circumstances that exist along the Dutch coast.

The types of innovation applied in a water management pilot can include technological, conceptual, and institutional or process innovations (e.g. different public participation practices). In laboratory experiments, the type of innovation is generally restricted to technological innovations. In routine projects, innovation is absent.

Innovation development can be demand-driven or supply-driven. Demand-driven implies that the user asks innovators to develop means address operational concerns in a more effective and efficient way. Supply-driven implies that innovators develop innovations without users asking for it. They think the system can be improved and subsequently deliver or sell the innovation to the user. Supply-driven innovations can better address long-term, potential envisaged needs. Pilot projects can be both demand- and supply-driven. Laboratory experiments are supply-driven.

The level of innovation of a pilot can range from 'radical' to 'incremental' (Henderson and Clark 1990). Sendzimir *et al.* (2007) indicate that compromise building limits the level of innovation. In routine projects, the level of innovation is low. Proven approaches are used. In laboratory experiments, in contrast, the level of innovation is high. The constraints of contextual dependency leading to compromise are absent.

4. Knowledge Orientation
'Knowledge orientation' indicates how a project is designed for knowledge creation and learning. In general, two stances towards knowledge design can be identified. These include an expert-driven model and a communicative model.

In the expert-driven model, experts define the problem, provide knowledge and prepare solutions. Monitoring focuses primarily on biophysical or technological impacts. The types of knowledge created are of a hard, substantive and relatively general nature (Dosi 1988, Flyvbjerg 2006) such as knowledge on the innovation itself, routine procedures and measuring methodologies. The type of learning taking place is of a single-loop nature, meaning that the actors modify their actions according to the difference between expected and obtained outcomes (Argyris and Schön 1994, Raven *et al.* 2008).

In the communicative model, the needs of the stakeholders and learning from each other have a central position. Local stakeholder knowledge is of importance, while expert knowledge is merely supportive. Social learning is used as a central mechanism to encourage participation and foster learning. A social learning process can lead to the development of a common understanding of the system or problem at hand, agreement and collective actions through communication and the interaction of different actors in a participatory setting (Muro and Jeffrey 2008). The types of knowledge that are created are of a process, soft and contextual nature (Dosi 1988, Flyvbjerg 2006) such as interactions and dependencies between actors and the interaction between actors and the innovation. The type of learning can be characterized as double-loop learning. In double-loop learning actors question and modify values, assumptions and policies that led to the actions (Argyris and Schön 1994, Raven *et al.* 2008). It is therefore learning about single-loop learning. Additionally, a broad range of actors gains experience (Kolb 1984, Dreyfus and Dreyfus 1984, Flyvbjerg 2006). Accordingly, the range of actors learning and the extent of learning are broader. How much is eventually learnt also depends on the involved individuals and their personalities.

For laboratory experiments the expert-driven model is most common. Interaction with the context is not desirable in a laboratory experiment. The goal is knowledge about the innovation itself, not about the context-innovation interaction. In pilot projects both models can be used. The communicative model with learning through social processes is, however, increasingly advocated from an Adaptive Management and Transition Management point of view (e.g. Pahl-Wostl 2006, Van der Poel 2003). For routine projects, the expert model is most common in the sense that experts design the project. However, a focus on learning is lacking, because well-known methods and technologies are used.

The extent to which knowledge creation is considered important is reflected in the monitoring intensity and the subsequent reporting and communication of knowledge. In laboratory experiments controlled observation in a controlled context is exercised (Lee 1999). In routine projects little or no monitoring takes place since there is little potential for new knowledge. The monitoring intensity in pilot projects is diverse, despite the claimed focus on knowledge creation and learning (e.g. Pahl-Wostl 2006, Pawson and Tilley 1997, Raven 2007). The type of monitoring is systemic, aimed at detecting surprises (Lee 1999) and is generally of a before-after nature.

5. Special Status

The characteristic 'special status' is a strong distinguishing characteristic of a pilot project. The special status is reflected in attitudes towards the project, its flexibility and the resource allocation.

The attitude towards pilot projects differs from the attitude to routine projects, because people have different expectations of and associate different meaning to pilot projects (Geels and Raven 2006). Accordingly, behaviour changes. Pilot projects are associated with innovation, one can identify a learning attitude and a tolerance towards what under non-pilot conditions would be considered 'failure'. Instead, all pilot outcomes are considered input for learning. The attitude is manifested as a 'spirit of experimentation' (Weiss 1977). As a result of the expectations, outsiders are attracted and commitment is enhanced (e.g. the risk for a person in a high position, such as a minister, is perceived as smaller and they can therefore risk committing themselves). New, previously non-existent, co-operations between actors can now take place. Additionally, there is space for creativity in contrast to routine projects where a conformist attitude is exercised. It should be noted that for some people the status of pilot project means that the project does not have to be taken seriously. In WINN however, the view of pilot projects was positive. They were associated with the chance to leave existing paths, collect resources, experience personal development, reduce personal responsibilities and so on. Like pilot projects, laboratory experiments enjoy a special status although this is of a different nature. The allowance for failure is high.

Flexibility is a second aspect of the special status. Flexibility means the freedom to not have to follow standard procedures. In routine projects both creativity and flexibility are constrained. One needs to follow strict rules and guidelines as well as meet policy goals. In pilot projects, there is more autonomy and it is possible to tailor-make applications to the biophysical and societal context and so to accommodate dynamics. Adjustments can be made during the implementation as well as in the analysis methods, the objects analysed and the interpretation of the findings from the pilot project. The use of this freedom can itself be a cause of conflict because of differences in the expectations and interpretations of different actors (Van Lente 1993, Geels and Raven 2006). In laboratory experiments, flexibility is high in the design phase but not during the experiment itself, because answers to specific research questions are then sought.

Lastly, the special status is reflected in the 'resource allocation'. Enhanced allocation of resources occurs because actors wish to be at the forefront of innovation, make societal contributions or try to influence the course of the pilot and related policies. By participating, actors bring resources to the project, but might also be prepared to invest more resources. Accordingly, resources become available that under routine circumstances would not have been available. Within WINN, the pilot projects for instance received support from the ministry in the form of people, access to information and knowledge, and through the provision of study sites. The resource allocation to laboratory experiments is variable, because it depends on the extent to which the experiment is understood to be potentially valuable. In routine projects the resource allocation, and particularly the sources thereof, are fixed.

6. Actor network

The initiators, participants and the exercised governance styles are of interest in characterizing projects by their actor-network. Initiators of laboratory experiments and routine projects are generally restricted to a specific single actor (e.g. researchers and government agencies). In pilot projects the type and number of actors initiating the pilot can be more diverse. Initiators can be governmental agencies (Hoogma *et al.* 2002), stakeholder groups including citizens, research institutes, companies, or (temporary) alliances between these (Brown *et al.* 2003). Next to the initiator, other actors also participate in pilot projects dealing with integrated water management. There is a multi-actor setting. These participants can be the same type of actors as the initiators, but have a different role (e.g. user instead of developer). However, the extent to which the different actors actively influence the pilot is variable.

Governance styles indicate the type of relation between the initiator and other participants, or, the possibilities provided by the initiator for participants to influence the pilot (Pretty 1994). In pilot projects, any type of style, ranging from closed to open, can be exercised. However, pilots have the ability to foster more facilitative, open styles. Responsibilities are less pressing and 'failure' is more tolerated. Moreover, the exploration of more open styles of governance could be a goal in itself, so as to enhance creativity, democracy and social learning. For instance, this took place in the WINN pilot 'Combi-kering' where urban development and coastal protection were combined through co-production with citizens. In routine water mangement projects, styles are generally relatively closed. Specialized staff members from governmental bodies generally work on the issues. The actor network is more limited. In laboratory experiments governance styles are not applicable, because of the single-actor setting and the distance from operational practice. Interaction with the context is avoided to enable to focus on the innovation itself and to ease replication.

Conclusions on the character of pilot projects

Based on six characteristics, the range of pilot project characters has been identified. The diversity in characters reflects the broadness of pilot projects and the consequent ability to address problems with low and high level of complexity. In IWM, problems are generally of a complex nature. Many actors and interests meet, problems are ill-structured and change over time, and uncertainties are high (Stacey 1996, Collins and Ison 2006). Pilot projects offer in this environment the opportunity to overcome initial barriers for the implementation of IWM such as the lack of capacity. Despite the wide range of problems pilot projects can cover, they can be distinguished from laboratory experiments and routine projects. A primary distinction with laboratory experiments includes the controlled context versus the field application to exactly develop context-dependent knowledge. In routine projects, proven technologies are used and the focus on learning is absent, while pilot projects focus on innovations and learning. However, the intensity thereon can range from high to very low. Additionally, in pilot projects scales are often confined in at least one dimension in contrast to routine management projects. Less tangible, but often of high importance is the special status of a pilot project in contrast to routine management. This implies a change in attitude leading to reduced risk and more possibilities in participation. Based on this analysis the pilot project definition can now be refined as ‘projects undertaken in the spirit of experimentation in a field setting with an –at least claimed- focus on innovation and knowledge development, usually at a small scale’.

2.4 Uses of Pilot Projects

In the comparative analysis of policy development models, I established that although pilot projects are nominally used for testing innovations in a real-world setting, their actual use is highly diverse. In this section, I seek to develop a coherent overview of pilot uses within the policy development process, based on the literature survey, WINN projects and interviews with water and nature managers.

2.4.1 Research, Managerial and Political-Entrepreneurial pilot projects

I follow Huitema *et al.* (2009) in first distinguishing two major types of pilot projects, namely: the Research Pilot and the Management Pilot. Additionally, based on the political view of policy-making as discussed earlier (Figure 2.1), I identify a third type, namely: the Political-Entrepreneurial Pilot. I subsequently divide the three types into nine uses (Table 2.2).

Table 2.2: Pilot project uses and frequency of occurrence within the analyzed WINN projects

Type of Pilot	Pilot Project Use	Frequency of occurrence within WINN (n out of 16)
Research Pilot Project	Exploration (innovation testing and refining, gaining experience)	16
	Evaluation (early policy evaluation)	1
Management Pilot Project	Communication (triggering dialogue, setting up non-existing cooperations)	7
	Problem Mitigation (resolve practical problem for which tools are lacking)	6
	Policy Implementation (policy enforcement, creating favourable conditions for implementation)	1
	Insurance (allow for (personal) failure, small impact, prevent large policy flaws, dealing with uncertainties)	0
Political-Entrepreneurial Pilot Project	Incentive (creating favourable conditions society to innovate)	2
	Political game (hidden intentions e.g. delaying policy decisions, shifting attention, commercial interest in pilot itself)	0
	Advocacy tool (convincing, demonstrating, accumulating evidence, lobby for its use after the pilot)	4

1. Research pilot projects focus on knowledge development. They aim to fill knowledge gaps, possibly identified with other research techniques (Walters 1997). The research pilot projects are associated with the Analytical Models and Holistic Models of policy development. Pilot projects are considered to supply rational decision-making with knowledge (Simon 1977, Miser and Quade 1985) and provide learning platforms to develop ongoing insights and so deal with social-ecological dynamics (Pahl-Wostl 2006).

Knowledge development can occur both through exploration and evaluation. *Explorative* pilot projects are used to test and refine innovations and to gain experience with the innovation. This purpose was explicitly presented for all WINN pilot projects. *Evaluative* pilot projects are used to evaluate policies at an early stage of their development. This means that policies are first implemented at a confined scale and are evaluated before the full policy is rolled out (Cabinet Office 2003). Results are used to inform policy-making and to refine the policy (Weiss 1975). This for instance occurred in the pilot project ‘clean shipping’. It was already decided that shipping had to be cleaner and the pilot project should provide the input whether this was the right approach. In contrast, the explorative pilot project is usually undertaken at an earlier stage of the innovation development trajectory and lies in the policy periphery rather than having a strong link with policy. This implies that in the explorative pilot the level of innovation can be higher and that researchers are the initiators instead of policy makers.

2. Management Pilot projects are used for communication, problem mitigation, policy implementation and as insurance*.* A *communication* pilot is used to initiate communication amongst actors on the specific topic addressed by the pilot. As such, social learning processes are initiated and new channels of communication can open up. Additionally, the pilot is used as an open conduit for spreading existing

knowledge. By this type of communication, I do not mean convincing or converting others to one's own point of view. This will be referred to as advocative. An example within WINN is the development of a dike in Den Helder, in which the pilot project is used to engage different actors to jointly explore dikes of the future. Direct implementation thereof was not the primary purpose.

Pilots used for *problem mitigation* are applied to mitigate an existing practical (often, biophysical) problem. Standard tools to resolve the issue are lacking and innovative solutions can be sought and found. The driving motivation for this use of a pilot project lies in the problem at the particular site itself, rather than with an innovation that is looking for an application site. For example, excessive vegetation along the river leads to an increased risk of flooding, for which a new concept is developed.

Pilots can be used for *policy implementation*. Operational managers are the people who ultimately put policies into practice. However, the translation from policy to implementation is often considered troublesome. The use of a pilot project can increase acceptance, by creating favourable conditions and delaying sensitive trade-offs. As such, it provides impetus to the implementation of an existing policy. The pilot project is used pragmatically to put fully developed policy into practice. Knowledge development is not central. For example, dike strengthening already be decided upon to meet policy requirements, but since this is often a sensitive issue, a pilot strategy is chosen.

Lastly, pilot projects are used as *insurance* against failure. They enable risk limitation and facilitate dealing with uncertainties. Since pilots are undertaken on a confined scale, impacts are small. Additionally, due to the special status, 'failure' is now more tolerated. This enables actors holding responsible positions to participate. Lastly, by confining the scale in any dimension of time, space or problem scope, boundaries are set and chances of unexpected biophysical and social developments are reduced.

3. Political-Entrepreneurial pilot projects are used to influence a policy process for personal or strategic reasons. This aspect of pilot project use is recognized and embraced in the political view of policy development. Uses include playing a political game, providing an incentive and for advocacy purposes.

Pilot projects are used as a *political game* when the real intentions of the initiators are disguised and they are solely trying to serve their own interests. The pilot is then used as a diversionary tactic, to set the agenda (i.e. 'guide' policy attention), delay decision-making, save political face, as a symbolic gesture ('look, something has been done'), or to gain commitment from actors that would otherwise not be forthcoming. Additionally, the pilot itself can be considered an opportune way to (commercially) implement a project. Owing to extensive use of the policy freedom there is no commitment to policy requirements while the pilot project label helps to collect support for the pilot initiation.

Pilots can provide *incentives* to individuals, organisations or societies (Schneider and Ingram 1990). Conditions are created that allow individuals to be creative, profile themselves and learn. Their organisations can also learn and build experience, and develop business by implementing prototype technologies in a practice setting. For societies, the use of pilot projects can provide a setting that stimulates innovation. The WINN program as a whole is an example of this. It creates conditions within which pilot projects can be developed and so create an environment in which innovation in general is stimulated.

Finally, pilots can be used for *advocacy* purposes. This means that the pilot project is specifically used to convince other actors of one's own point of view or to lobby for specific solutions to envisaged future problems. The pilot project itself is used as an example to convince others of the excellence of the innovation and the conditions that are necessary for it to work well. An example is the project 'zandmotor' (*sand motor).* Sand nourishment is undertaken at a distance from the coast for coastal flood defence purposes. The sand piles form islands that are 'eaten' by the water over time and subsequently deposited on the beach (the ultimate purpose). One aspect of the pilot is to give these islands a societal function and to find financial resources. Therefore, project developers are invited to participate. What is advocated is not the core of the pilot (the concept of the *sand motor*), but the idea that properties can be developed that take the ephemeral nature of the islands into account. Convincing is considered necessary because the project developers would otherwise not be interested in such small-scale, high risk, innovative projects when there are enough other places where conventional business can be done.

2.4.2 Analysing the WINN pilots on their use

An analysis of the WINN database revealed that most projects were used for multiple purposes, instead of for a single use (Table 2.2). Not all potential uses were explicitly mentioned (e.g. political game, insurance) and some were only alluded to (evaluative, policy implementation). The reasons for this include (i) the implicit nature of the goal (difficult to explicate), (ii) the use is assumed as a general characteristic of a pilot project (e.g. insurance) and was therefore not considered worth mentioning, (iii) it is at a meta-level (incentive), and (iv) it is a hidden intention (political game). I have included all of these uses, because they were mentioned during the interviews and can be found (implicitly) in literature (e.g. De Bruijn and ten Heuvelhof 2008, Schneider and Ingram 1990). Since the use of a pilot is subject to interpretation, asking different actors for their perception might lead to different sets of uses for one pilot. Actors' perceptions on the pilot depend on their role, background and reasons to participate in the pilot. Additionally, some uses will dominate over others. Therefore it is more appropriate to speak of the degree to which a certain use is considered to be present in a pilot. Lastly, all project descriptions claimed that the pilots were exploratory tools contributing to knowledge development. However, the extent and nature of this knowledge development, was not always indicated. It seems that claiming the exploratory use provides the justification for naming a project a pilot project.

2.4.3 The typical characters of Research-, Managerial- and Political-Entrepreneurial pilot projects

From the above two sections on pilot characters and uses it appears that these two aspects are related. This means that when one understands the purpose for which the pilot is used, one can better understand the pilot character. In this section I describe the typical characteristics that one can find with the research-, managerial- or political-entrepreneurial pilot project.

Research-oriented pilot project places more emphasis on monitoring and analysis than a pilot project in which research is not dominant. The nature of knowledge and the types of knowledge creation can be diverse across the pilot types. In the more classical research pilot projects the focus will be on monitoring and analysis, in managerial pilot projects social learning is dominant, whereas in political-entrepreneurial pilot projects both can be used. Research-oriented pilot projects usually have little eye for future users and therefore most likely have smaller or less intensive actor involvement. A managerial pilot is embedded at the core of policies, is moderately innovative, and can be applied at both full scale to resolve an issue or implement policy or at confined scale to reduce risks. The managerial pilot project is demand-driven, which immediately reduces the level of innovativeness. The site is fixed and communication is of importance with implementers, users within the site and external actors. There is no advocacy or a hidden agenda. In managerial pilots it is not unlikely that developers are users as well, such as in Altenheim. A political-entrepreneurial pilot has a strong focus on future users, because it is understood that the pilot is a means to convince users. Political-entrepreneurial pilot projects make use of the pilot status to initiate a pilot project. However, also the other types of pilot projects tend to make use of the status, in particular when dependencies for initiation on other actors are understood. Given the often hidden character of political-entrepreneurial pilot, their character can be highly diverse, depending on the chosen strategy, which is usually not transparent. The relation between use and character is thus also less clear for this type of pilot. In political-entrepreneurial pilot projects strategic behaviour is important. The pilot project can be used to develop a specific type of knowledge that helps to support the actor's case. Political-entrepreneurial pilots are often initiated at the policy core, but can be steered by participants to be kept out of the core to prevent policy influence.

In Table 2.3 an overview is provided of typical characters of the three pilot project types. In practice, an individual pilot will most likely deviate from this, because a pilot is used for multiple purposes by different actors at the same time. The initiator can use the pilot in diverse ways, but other actors also influence the character of the pilot. This leads to the specific character of an individual pilot.

Table 2.3: Typical characters of the three different pilot types

	Research	**Managerial**	**Political-Entrepreneurial**
Relation to context	In the periphery	At the core	At core or in periphery
Scale	Confined	Full or confined	Full or Confined
Innovation level	High Supply-driven	Moderate Demand-driven	Low-High Supply-driven
Knowledge Orientation	High Monitoring and Analysis	Low Social learning	High Both monitoring and analysis and Social learning
Status use	High	Moderate Fixed site	High Deliberate site choice
Actor involvement	Initiative from research institute Closed	Developers are users Focus on implementers and external actors	Focus on users

2.5 The Context of Pilot Projects in IWM

2.5.1 The pilot-context interaction

Pilot projects cannot be regarded in isolation from their context. Decisions made before, during and after the pilot are to a large extent shaped by the context. External developments and elements influence pilot projects for instance through how problems are perceived, what type of innovations are developed, what is considered as 'good' governance of water systems and how different water functions are related to each other. However, the relation between the context and the pilot is two-way. The pilot project and particularly the dynamics surrounding the pilot can influence the context in return. The influence of the pilot on the context though is more unpredictable. Factors at a larger spatial-, temporal- and intuitive distance are less likely or less intensively influenced than more nearby factors. For instance, actors and biophysical systems in close connection to the pilot are likely to be influenced by the pilot, but those at a larger distance are less likely to be influenced. In case they are influenced it is likely this goes indirectly through other contextual factors that are closer to the pilot. Additionally, some elements such as individual projects are also more susceptible for influence than other elements such as structures and beliefs. These are in general difficult to change and take a long period to do so (Sabatier 1988, Zonneveld 1991). Even if a change in the context can be observed, it remains difficult to specifically attribute this change to the pilot. Namely, a pilot is just one of the many developments during a certain period and contextual elements also influence other contextual elements. This discussion on effects of pilot projects on its context is continued in the next section. In the remainder of this section the nature of the context of pilot projects in IWM is discussed. Understanding the context of pilot projects is conditional to understand the dynamics of pilot projects.

2.5.2 Contextual Factors

The water management context includes biophysical, institutional and socio-economic elements (GWP 2000, see Figure 2.2). Integrated Water Management takes place at the heart of the system, where the different elements meet and interact.

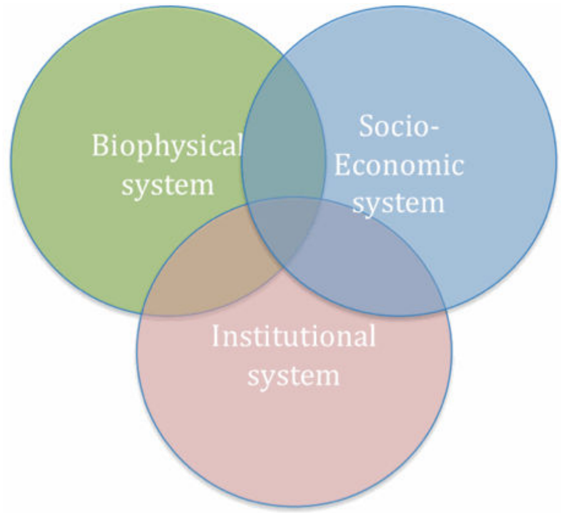


Figure 2.3: IWM Context

To describe the elements within the context of a pilot within IWM more specifically, I develop a context chart, which is a method to visualize and structure a context (Miles and Huberman 1994). In Figure 2.3 the pilot project is in the centre and is surrounded by the contextual elements. Nearby is the *direct context*, whereas at a larger distance the *broader context* is depicted. Even within the direct context the 'distance' between an element and the pilot varies. For instance, pilot participants are more directly related to the pilot than non-participating water management actors. The boundaries between the pilot and the context, and also between the different sub-systems are open and arbitrary. Therefore they are indicated by dotted lines.

The direct context of the water management system can be conceptualized by the interplay of the biophysical, institutional and socio-economic settings. The direct context consists of those elements that most directly influence the pilot project and each other during a certain period. The biophysical setting includes the physical elements, while the elements in the institutional and socio-economic setting indicate the mental aspects of societies towards water systems. It indicates how we view and arrange the system in general and the pilot project in particular. The institutional setting indicates interactions (between actors, between social and ecological systems) within the water system are arranged, while the socio-economic setting indicates the use of the water system for society.

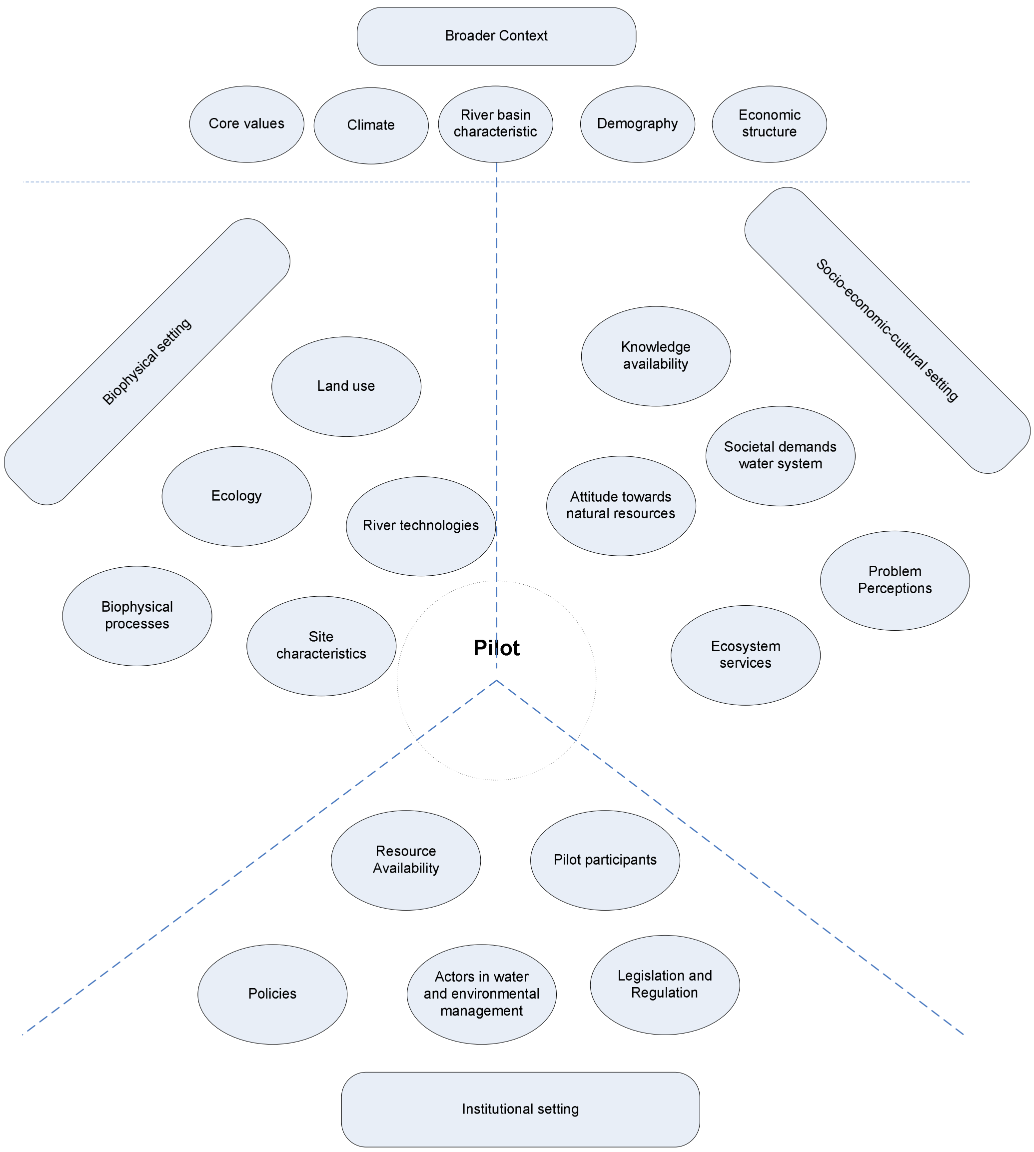


Figure 2.4: Context Chart. Contextual elements of pilot projects subdivided in the biophysical setting, institutional setting, socio-economic setting and broader context

The elements within the *biophysical setting* include land use (e.g. infrastructure, housing, factories, agriculture), river technologies (e.g. dikes, groynes, dams), biophysical processes (e.g. hydrological cycles, geomorphology, discharge), ecology (e.g. habitats, species) and specific site characteristics (e.g. dimensions, connectivity to river, soil, vegetation, presence of riverine dynamics). The elements identified in the *institutional setting* include legislation and regulation guiding the project and setting boundaries (e.g. water and soil quality standards, permits for land use), the actors in the field of river and environmental management (e.g. government agencies, administration, NGO's, research institutes, citizens), but also the actors specifically involved in the pilot (e.g. regional government agency, province, farmers), the water management and environmental policies (e.g. national policy programs, EU WFD, spatial plans) and the resources made available for the pilot (e.g. time, money, sites). Factors related to the *socio-economic setting* include ecosystem services (e.g. navigation, drinking water, recreation, hydropower), demands on the water system (e.g. extraction, pollution), attitudes towards natural resources that are driven by factors such as history, political colour, societal beliefs, norms and values, policies and disciplines (Vreugdenhil *et al.* 2008, Sabatier 1988), the quality and quantity of knowledge available for the pilot (e.g. substantive, explicit, experience) and the problem perception (e.g. technological, social). The socio-economic setting thus includes many soft and tacit elements representative for a culture. Understanding norms, values and attitudes helps to understand choices made. In the broader context, factors are identified that do influence the project or other factors in the context. These are relatively autonomous and unlikely to be influenced by the pilot project. Elements include national economic structure and development, climate, demographics, river basin characteristics and deep core values.

The recognition of the nature and influence of the context on a pilot and the position within the context (e.g. in policy or management periphery) enables pilot initiators to adjust the pilot to the specific situation. The relevance for the given situation can be increased and valuable context-dependent knowledge can be developed (Flyvbjerg 2006). Transferring knowledge only makes sense when contextual factors are comparable (Pawson and Tilley 1997). Therefore, understanding the context of a pilot increases the possibility to distinguish between situation-specific knowledge that is not transferable, context-dependent knowledge that is transferable to situations with comparable contextual situations and more generic knowledge that is wider applicable.

2.6 Effects of Pilot Projects on Policy-Making and Management

In the previous section it is already discussed that the context not only affects the pilot, but that the pilot also may have an impact on its context. Those are considered the effects of pilot projects. The reason to discuss effects in-depth is that pilot projects are undertaken to achieve certain effects both within and beyond the pilot, such as answering research questions, anchor policies in evidence or implement an innovation on a small scale before further roll-out. Hindering the diffusion of the innovation or resolving a local problem might also be intended effects. In this section, effects and their relations are discussed in a structured way to recognize all types of effects a pilot might assort, both within or beyond the pilot and intended or not,.

Based on the insights in context and use, complemented with discussions in literature, three types of effects of pilot projects on its context can be identified, being *system responses, knowledge development* and *diffusion*. These effects are interdependent, whereby system's response (either from the biophysical or actor-network system (is a direct effect, knowledge development entails knowledge creation and learning and diffusion is the broader application of what has been learned. Their embedded relation is depicted in Figure 2.4. An IWM pilot project establishes all three types of effects when undertaken in a biophysical, multi-actor context. In Table 2.4 the effects and major indicators are depicted.

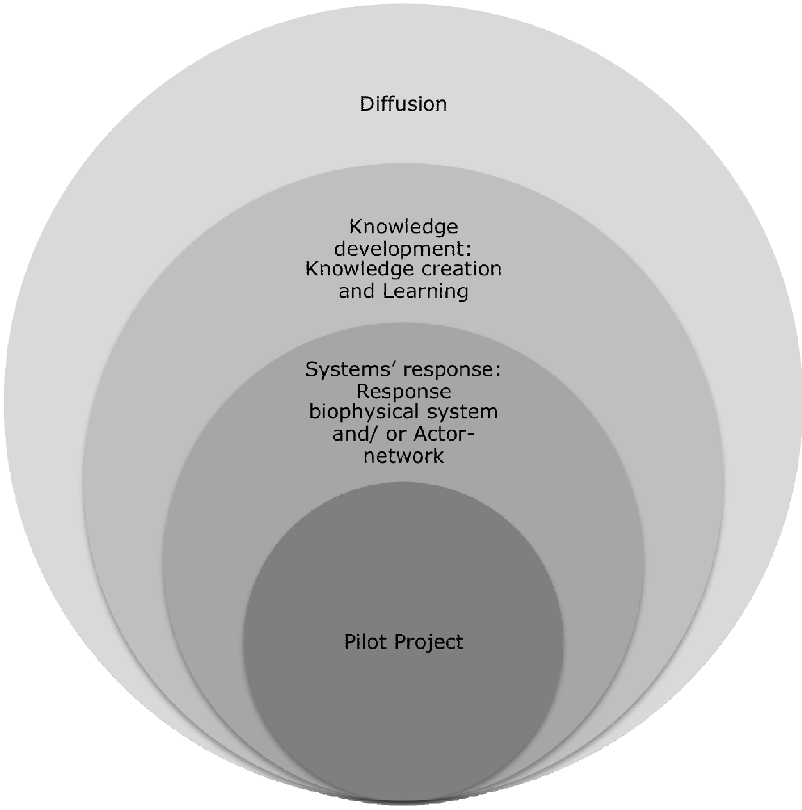


Figure 2.5: The embedded relation between the different type of effects of pilot projects

Table 2.4: Effects of pilot projects

Effect		**Indicators**
System's Response	*Biophysical system*	• Landscape • River processes • Response time • Ecosystem's health
	Actor-Network	• Network structure/ Actor participation • Resources • Relationships/ dependencies • Governance style
Knowledge Development	*Knowledge Creation*	• Type (hard/soft, contextual/generic, substantive/process) • Extent • Distribution activities
	Learning	• Type (single/double loop) • Actors • Mode (social, rule-based, experience)
Diffusion		• Pattern (Dissemination, Expansion, Institutionalisation) • Nature (Artefact, Hard Knowledge, Soft Knowledge) • Channel (Internal, External, Partnership)

2.6.1 Systems' response

The first and most direct effect a pilot project assorts is the change in and consequent response of the biophysical system and actor-network that are affected by the pilot project (Vreugdenhil *et al.* 2009a, Vreugdenhil and Slinger 2009).

Biophysical system

The implementation of a pilot project influences the biophysical system, at least at the pilot project site and possibly beyond. For example, when a pilot concerns the excavation of a secondary channel in a floodplain, the site and possibly the present infrastructures are adapted. Immediately after, the river system starts to respond with sedimentation and colonization processes to find a new 'equilibrium' (Smits *et al.* 2000). Indicators for this effect include changes in the landscape, in river processes, the duration to achieve the new equilibrium or return to the initial state, and the ecosystem's health (cf. Postel and Richter 2003). Changes in the landscape include change in i) land use such as infrastructures, agriculture and housing ii) river technologies such as dikes and groynes, and iii) biotic and a-biotic site characteristics such as vegetation structures, water quality, quantity and sediment deposits (Mitchell 1990). Exception to the biophysical response is when the intervention does not affect the biophysical system, for example when a wave rotor is placed in an estuary to generate power.

Actor-Network

Next to the biophysical response, actor-networks respond to the pilot project. They function as a mirror of change (Quist 2007). Actor-networks are social structures of actors and their relationships. The actors in the network have different goals, interests and resources and depend on each other for the realization of their goals. Actors can be individuals, groups of individuals, organisations, groups of organisations or units of organisations in both the public and private sector (Adams and Kriesi 2007, De Bruijn and Ten Heuvelhof 2008). The network provides a framework that influences the behaviour of actors, but at the same time the behaviour of the actors influences and shapes the network (Quist, 2007). In pilot projects in IWM, different disciplines and interests meet. The projects are often developed by project teams with different actors. Each of the different actors, either users, developers or stakeholders and being governmental, non-governmental or commercial, has its own motivation to participate in or initiate a pilot project (Raven *et al.* 2008).

The actor-network response is not only a response to the intervention, like the biophysical response, but can already take place when only discussing the initiation of a pilot. Due to the initiation and development of the pilot, the actor-network is activated (e.g. actors start cooperating), triggered by expectations (van Lente 1993), or altered, whereby new forms of cooperation emerge. Ongoing development of the pilot (e.g. the implementation) might also attract new actors and make others to decide to leave the network. The network also creates its own dynamics whereby actors respond to earlier changes in the actor-network. Actors learn from and about each other and the system. As a result, problem perceptions, interests, resource structures and relationships might change. The relation between the initiator and other actors in the network is expressed in terms of governance style (Pretty 1994, Ker Rault 2008). Since relations can be different between the different actors, in one pilot can multiple governance styles can be present. Governance styles can change during the pilot.

Except for insight in responses of actor-networks as an effect of pilot projects, understanding the actor-network response is crucial in understanding how the pilot itself is changed, how learning- and decision-making processes and how diffusion of the innovation are influenced (Mostert *et al.* 2007, Van Mierlo 2002). Diffusion goes through the network and actors are the conduit for diffusion (Rogers 2003, Argote and Ingram 2000).

2.6.2 Knowledge Development

Knowledge development is often claimed as the main goal of pilot projects and provides its legitimacy (Pawson and Tilley 1997, Vreugdenhil *et al.* 2010b). With the knowledge, questions can be answered, opponents convinced, 'evidence' provided for policies and competitive advantages developed. Therefore, knowledge is a source of power (Nonaka and Takeuchi 1995). However, not only the focus and intensity on knowledge can be diverse, as was discussed in section 2.2, but also the knowledge that is eventually developed can be diverse. Knowledge development in this thesis includes both which knowledge has been created and what has been learned by whom as a result of the pilot (cf. Vreugdenhil *et al.* 2009a, Bhatt 2000).

Knowledge Creation

Knowledge is not only a multiform entity, the quality and quantity can vary widely across pilots. The knowledge stance and focus (see 2.2) and consequent monitoring type, monitoring intensity, analytical process and identification of research gaps, highly influence the quantity and quality of knowledge that is developed and recognized. Biases and interests highly influence the nature of knowledge developed (cf. Bergman and Coxon 2006, Sabatier 1988). For instance, in an expert driven pilot with a low intensity, some engineering knowledge is likely to be created. In a more communicative oriented pilot with high monitoring intensity, much knowledge on actors is created.

For the purpose of this thesis three distinctions in types of knowledge have been made, although in literature more distinctions can be found (e.g. Dosi 1988, Leeuwis 2002, Nonaka and Takeuchi 1995). A first distinction can be made between substantive and process knowledge (Dosi 1988). Examples of substantive knowledge include knowledge on the biophysical system and on technologies. Particularly in the rational paradigm, this type of knowledge is expected to feed the decision-making process. Examples of process knowledge include knowledge on developments of the project, on interactions between actors and on management approaches. A second distinction can be made between generic and contextual knowledge (Flyvbjerg 2006). Whereas generic knowledge is broadly applicable, contextual knowledge is directly related to a particular context. Examples of contextual knowledge include the presence of interests and the interaction of the innovation with the context such the response of the biophysical system at that location and time. Contextual knowledge is in the first place not meant to be transferable, but if it is, it only keeps its value if it remains contextualized. A third distinction can be made between hard and soft knowledge (Nonaka and Takeuchi 1995). Hard or ‘objective’ knowledge is often written down in detail in manuals, articles and study books, which often contains hard, quantifiable data (Nonaka and Takeuchi 1995) or explicit qualitative data such as organisation structures. Soft or ‘subjective’ knowledge is embedded in individuals such as intuition, experience and ideals or between actors and is mainly learned through practice, social interactions and practical examples. Examples include experience and shared values. In pilots, soft knowledge of participants is sometimes tried to be made explicit, but the formulation of principles and theories is often incongruent with the understanding of practice (Schön 1993). As a result of the interactions in pilot projects new soft knowledge, such as building relationships, is developed. Knowledge creation is an ongoing process and can take place from many viewpoints. The entrance of new actors will lead to new knowledge or the recognition thereof. Particularly the development of soft knowledge is little structured and ongoing.

Learning

Knowledge becomes valuable when it is being learned. For the purpose of this thesis learning means that knowledge is internalized by an actor (for more extensive discussions on the meaning of learning see for instance Muro and Jeffrey 2008 or Argyris and Schön 1994). In understanding learning, one needs to know who learns what. The level of what is being learned is limited by the quality and quantity of knowledge that is created and distributed. Knowledge can be actively and passively distributed amongst direct project team members, the organisations they represent, and external actors. The different ways for spreading knowledge within the pilot include formalized reports, presentations, meetings and field trips. However, also less formalized knowledge can be distributed through the same channels or by participants moving between projects and organisations.

Again, the stance towards knowledge and subsequent pilot design can be taken as a starting point for who learns what. Both actors within the pilot and external actors can learn, but internal actors are more in contact with the knowledge. They are likely to learn more. In expert driven models, the range of actors involved is limited to professionals such as research institutes and governments agencies who are both developers and users of the innovation. Since the knowledge focus is on substantive knowledge, it is most likely that these actors learn these aspects through rule-based learning (Dreyfus and Dreyfus 1984). Of course also external actors might learn about the project, but since their learning has not been facilitated, the learning might be in unexpected ways. In more communicative oriented pilots, the range of actors involved is larger and there is more focus for procedural and soft knowledge. Consequently, a broad range of actors might learn, particularly through and about each other (i.e. social learning) (Leeuwis 2000, Healey 2006). In social learning shared meanings and values are developed at the actor level, which provides a basis for joint action (Muro and Jeffrey 2008, Pahl-Wostl *et al.* 2007). Risks are that more substantive knowledge is undermined and that little knowledge is formalized and so might get lost. Actors may also develop negative feelings and the lessons might be considered less valuable than hard and generic knowledge. In all instances, actors learn through experiencing or 'learning-by-doing', although the nature can differ (Hoogma *et al.* 2002). This is a powerful aspect of pilot projects that is very convincing both for participants and external actors (Flyvbjerg 2001). Participants gain experience and for external actors a real example is provided. In practice, all three modes of learning can take place in pilot projects, but it is the emphasis that changes.

The extent and type of learning not only depends on what is send, but also by whom it is received and how (Sabatier 1988). For instance, quantifiable factors between which easily causal relations can be made, are easier accepted than less obvious causal relations (ibid) and every actor has its own mind-frame that works as a filter and so guides what is recognized (Nilsson 2005). Who learns what further determines what is done with the knowledge and so whether goals such as policy change or duplication of the innovation can be achieved. For these purposes the 'right' actors that have the resources need to learn the 'right' thing. Learning is conditional for change, but it is not a guarantee (Grin and Van de Graaf 1996, Pawson and Tilley 1997). Learning can lead to instrumental changes in strategies (i.e. single loop learning), but also to changes in norms, values, relationships, problem perceptions, the water management concept, goals and policies (i.e. double loop learning) (Argyris and Schön 1994, Sabatier and Jenkins-Smith 1999, Schön and Rein 1994). In the following section on diffusion the contribution of the learned knowledge to IWM is discussed.

2.6.3 Diffusion

The third type of effect is the diffusion of the pilot. Diffusion in this thesis means that the learned knowledge is applied in new projects, in policies and in the pilot itself, but also in the decision- and policy-making processes (Scott 1987, Healey 2006, Dryzek 2005). In contrast to most studies on innovation, I use a broader definition of diffusion in this thesis. In innovation studies diffusion is the actual decision of an individual to use the innovation (Rogers 2003). Diffusion is considered a relatively easily quantifiable effect of pilot projects and a more neutral indicator than learning (Van Mierlo 2002). This view might allow to evaluate the diffusion of product innovation in commercial settings instead, but stops short in understanding the diffusion of knowledge in and about complex processes, which is the case in pilot projects in IWM. Hoogma *et al.* (2002, p.191) already propose a broader view by focussing on the 'translation' of the innovation that is of a more conceptual nature.

This implies that the innovation is adapted to the new application context instead of the 'simple and mechanistic spread of a specific artefact to a group with specific preferences and other characteristics'. Even though this process applies better to the processes studied in this thesis, the definition is further broadened by focussing on the knowledge developed and diffused, rather than on the adoption or translation of the innovation alone. The view exercised in this thesis enables the identification of multiple types and extents of contributions of a pilot project to IWM, including hard and soft knowledge or lessons on specific aspects encountered in the pilot. Measuring diffusion is no longer easily quantifiable and neutral. Elements of importance with regard to diffusion include the *pattern, nature* and *channels of diffusion*.

Patterns of Diffusion

Diffusion patterns are in this thesis conceptualized as *dissemination* and *scaling up* (see Figure 2.5). "Dissemination" includes the duplication of the pilot project to other pilot projects or comparable management projects in other locations or times. The context changes, but the scales and accompanying type of issue addressed and level of complexity remain comparable. The stakeholder group also remains comparable (e.g. from farmer to farmer) (Douthwaite *et al.* 2003, Van den Bosch and Rotmans 2008). Dissemination can also refer to the diffusion of knowledge within the pilot to improve the innovation or adapt the pilot to local circumstances. In contrast, "scaling up" refers to increasing the scale dimensions of the pilot project, whereby the nature of the problem addressed changes. More actors, interests and administrative layers are included and different biophysical processes start to play a role. Consequently, scaling up increases the number of relationships and uncertainties and so the complexity of the problem addressed. In case of "*expansion*", the initial pilot is expanded in the scale dimensions of time, space (e.g. from floodplain to river branch) and problem scope (e.g. more issues included). Consequently more administrative bodies and layers are included (Douthwaite *et al.* 2003). The pilot can also be the basis for a full scale management project that is grounded in the lessons of the pilot. Diffusion then remains at the operational level. In case of "*institutionalization*", regional or national policies and regulations are initiated or adapted based on the pilot project. The knowledge becomes part of the standard practice of governmental bodies. This is also referred to as the *standardization process*. Again, the different scale dimensions (time, space, problem scope) are expanded. Indicators for diffusion include the recognition of knowledge developed in the pilot in the pilot itself, in regulation, in management projects, in policies and management plans.

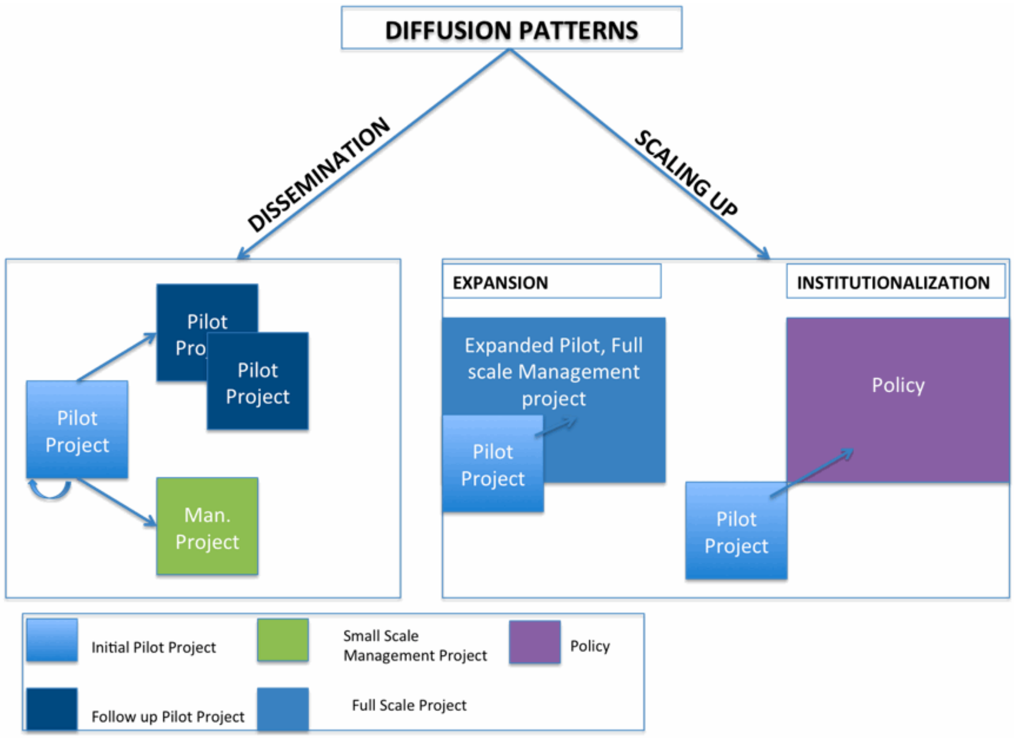


Figure 2.6: Diffusion of pilot projects includes dissemination and scaling up

Nature of what is being diffused

In general the nature of what is being diffused can be classified into artifacts, hard and soft knowledge. Examples of artifacts include dikes or groynes, but also specific designs. Artifacts are particularly of importance in commercial contexts and in pilots that are initiated to test technologies. Examples of hard knowledge, which is generally explicated in handbooks or articles, include knowledge about the design of the innovation, quantifiable impacts such as change in water quality, but also formal institutional structures. Soft knowledge deals more with what is between different elements and characteristics of the pilot, rather than the elements itself. This includes knowledge often in the form of experience on power structures, actor relations, shared values and dilemmas over scarce resources, possibly clustered in cooperative structures.

Pilot projects dealing with IWM concepts often have the potential for the development of both hard and soft knowledge and so have the potential for this knowledge to be diffused, either in formal or in informal ways. This may include both what is considered successful and what is considered failure. In practice, the emphasis often lies with development and diffusion of formalized hard knowledge – if there is any attention for diffusion at all. Soft knowledge is not recognized and particularly difficult to diffuse because it is context-dependent and embedded in individuals. Additionally complicating in recognizing is that for diffused soft knowledge to become visible, it needs to be made explicit (e.g. through cooperation with a certain actor) and so loses its soft character.

Channels of diffusion

'Channels of diffusion' refers to the actors promoting the diffusion of pilot projects (Rogers 2003, Argote and Ingram 2000). Channels of diffusion influence and are influenced by the nature and patterns of diffusion. The channels of diffusion are based on who takes ownership of diffusion. Particularly for soft knowledge this is of importance, because gained experience and social values are embedded in individuals, more than in reports. I identify three types of channels of diffusion. The channel of diffusion based on the actors that experienced the pilot is the "*internal channel*". The people involved in the pilot project expand the pilot or develop new projects. The channel of diffusion that relies on actors external to the pilot project is the "*external channel*". External actors decide to adopt the concept, independent from the initiators of the pilot project. They have seen and heard about the pilot and decide to use it. In between these two types of actors I propose a third type of diffusion channel, the "*internal-external partnership*". The diffusion is promoted by a joint partnership between actors with experience in a pilot and those willing to promote innovation, but external to the pilot.

2.7 Conclusions

In this chapter the relevant themes to describe and understand a pilot project in IWM have been discussed, based on literature review, interviews with people currently or previously working in IWM and an analysis of WINN pilot projects. The themes included the use of pilot projects, their characteristics, the nature of the context and the types of effects. The main outcomes are summarized in Table 2.5 and provide the basis for the framework of analysis of pilot projects used in this thesis and further discussed in chapter 3.

Table 2.5: Overview themes for framework of analysis

Pilot project themes	Main elements
Use	3 types/ 9 uses: • Research (explorative, evaluative), • Management (communication, problem mitigation, policy implementation, insurance), • Political-Entrepreneurial (incentive, political game, advocacy)
Context	• Biophysical (e.g. land use, infrastructure, biophysical processes) • Institutional (e.g. regulation, actors in pilot and IWM, resources) • Socio-Economic (e.g. ecosystem services, attitudes, demands toward natural system)
Characteristics	6 characteristics: • Relation to local and policy context • Scale (confined in at least one dimension) • Innovation • Knowledge Orientation • Special status • Actor involvement
Effects	3 Types: • System's response (biophysical and actor-network) • Knowledge development (knowledge creation and learning) • Diffusion (patterns, nature and channels)

Main insights on pilot projects include that pilot projects are broadly applicable and interpretable. Three broad pilot types (research, managerial and political-entrepreneurial) and nine different ways to use a pilot have been identified. The research pilot is initiated from the idea to develop knowledge as a primary goal that is possibly supposed to feedback into policy. In managerial pilots, more pragmatic reasons to support management exist to initiate a pilot project. In political-entrepreneurial pilots, the reasons for initiation are often hidden or strong interests for broader implementation of the innovation drive the pilot. A pilot can be used both as means for further diffusion of the innovation and as an end to develop knowledge or implement policies. Since pilot projects in IWM deal with complex problems and multiple actors are involved, a pilot is generally used for multiple purposes at the same time. This use may change over time. Moreover, perspectives upon uses are actor-dependent and so diverse views exist upon one single pilot.

Six characteristics will be used to specify a pilot. Pilot projects can differ from routine project and laboratory experiments in both physical and mental terms. Particularly the special status represents the subjective nature of pilot projects. For pilot projects in IWM, the context is of large importance in the design and course of the pilot. The context in IWM consists of biophysical, institutional and socio-economic factors of both hard and soft natures (e.g. infrastructures and percepetions). The pilot is highly influenced by its context and has the potential to influence the context. These influences are considered the effects of pilot projects and include: systems response, knowledge development and the diffusion thereof. Mutual relationships and dependencies between the different types of effects can be identified in different places. For example, changes in actor-networks lead to knowledge development and learning, which can again cause the actor-network to change, or the need for knowledge creation and subsequent learning for diffusion to take place.

PART II: Case Study Research

3.

Case Study Research in the Rhine Basin

The second part of this thesis is the case study research. The step builds upon the results from the primary analysis and contains the analysis of three case studies in the Rhine Basin (chapters 4-6) and their cross-comparison (chapter 7). The purpose of the case studies is to apply the framework in empirical settings. As a result, the individual pilot projects are better understood and the concepts of the framework can be validated and adjusted where needed. This chapter first explains the idea of and reason for case study research and then discusses the application thereof for this thesis. This includes the rationale behind selecting the case studies, data collection and analysis thereof. The chapter finishes with a short introduction to water management in the Rhine Basin, which is the shared context for all case studies.

3.1 Case study research as a research strategy

Case study research is a useful strategy for this study, because pilot projects in water management are a complex topic within a real-life context, not much theory is available, the researcher has little control over the projects, and the context is very important but cannot be clearly distinguished from the phenomenon (Yin 2003, Dul and Hak 2008). Holistic and meaningful characteristics of real-life events and its related processes can be retained and so the pilot project and related concepts and mechanism can be better understood. Moreover, a case study research fits well within the abductive research strategy exercised in this thesis (see chapter 1). It allows me as a researcher to learn about actors' interpretations of pilot projects and to build my interpretation thereof.

Case study research is often considered useful for exploratory phases of investigation (McCutcheon and Meredith 1993, Stuart *et al.* 2002). Additionally, many case study research proponents argue that case studies can also be used for descriptive or explanatory research. The same scientific rigour can be achieved as from other research methodologies (Flyvbjerg 2006, Dul and Hak 2008, Yin 2003, Miles and Huberman 1994, Meredith 1998). In this study, the case studies are used for all three purposes. Based on the developed framework, real-life projects are described in a structured way. Meanwhile the phenomenon pilot project is further explored and the framework refined. The study is explanatory, because relations between factors are identified based and for which explanations are sought. As such, new theory is developed on pilot projects and their dynamics.

Despite the encompassing nature of the strategy, case study research is not undisputed. A first criticism is that case studies would have bias towards verification. Many authors including Flyvbjerg (2006) and Blaikie (2007), argue that un-biased research on social systems does not exist. Case study research is no better or worse than any other strategy in this respect. One should just realize that one cannot create a universal truth and that fair reporting is an essential element in building the validity of the argument (Yin 2003, Blaikie 2007). A second criticism is the dependency on practical knowledge. Flyvbjerg (2006) contradicts this that 'in the study of human affairs there appears to be only context-dependent knowledge'. Practical knowledge deriving from a diverse range of stakeholders, including local, is therefore essential to understand a phenomenon. Rather, it is a strength of case study research to study the interaction between the phenomenon and its context. However, matching a case for every single relevant variable is practically impossible. A third criticism is the difficulty to summarize case studies. Flyvbjerg (2006) agrees that summarizing case studies is often difficult, but this is more due to the properties of reality studied than to the research method. Moreover, he argues that good case studies should be read as narratives. This means that the case studies have a value on their own. The fourth, and most common criticism, is related to generalizability. Flyvbjerg (2006) argues that, although generalization has its limits for scientific development, often one can already generalize from a single case study. They can namely be used for falsification tests as discussed by Popper in 1959. Rather than generalizing, scientific development lies in the accumulation of knowledge (Kuhn 1987, Pawson and Tilley 1997). Case studies are particularly useful for this purpose. They enable learning by both the researcher and a broad audience. The researcher gains experience and learns through being close to the studied reality and receives feedback from those studied. To a broad audience a case study provides insights in new situations and can serve as an example. Multiple case studies contribute to the accumulation of knowledge, but also a single case study can be very powerful if it provides a convincing example. The selection of the case is therefore very important.

So, like with any research method, much of the quality of the research depends on the research design and whether the method fits the purpose. The design should be driven by the research problem and not the other way around. For instance, case study research is not the most suitable methods for assessing prevalence of phenomena. It has its strengths in the interaction between the phenomenon and its context. However, matching a case for every single relevant variable is practically impossible. Additionally, not all topics can be empirically studied, for instance because of the lack of data availability (Yin 2003).

3.2 Case selection

An essential element of the design of the case study research is the choice for the cases. This section addresses the unit of analysis, which cases are selected and why.

The assumptions and expectations developed in the framework in the previous chapter guide the choices to be made for the case study research. In short, the nature of these assumptions and expectations include that (i) pilot projects can be used for multiple purposes; what a pilot is used for is perception-dependent and changes over time, (ii) pilot projects are multiform entities, (iii) some of the pilot characteristics can be influenced, other characteristics are determined by the context: it is the interaction between design and context that guides the course of the pilot, (iv) the contributions of pilot projects to water management can be found in at least three interlinked levels: responses of the socio-ecological system, knowledge development and diffusion and (v) diffusion of pilot projects is a complex process that exists of patterns, channels and nature of diffusion.

The unit of analysis of the case studies is at the project level and the project team, because the research questions are at this level. This level implies that the initiation and evolution of the pilot project is studied and that the project is related to its management and policy context. Particularly the actor perceptions on the project, interactions between the actors, and the consequences of these interactions for the project are studied. Additionally, to understand pilot diffusion, not only the pilot itself but also the projects and policies to which is being diffused are explored.

The case selection determines the type of results that can be derived from the study and the potential quality of study. To reduce variation in findings and enable a comparison between the case studies, the variation between the cases should be minimised (Swanborn 1994). The following list represents the demands and criteria that were of importance in the case selection process:

- *Accessibility of information* either in reports or directly through people, and preferably both
- *Issue addressed* in water management, the application domain of this study. The case studies should address IWM and more specifically operational applications of floodplain rehabilitation
- The floodplains are all located in the same river basin (i.e. *the Rhine Basin*) with democratic policy, economic and water management *contexts that function comparably.*
- The projects have been claimed to be *pilot projects*
- The pilot projects take place in the *public sphere*
- *Initiation* is conducted by either a river authority or a knowledge institute specialised in water management
- The pilot project is at least *in the stage of implementation* in the field
- The study focuses on *multi-actor contexts* in which actors all have their own reasons to participate in the pilot project.

- The nature of the innovation applied in the pilots was of a *conceptual nature* that encourages changes in water management approaches
- Different types of effects, including some form of *diffusion* can be recognized

The chosen case studies that meet the requirements are three floodplain management pilot projects in the Rhine Basin and include

- **Cyclic Floodplain Rejuvenation** in the floodplains of Beuningen, the Netherlands
- **Ecological Floods** in Polder Altenheim, Germany
- **Recharge Area Restoration** in the Lange Erlen floodplains in Basel, Switzerland

The Rhine has a long tradition of international cooperation, from the international committee on the navigation of the Rhine, to the Rhine Action Plan and the EU Water Framework Directive (see section 3.5 for more background information on the Rhine Basin). Water management approaches are therefore relatively well comparable in the entire basin. The cases all deal with the introduction of floodplain rehabilitation management concepts that aim to enhance both ecology and other societal functions, including flood defence, more efficient drinking water production and recreation. Differences across the cases can amongst others be found in the nature of initiators, the embedding in policy, the stage of the project and the extent the pilot is considered as a contribution to policy and management. Variety in the case studies allows for exploring the diversity of pilot projects, including their characters and rationales, and diversity in factors potentially influencing the dynamics. Furthermore, diverse patterns in effects can be distinguished. By relating effects to the pilot characteristics and context, explanations and speculations for pilot dynamics can be further developed.

The reasons to choose three case studies is that multiple case studies enable replication of the application and testing of the framework. Each case may confirm some aspects and suggest modifications for other aspects in the framework. Below, the three case studies are briefly introduced. The order Beuningen, Altenheim, Basel represents the historical study order and logic of increased focus of this research. My involvement in the Beuningen project was the trigger for this research. The experience from within the pilot provided a strong basis of understanding what was going on and which initial research questions should be asked. Additional pilot projects were sought so that as a whole they could deal with these research questions. Insights of the individual cases could be accumulated and the cases cross-compared to find regularities or broaden the range of options. In contrast to the Beuningen project, projects were sought that had been fully implemented. The next example (Altenheim) was like Beuningen in combining nature and safety and resulted in a strong embedding of the concept in a policy program. To compare other elements and provide a different course of a pilot, the third case study (Basel) was added. This had a comparable initiator to the Beuningen case (university), but showed a negative development in terms of diffusion and emotions.

Beuningen: Cyclic Floodplain Rejuvenation

The floodplains of Beuningen are located along the Waal River (the main branch of the Rhine in the Netherlands), just west of the city of Nijmegen. To restore flood defence levels that decreased during the past two decades due to vegetation development and sedimentation, and to simultaneously enhance ecology by enabling river dynamics such as erosion, sedimentation and succession, the Cyclic Floodplain Rejuvenation concept has been developed (Peters *et al.* 2006, Baptist *et al.* 2004, Duel *et al.* 2001, Smits *et al.* 2000). In 2004, the Radboud University initiated a pilot project on the floodplains of Beuningen to introduce Cyclic Floodplain Rejuvenation and to resolve the local nature-safety dilemma. The case provides an example of a pilot project initiated by a university to advocate dynamic river management and to contribute to societal debate on river management at the operational level. The case provides surprising insights in the role of evidence for diffusion into policy- or decision-making.

Polder Altenheim: Ecological Floods in the Integrated Rhine Program

The floodplains of Altenheim, located in the Upper Rhine section of the state Baden-Wuerttemberg in Germany, formed part of a policy to increase flood defence levels by using the floodplains as inundation areas. Initial policy implementation showed the ecological deficiencies of the policy. The authorities and politicians decided to modify the policy. The two major changes were the reduction of inundation levels and the development of the 'Ecological Floods' (EF) concept (GwD SO/HR 2000). EF encompasses the restoration of the semi-wet conditions natural to floodplains. As a consequence, floodplain-typical flora and fauna return. Since these can better deal with wet circumstances, they enable inundation without ecological damage. The case provides an example of a pilot in a policy context initiated by the river authority that is user at the same time. The pilot functions as a first trial before inclusion in and roll-out of the national policy program IRP. Insights are in the influence of the spirit of the times and in risks of interdisciplinary management and research.

Basel: Restoring recharge areas in the Lange Erlen

The Wiese is a tributary of the Rhine that flows through Basel, Switzerland. The Lange Erlen floodplains of the Wiese are a green lung in an urban environment. They function primarily as a recharge area for drinking water production. For the drinking water production, water from the Rhine, that is approximately 5 kilometres away, is transported to the Lange Erlen to recharge ground water tables. Despite this relatively environmental friendly production method, the University of Basel initiated in 2001 a pilot project to study the possibilities and effects of using Wiese water instead of Rhine water for recharge. During the project, attempts were made to scale the project up, but –so far- this has had the opposite effect. The project is not continued and participants no longer co-operate. Particular insights from the case include the confirmation of the special status pilot projects can enjoy, and the role of perceptions on evidence, representativeness and governance styles.

3.3 Data collection

For the collection of data in the case studies, a combination of data sources was used to enable triangulation (cf. Yin 2003). Primary data sources include:

- Grey and scientific *literature*, whereby grey means project documents from diverse actors and scientific means articles on the pilot itself published in scientific journals
- *Observation* through participation, conference- meeting- and workshop attendance. These include both workshops related to the pilot and workshops that more deal with the context, such as the intervision meetings of the EU-Freude am Fluss project in which Beuningen and participants of Altenheim project participated
- *Interactions*, including in-depth interviews, less formal (email) discussions on the project and co-operation with project participants in writing papers

Secondary data sources include literature on interpretations of interviews conducted within pilot projects by other researchers and newspaper articles. Table 3.1 gives an overview of the data sources for the case study research. In Appendix 1 (Table 1 and Table 2), a more extensive version of the data sources can be found, including interview lists and workshop data used in the entire thesis, including the primary analysis and reflection (e.g. 16 interviews, WINN meeting and workshop participation).

Table 3.1: Data sources of the case study research

	Primary data sources			**Secondary data sources**
	Literature	Observation	Interactions	
Beuningen	Grey	Project Participation (2004-2007) 4 project Meetings 4 Citizens workshops 2 participants' workshops Sites visits before and during pilot	14 interviews Regular discussions 3 joint papers Survey	Newspaper articles
Altenheim	Grey Scientific	Site visit after pilot Workshop meeting	9 interviews Email discussions	Newspaper articles PhD thesis
Basel	Grey Scientific	Sites visit after pilot Conference	5 interviews Discussions 1 joint paper	PhD thesis Magazine article

The procedure followed in the data collection was always to start with the contact people through whom I became familiar with the pilot project. With the Beuningen project I was rather familiar with because of my previous participation. The Altenheim case I learned to know through the partners of the 'Freude am Fluss project' and whom I met during exchange activities. The Basel case I learned to know in the CAIWA 2007 conference in Basel. After the initial familiarization, data were collected through interviews and documents. In the Beuningen case I was also invited to participate in regular meetings and workshops in which pilot participants and broader audience (e.g. provinces, water boards, contractors and NGOs). In these workshops I could observe progress, assess perceptions and note interactions at the time. Additionally, I could present some of my work and so gain feedback from the participants and open up discussions with them. Furthermore, I could collect perceptions of 24 participants (9 different type of actors) on scalar aspects of the concept through a small survey that included three open and one closed question on scale preferences in river management and their anticipated role. The process of data collection changed over time when, based on new insights from earlier interview- and document study, interview formats and the scope of document analysis were adapted.

Interviews
The interviews were conducted with people closely involved in the pilot project. The interviews were of a semi-structured nature and so followed a certain pattern but also maintained freedom to adapt to the interviewee and to new insights. Rather, one could speak of guided discussions. The questions addressed the following issues:

- background of the interviewee;
- perception of the project, its design, embedding in the policy context and its development;
- their role in the project and interactions with other actors
- contribution and lessons of the pilot
- general experience with pilot projects
- ideas on hurdles for diffusion

The interview guides for the case studies can be found in Appendix 3. The duration of interviews ranged from 20 min to full days in which interviews were combined with field visits, although the majority took about 1.5 to 2 hours. Conducting an interview in the field was found to be very enriching because the interviewee clearly became more eager to communicate their interpretation. At the same time, the field setting was used to demonstrate their argument, it reminded them of issues they might otherwise have forgotten and allowed for taking the time for the discussion. At the end of the interview it was always asked to mention other people of interest to be interviewed. Through this ‘snowballing’ technique, new people could be identified up to the point that no new names appeared. The full list of interviewees can be found in Appendix 1. After the interviews, an interview-report was produced and sent to the interviewee so that they had the chance to review the interview. In addition to their spoken word, many interviewees also provided written documents after the interview. Four case study interviews, and the interactions with WINN participants were held in the last stages of the research to validate findings (see Appendix 4). In these interviews, propositions and conceptual models were tested, including recognition of pilot use, diffusion patterns and hurdles for diffusion. Another quality assurance was the joint writing a peer-reviewed scientific paper with a key person in both the Beuningen and the Basel case.

As one can see from Tables 3.1 the intensity of the data sources varies over the cases. Three reasons for these differences can be indicated: First, the Beuningen case was first studied after the primary analysis and so more resources were needed for familiarization, testing and refining of the research questions and framework. Consequently, for Altenheim and Basel a more focussed search for interviews could be conducted. A second reason for the high intensity of Beuningen is, because of the involvement, the easy access to the project and the diverse parallel studies done on this project on biophysical and social aspects. Altenheim had, because it was well organized and documented, a large number of structured reports and relevant persons could be easily identified. A third reason for a larger primary data availability of Beuningen and Altenheim is the broadness and policy importance given to these compared to Basel. The Basel case was more strongly research oriented. Consequently, fewer actors were involved or felt committed and the budget for producing reports was smaller. However, more than quantity, speaking to the right people is of importance. Analogous to the arguments of Flyvbjerg (2006) on case study research, is that interviewing the critical person can be convincing. The relatively limited scope and difficulty to access actors is, however, also an indication for the nature of the pilot project, the emotional approach (after many years it is still sensitive) and the position of the initiators (e.g. the authorities, who are usually strong in developing large numbers of reports, are more trained in access to media and have funds to do so, were not too supportive and so put limited resources in). In the Basel case, primary data could be complemented with the rich collection of data gathered by Knall (2006), Freiberger (2007) and Wüthrich and Geissbühler (2002) on actor perceptions of the pilot and its course.

3.4 Data analysis

In this section, the analytical activities are discussed for both the within case study analysis and their cross-comparison. However, first the general approach towards data analysis is explicated.

3.4.1 Natural analytic progression

As an analytical strategy for the case study research, a natural analytic progression (Rein and Schön 1977) has been exercised. In this strategy, first a case-by-case story is reconstructed about what happened before, during and after the pilot. Through data reduction key elements are located and formalized (Miles and Huberman 1994). Data reduction refers to the process of selecting, conceptualizing and transforming the data that appear in written-up field notes or transcriptions into categories (Corbin and Strauss 1998, Charmaz 2006, Braun and Clarke 2006). This occurs continuously, even before the actual data collection starts (e.g. which framework, which cases, which data collection approach). Activities include the grouping and categorization of data along the lines of the themes (use, character, context and effects) that were identified during the development of the framework. Subsequently, information is compressed in data displays such as matrices, schemes, networks and narratives (Miles and Huberman 1994). The displays are presented in the following section.

Next to the contribution this has for the analysis of individual cases, the structured approach enables a cross-comparison. Based on the data reduction and data display, conclusions can be drawn on different elements of pilot projects. In the cross-comparison, the conclusions focus on differences and similarities of pilot elements and the identification of patterns between those across the cases. As such, the cross comparison provides the basis for development of explanations for why, when and how pilot dynamics take place. Pilot dynamics are discussed in more detail in chapter 8. The last element of the analytical strategy is testing the validity, whereby the meanings emerging from data are tested for plausibility and sturdiness. Strategies to validate and sharpen results include, next to the replication of the analysis in the three case studies, going back to field notes and setting up specific interviews, discussions and co-operation with key informants to cross check findings.

3.4.2 Structure of the within-case study analysis

The framework developed in chapter 2 provides the underlying structure clustered around use, characteristics, contexts and effects, for the case study analysis. The data displays used for this purpose are presented in this section to summarize the structure of the analysis. However, the analysis starts with the general reconstruction of the pilot and its story.

General

In the general description of the pilot project, its history, the site, the problem subjected to the pilot study and the actors are introduced. In a way, this general discussion contains an elaborated and yet looser version of the contextual analysis (see below). Results are presented in the form of a narrative. The extensive attention for the development and its pre-history of the pilot is an attempt to justify the understanding that only by understanding a context, an event can be understood (Miles and Huberman 1994).

Use

Pilot projects can be used for various reasons. Together with the character, the use indicates the nature of the pilot. A basic distinction in pilots has been made in (i) research, (ii) managerial and (iii) political-entrepreneurial pilots. Within these, I identified nine different uses (see chapter 2). Rather than being used for one purpose, pilot projects can be used for different purposes to different extents. Moreover, the extent to which a pilot is used for a certain purpose can change during the piloting process and differs per actor. Every actor perceives a pilot differently and has its own goals in the pilot. The perceptions can also change.

For the purpose of this research, a policy analyst perspective has been exercised. This means that the pilot project uses have been determined based on the interpretation of the available data with an helicopter view, while substantive stakes are lacking (Mayer *et al.* 2005, Karstens 2009, Walker 2000). Since all actor views are included, the policy analyst's view represents an accumulation of views. To determine the type of pilot, each of the nine possible uses has been indicated on a scale from 0 (=absent) to 5 (=entirely). To visualize the extent to which a pilot project is used for a certain purpose, the Nonagon has been developed (see Figure 3.1). It is the specific mixture that represents the use of a specific pilot at a certain point in time. The pilot is thereby evaluated twice; once at the start of the pilot and once at the current state, meaning at the moment of the case study research. This allows one to gain insight into the development of perspectives on the use of an individual pilot. Additionally, it provides a standardized comparison of the different pilot projects. From a managerial perspective, the Nonagon enables the measurement of differences in actor perspectives. Pilot managers can now communicate about these differences in perspectives and associated expectations, which might prevent disappointments at later stages (Van Lente 1993).

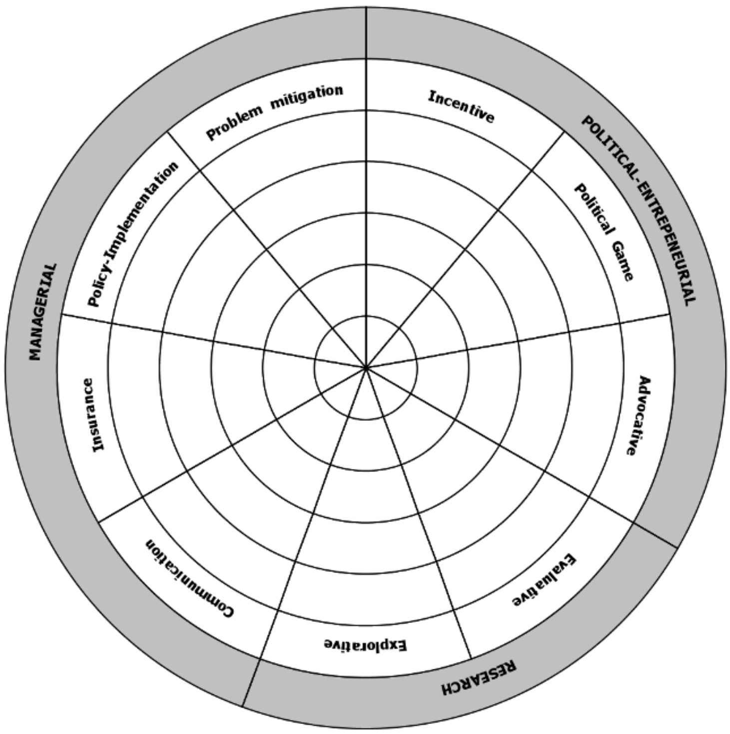


Figure 3.1: The Nonagon

<u>Character</u>

The second aspect of the pilot projects discussed in the case study analysis is the character of the pilot. To enable the identification of the character of a pilot under study, diverse characteristics have been identified on the basis of which the pilot can be described. The primary analysis in which pilot projects were compared to laboratory experiments and routine projects demonstrated that the character of a pilot project can vary within a certain bandwith of these characteristics. The characteristics are summarized in Table 3.2. In brackets the range of values is indicated. By determining the specific value of a pilot characteristic, the character of a pilot can be identified.

Table 3.2: Characteristics of pilot projects

Characteristic	Sub-characteristic
Relation to policy and local context	• Connection to policy (core/ periphery) • Local contextual dependency (high/low) • Incidence of occurrence (single/ multiple)
Scale	• Confinedness in time, space, problem scope (yes/no) • Reversibility to biophysical reference situation (yes/no)
Innovation	• Type of Innovation (concept/ technology) • Driver of Innovation (supply/ demand) • Level of Innovation (radical/ incremental)
Knowledge Orientation	• Knowledge stance (expert/ communicative) • Monitoring programme (intensity, nature) • Type of Knowledge (hard/ soft, contextual-generic) • Type of learning (single/ double loop, experience)
Special status	• Attitudes (allowance for failure, creativity) • Flexibility (high/low in design and course) • Additional resources (yes/no e.g. freedom, protection, time)
Actor-network	• Initiator (type, role) • Participants (single-actor/ multi-actor; roles) • Governance styles (authoritative/ consultative/ facilitative)

Context

The contextual factors of a pilot project at a generic level at a given time have been identified and mapped in the context chart in chapter 2. Since pilot projects are open systems, they are intertwined with their context. The distinction between context and pilot project is therefore to some extent arbitrary and artificial. The context chart contributes to the awareness of the factors that make up the system and how these might interact. Through the interaction between pilot and context the pilot takes shape and develops. On the other hand, the pilot influences diverse contextual factors to various intensities. Factors that are relatively close to the pilot, relatively flexible and relatively open to the pilot are more likely to be influenced by the pilot than other factors.

Contextual categories that are distinguished include the biophysical system, institutional system and socio-economic system. Each of these categories contains several factors, such as the river system, land use, actor-network and values towards flood defence and floodplain restoration. Table 3.3 provides an overview of contextual factors that are discussed per case study.

Table 3.3: Contextual elements

Biophysical system	Site characteristics, Landuse, Biophysical processes, Ecology, Technologies/ Infrastructure
Institutional system	Pilot participants, Resource availability, Policies, Legislation and regulation, Actors in water and environmental management
Socio-economic system	Knowledge availability, Societal demands water system, Attitude towards natural resources, Problem perceptions, Ecosystem services

<u>Effects</u>

Lastly, the question of what effect the pilot exerts is discussed based on a three-layered structure. The first layer represents the systems response. Both the biophysical and actor system are altered due to the initiation of the pilot project and further progress. The second layer represents the knowledge development. This consists of both knowledge creation and learning. Different types of knowledge can be created, including hard and soft, substantive and process and context-dependent and generic (see Table 3.4). Learning is closely related to knowledge creation. Without learning the created knowledge does not become of any use and without new knowledge nothing is to be learned. However, the type of learning taking place in a pilot project can vary in depth. Who learns what is also variable. It should be noted that in this discussion on the effects, I discuss the achieved knowledge development. In contrast, the characteristic 'knowledge orientation' describes the design for knowledge development.

Table 3.4: Framework to structure developed knowledge, including examples

		Process	*Substantive*
Context-dependent	*Hard*	e.g. responsibilities different actors	e.g. observed change in species
	Soft	e.g. relationship between two actors	e.g. participants' interests
Generic	*Hard*	e.g. permit requirements	e.g. water quality river
	Soft	e.g. influence of participation on learning	e.g. water management actors' core values

The third level of effect is diffusion. Diffusion refers to the spread of the pilot or elements thereof, such as specific knowledge and renewed cooperations. Diffusion consists of at least three elements: the pattern, nature and channels of diffusion. The pattern indicates to where diffusion takes place, the nature what is being diffused and the channel through whom diffusion occurs (Table 3.5, see also Figure 2.5). Since diffusion in this thesis is interpreted in a broad way, the nature of what is being diffused goes beyond transposing the initial pilot project. Diffusion can be partial and include soft elements that go through diverse patterns, channels and time spans. The determination of the patterns has been limited to first order patterns, which are the direct connections between the pilot and its diffused.

Table 3.5: Diffusion scheme

Pattern	Dissemination Scaling up: Expansion or Institutionalization
Nature	Innovation, Knowledge, Cooperation
Channel	Internal, External, Mixed

A summarized effects scheme is depicted in Table 3.6. The effects are discussed at the time of investigation, meaning that the results represent the knowledge of the case at that point in time.

Table 3.6: Effects matrix of pilot projects

Systems response	Biophysical response Actor-network response
Knowledge development	Knowledge creation: Types Learning: Who learns what
Diffusion	Patterns, Nature and Channels

3.4.3 Cross-comparing the case studies

After the analysis of the individual cases, the case studies will be cross-compared. As a result, more general observations and explanations can be identified and the understanding of pilot projects can be deepened. The structured analytical approach within the cases enables such a comparison across the cases. Similarities and differences can be directly observed in the different categories explained above. Additionally, patterns that are found within the cases can be evaluated on their more general presence, leading to insights in the nature of pilot projects, dynamics in pilot use, design dimensions and interactions of different effects. Additionally, patterns across the categories allow for the development of explanations for establishing effects and particularly for diffusion. This aspect was considered of importance to all project initiators, while results were considered meagre due to many hurdles. To understand diffusion and move from what happened to why it happened, pilot dynamics need to be understood. 'Pilot dynamics' are therefore added as a theme to the research and discussed in detail in the reflection in chapter 8. It should be noted that diffusion is just one aspect of pilot projects and not all pilot projects aim for diffusion, but all pilots do have some sort of dynamics guiding the course it takes. Overall, the analytical activities in combination with the reflection contribute to theory building on the nature and functioning of pilot projects and their dynamics.

3.4.4 Note on Research Quality Assurance

The in this section described case study research strategy contains several elements to ensure a certain level of quality. These are focussed on construct validity, internal and external validity and reliability (Yin 2003, p.34). Construct validity means to establish the correct operational measures for the concepts studied. Construct validity is addressed through the use of multiple sources of evidence, reporting in such a way that a chain of evidence is built, and validating draft findings with key informants of the different cases. The validation is done by returning to key informants with early results and jointly writing scientific paper. Internal validity is the establishment of causal relationships. This is addressed by building relations whereby one addresses multiple explanations (e.g. different factors relating to diffusion dynamics), and by using models to support data analysis. External validity is establishing the domain to which the findings can be generalized. The external validity is enhanced through the replication of the framework in the three case studies. Lastly, reliability is demonstrating that operations of the study can be repeated with the same results. Reliability is addressed by making data collection and analysis procedures transparent, reporting regularly in (conference) papers and maintaining a database. Reliability does not imply that the study can be copied or the researcher replaced. The role of the individual researcher in data treatment and interpretation is large.

3.5 Integrated Water Management in the Rhine Basin

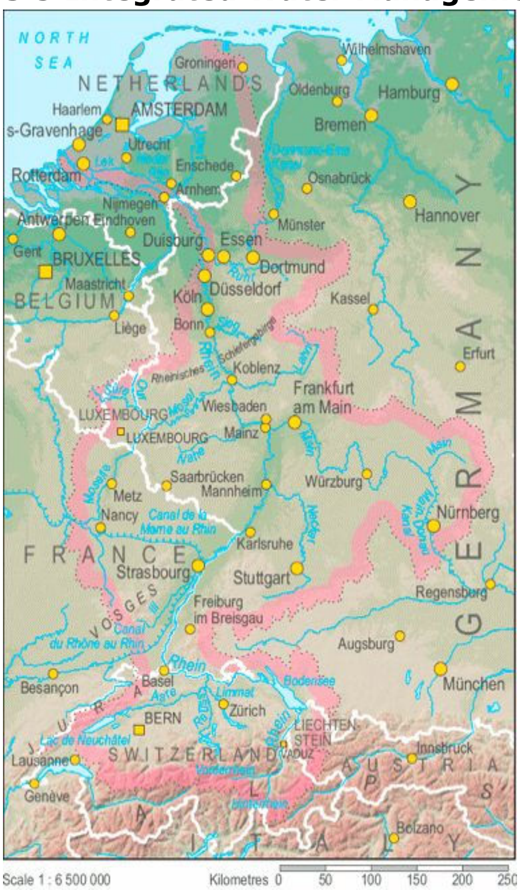


Figure 3.2: The Rhine Basin (UNEP 2004)

To finalize this chapter, I introduce the (Integrated) Water Management history of the Rhine Basin. The Rhine Basin provides the general and shared context of the three case studies in the following chapters. Insights have mainly been derived from interviews with current and former secretaries of the International Committee for the Protection of the Rhine and water directors of the Dutch Ministry of Transport, Public Works and Water Management.

The River Rhine is with its length of 1320 km one of the largest rivers of Europe and runs through Switzerland, Germany, France and the Netherlands. The Rhine Basin lies in nine different countries (see Figure 3.2). The Rhine has long been important for transportation within Europe, in demarcating borders, and has been used for military purposes (Bosch 2002). Many remnants of these uses, such as castles and early settlements, are still present in the landscape. Its contemporary importance is for instance visible in the presence of industries and hydropower installations. The river has been canalized and regulated by dams, dikes and groynes. One of the most remarkable engineering works was undertaken by J.G. Tulla in the Upper Rhine at the end of the 19th century. This river section was highly dynamic with meandering and braiding streams, but was transformed into a relatively straight canal to enable navigation up to Basel (see Figure 3.3). Despite the advantages for navigation, the works also caused severe environmental and social impacts, including reduced breeding places for fish and the drying out of vegetation. After WWI, the Treaty of Versailles arranged the construction of a lateral canal (Canal d'Alsace) for hydropower reasons. As a side-effect, the hydropower infrastructures largely reduced the space available for water to flow during high water.

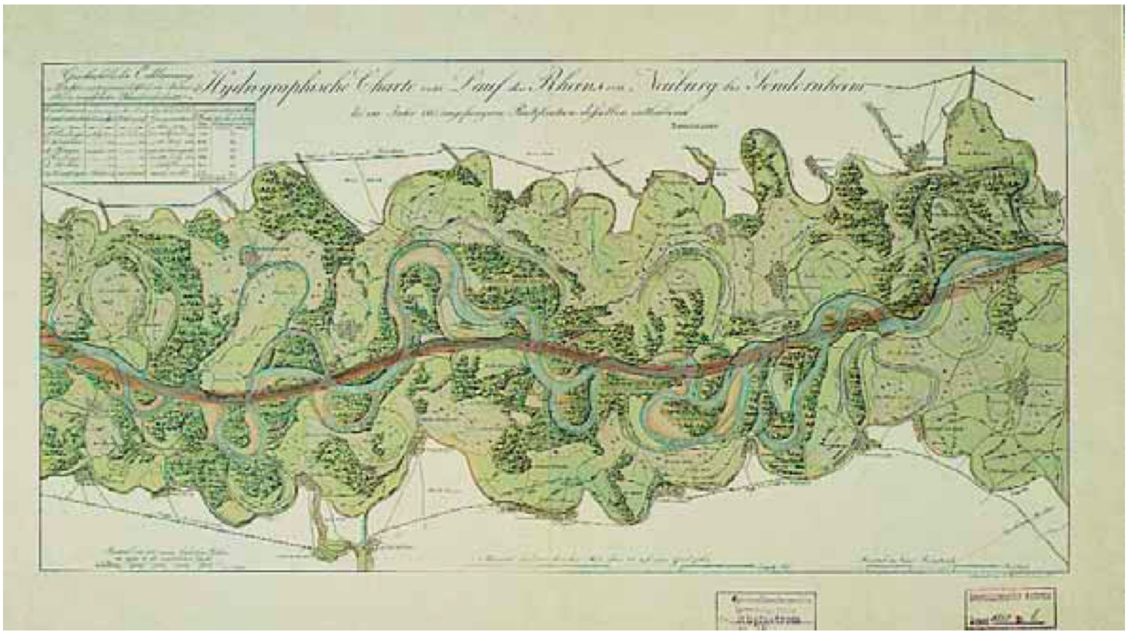


Figure 3.3: Section of the Upper Rhine before the construction works of J.G. Tulla and nowadays (red line) (ICPR 2008)

The importance given to the Rhine by Rhine nations, and particularly the conviction that the Rhine transport is important for the prosperity of NW Europe, resulted in the early development of international water institutions. Co-operation first occurred in 1815 when the Central Commission for Navigation on the Rhine (CCR) was established to safeguard the freedom of transport on international waterways that was increasingly hindered by barriers put up by diverse cities. After WWII, when industrialisation and pollution increased quickly, international discussions were considered too complex to resolve the pollution. A new institute was initiated (1950) and legally founded (1963): The International Commission for the Protection of the Rhine (ICPR). Representatives of the governments of the five Rhine bordering countries (France, Germany, Luxembourg, Netherlands and Switzerland) and the European Community became members of the ICPR. However, mutual distrust (e.g. the Netherlands did initially not do much herself to prevent pollution while asking upstream countries to do so) and cultural differences (e.g. do we want to do much or not against pollution, how do we make decisions, which priorities do we have) did not lead to successes in the short-term, with all-time low in oxygen in 1971. During the low water period, oxygen-consuming wastewater and toxic substances reached such high levels that the Rhine lacked oxygen in its downstream sections (Huisman *et al.* 2000). The press called the Rhine the open sewer of Europe (pers. comm. Huisman). Only then the first steps to develop treaties on chemical and saline waste were taken. The next important issue to be resolved became the long-term impacts of waste in sediments that were used for diverse purposes on land (fertilizer, land heightening). After the Sandoz disaster in 1986, the scope broadened towards a healthy river. This resulted in the Rhine Action Plan and the Salmon 2000 policy with having the salmon back in the Rhine as a symbol. Nowadays the WFD is the leading directive. The implementation of the WFD requires defining a River Basin Management Plan aiming at reaching good ecological water quality status in 2015 (EC 2000 Article 30). Additionally, democratic ideals and political influences are entrenched by requiring the integration of economic, environmental and ethical elements via 'active involvement' of the diverse stakeholders (EC 2000 Article 14). Switzerland as a non-EU member does not have to comply with EU directives. Nevertheless, given their bilateral and international agreements and their own regulation and policies that are comparable, their Rhine management is comparable with other states in the Rhine Basin (Ministry of TPW 2008, ICPR 2004).

In contrast to many of these international plans and directives, the inclusion in policies and operational implementation is generally a national affair. Additionally, at national and local levels many initiatives are taken affecting the Rhine, both in water management and other domains. In every country, however, values differ and practices for safeguarding interests are different. Every country has its own history in river management, and its own institutional and economic systems with different layers and related boundary issues. Since water management is an ongoing process, not starting from zero, in biophysical, institutional and cultural terms, IWM interpretations and trade-offs and so management practices differ across, but also within, countries. As an example of the development in water management and associated values and trade-offs at the national and regional level, the recent history of Dutch water management is briefly outlined:

Living in a delta like the Netherlands requires a balanced water management. Land needs to be protected against floods, but the Rhine has also always been very useful for navigation, fisheries, waste discharge and as a source of fresh water for drinking, agriculture and to prevent salinization. For reasons of fisheries and fresh water supply, the Netherlands already argued for international environmental agreements since the 1880s (fisheries) and 1930s (pollution). The latter was not very successfully though, not in the last place because the Netherlands was not active herself. Ecology in the Netherlands started to become an issue in the 1960s when the Delta works were constructed and for the first time ecologists were hired by Rijkswaterstaat. A first real change occurred in the 1970s after a period of heavy pollution. Legislation on water pollution (the 'Wet Verontreiniging Oppervlaktewater –

WVO') was developed. A second change came from the prize-winning 'Plan Stork' (De Bruin *et al.* 1986) in combination with the policy document 'Omgaan met Water' (Ministry of TPW 1986), and the PAWN study (The Rand Corporation 1982). Plan Stork introduced the –back then- revolutionary ideas that summer dikes could be removed and that nature and flood defence could go together. For the first time not end-of-pipe management was exercised, but IWM was proposed and ecology was included in policy. More recently, (near) floods contributed to the third change in thinking that instead of relying on dikes for flood defence, space is a key feature of a river and parts should be given back, particularly in the light of climate change. The resilience of the system came to the foreground. Other societal developments such as decreasing agriculture in floodplains and increasing recreation changed the dominant values in water management. Many initiatives to combine different functions have been taken. Natural river functioning provided the inspiration for designing these measures. Employees of RWS indicated that nowadays nature and flood defence cannot be considered independently anymore. The accumulation of examples from pilot projects, particularly Ark foundation was mentioned, made that these types of practices have become common good.

Future challenges will lie in climate change and land subsidence. Next to the developments in IWM, navigation is, owing to its historical and contemporary importance as an alternative to road and air transport, still the leading interest. One major implication is that the main channel needs to remain stable and deep. Morphological dynamics or large fluctuations are undesired. Nature development and recreation are directed to the floodplains. Flood defence and agriculture combine very well with navigation. Existing land use (e.g. the presence of a town) is also often a guiding principle in practice. The different values and interpretations that co-exist and sometimes do, sometimes do not go very well together can lead to controversies when implementing IWM. However, the emergence of the IWM paradigm is also a driver for many new initiatives. Pilot projects are often undertaken at national and regional levels to sort out interpretations, to give meaning to IWM and to test new approaches that aim to balance different interests in new, innovative, ways and develop knowledge about this.

4.

Cyclic Floodplain Rejuvenation in the Floodplains of Beuningen

This chapter is the first in a series of three case study chapters to analyse a pilot project. This case study is about a pilot project in the floodplains of the Rhine river branch Waal in the Netherlands. In this pilot project, the concept 'Cyclic Floodplain Rejuvenation' is applied for the first time. The project is initiated by the local university in cooperation with the local floodplain managers and the operational river manager. In the project, research and innovation at one the hand and maintenance at the other, meet. The project started in 2004, formally ended in 2008 and by then had not been fully implemented yet. Nevertheless, implementation and monitoring are still planned (excavation of the floodplains is taking place when this thesis is printed, in November 2010). Despite the pilot not being physically implemented and monitored during the time of study (2006-2009), the pilot does show diverse forms of effects. For example, knowledge is developed on the CFR concept and on river dynamics. The case is of particular interest for its focus on the design. Explicating the design process of pilot projects is one of the core aspects of this research. In addition to 14 semi-structured interviews with participants and stakeholders and document analysis (see Appendix 1 and Appendix 2), I participated actively in the project during a year. I contributed to designing interventions, contributed to workshops and meetings, and addressed questions of how scale preferences influence the design (see Vreugdenhil *et al.* 2008, Vreugdenhil *et al.* 2010a). In this chapter, the character of the pilot, its use and context are first analysed, followed by the identification of effects. The chapter finishes with a discussion on factors that influenced the evolution of the pilot.

4.1 General pilot project description

4.1.1 The pilot area and the problem at hand: a nature-safety dilemma

The floodplains along the Waal, which is the main branch of the Rhine in the Netherlands, have been cultivated for centuries. Whereas this agricultural and pastoral tradition waned over the past two decades, there has been an increase in the awareness of the importance of riverine nature. Therefore, many of these floodplain areas could change from grasslands to alluvial forests. The Floodplains of Beuningen is one of the areas in which this change occurred. The floodplains, with a surface of circa 250 hectares are located just west of the city of Nijmegen (see Figure 4.1) on the left bank of the Waal. When the area was still used for pasture, the high density of cattle assured a land cover of agricultural production grass in which no other species could develop. Ecologically speaking the area was not valuable, but from a river engineering perspective, the layout contributed to the desired fast discharge of the water.

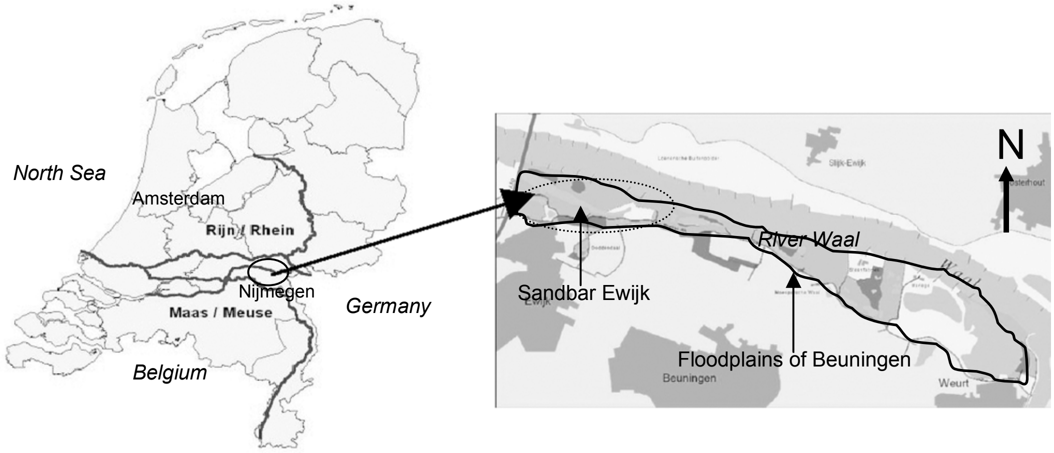


Figure 4.1: Location of the floodplains of Beuningen/Ewijk at the south banks of the Waal River in the Netherlands, just west of Nijmegen. The Sandbar of Ewijk (dashed line), the CFR testing site, is a subarea of the Floodplains of Beuningen (black line) (adapted from RWS-RIZA and Stichting Ark)

During the change from pasture to nature reserve, the area was, according to river managers, 'not prepared for nature development'. This implies that no room was created in precaution for hydraulic resistance to increase through vegetation development. Preparing a floodplain for nature development means reducing hydraulic resistance and providing accompanying permits to remain within limits. Instead of preparing the floodplains of Beuningen, they were 'abandoned to nature' for almost two decades before alarm bells started to ring at the river manager in 2004. Calculations showed that a maximum increase of 5.6 cm was found at river kilometre 888 compared to the reference situation (see Figure 4.2) (Mannaerts, 2004).

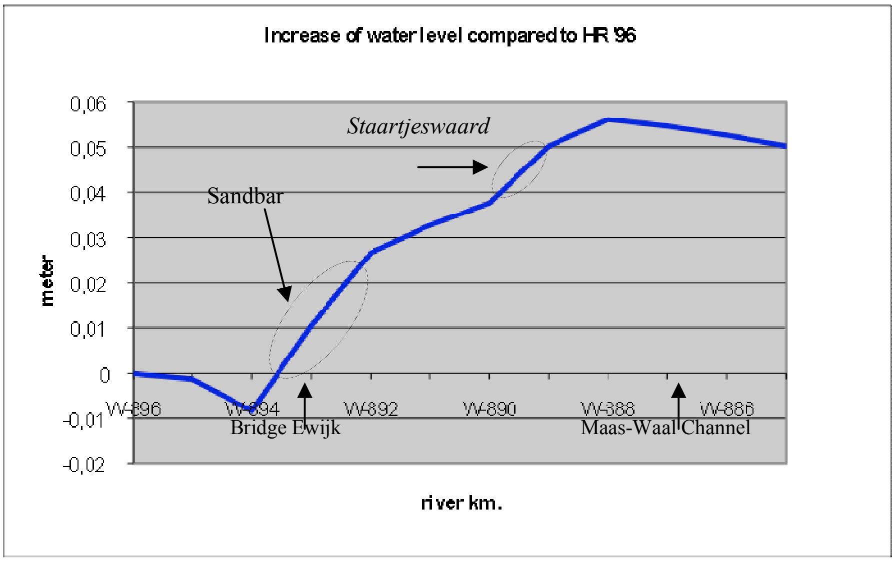


Figure 4.2: Increase in water level at Beuningen, determined in the 'Rivierkundige toets 2003'

Particularly in three locations in the floodplains forest development could be identified. Due to the consequent increased hydraulic roughness discharge capacities decreased compared to the reference situation (see Figure 4.3a). The first location of interest is the Sandbar Ewijk, which serves as a natural sediment deposit area. An excavation of the Sandbar in 1989 provided favourable conditions for forest development and so enhanced the process of riverine softwood development. The difference in land cover can be viewed in Figure 4.3b.

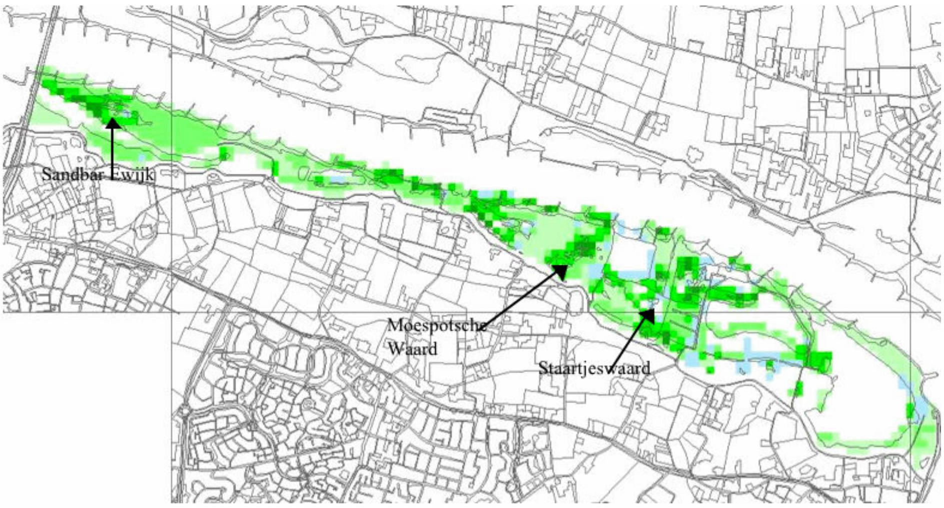


Figure 4.3a: increase in the hydraulic roughness of the floodplains of Beuningen between 1989 and 2003 (Kater and Smits 2005). The darker spots imply a larger increase in hydraulic roughness.

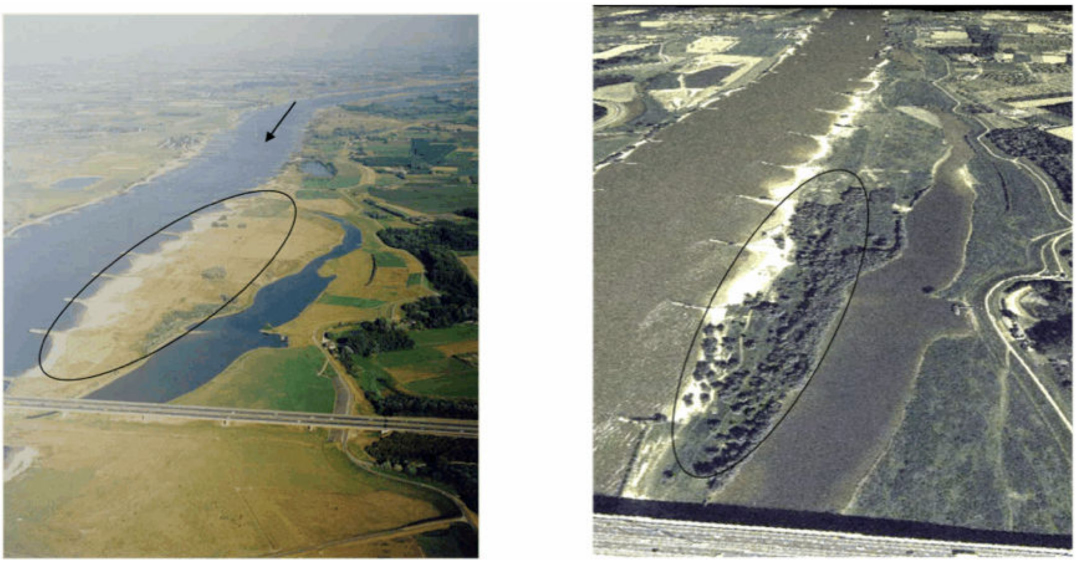


Figure 4.3b: Aerial photos of the sand bar of Ewijk, looking east, in 1989 after the excavation and in 2003 when vegetation covers the area (www.beeldbankVenW.nl, Rijkswaterstaat)

Second, in the Moespotsche Waard a hardwood forest was developing. This land was less inundated, which is a condition for hardwood forest development; softwoods grow in frequently inundated areas. The Moepotsche Waard used to be a deposit area for polluted waste of an electricity company. After they quit these activities, they covered the area with soil, on which now the hardwood forest develops. The ecological developments in these floodplains are considered valuable, because not many of these riverine areas exist along the Waal. Additionally, experiments on forest growth between groynes have been performed in this area and so contributed to increase in hydraulic resistance. Third, the Staartjeswaard hosts one of the oldest softwood floodplain forests along the Waal. It is about 50 years old. The increase of hydraulic roughness at the Staartjeswaard can mainly be explained by the development of old maize fields, which have been run wild and by the expanding softwood forest.

The identified decrease in flood defence levels (depicted in Figure 4.2) implied that flood defence levels no longer met the safety norms. The discharge distribution at the Pannerdensche Kop, where the water of the Rhine is divided into its branches, was affected. Furthermore, the act on public river management 'Wbr' (*Wet beheer rijkswaterstaatwerken*) was broken, because permits for allowing additional hydraulic resistance in the river bed were lacking. For these reasons, the river manager decided that flood defence levels had to be restored. Simply removing the vegetation was not considered an option, because of the natural values of the area and the management of the area lying in the hands of an environmental organisation. Additionally, the river manager considered herself to have been indifferent towards floodplain management and so thinks it is not justifiable to now impose rigid measures. As such, the *nature-safety dilemma* was born. No strategy existed yet to resolve the issue, new management and governance issues arose (e.g. who is responsible, which source of finance?) and existing instruments such as the permit system were considered inappropriate. The permit system is grounded on static situations and is unable to deal with dynamic situations. Moreover, the expectation that similar situations would be identified in other areas urged the development of a strategy that could be applied more widely.

In earlier years, the environmental manager of the Floodplains of Beuningen started developing the idea of 'Cyclic Floodplain Rejuvenation' (CFR) for river revitalisation purposes (Helmer 1999). During the identification of the nature-safety dilemma, the environmental manager and the local university joined up to further develop the CFR concept. This idea was embedded in the EU Interreg IIIB project 'Freude am Fluss'. In this project Dutch, German and French partners cooperated on the subject of flood defence and living with water. In the sub-project 'Symbiosis between Nature and Safety' particular interest was paid to how nature development can be integrated with flood defence and can create opportunities for economy, recreation and cultural development. One of the project goals was to apply CFR in practice (Freude am Fluss 2007).

4.1.2 The pilot project: the Cyclic Floodplain Rejuvenation concept and the pilot design

To resolve the nature-safety dilemma, to address management questions and to further develop the CFR concept, Beuningen was appointed as a pilot site. Within the floodplains of Beuningen, particularly the Sandbar of Ewijk has been of interest for CFR application. The reasoning is threefold. First, this is the area where the increase in hydraulic roughness has been highest due to vegetation development and sand deposit. According to the river manager it is most justifiable and effective to remove the obstacles at the location where they have emerged. Second, intervening in the Sandbar would fit with the philosophy of CFR. The main assumption of CFR is that in natural river systems ecological and morphological processes take place that are absent in highly regulated rivers (Duel *et al.* 2001). CFR application means imitating or re-initiating these river processes and so enhancing its robustness and resilience to flooding (Peters *et al*. 2006). Overmars (1993) demonstrate that the Sandbar of Ewijk has been a moving island between 1800 and 1873, that the canalisation works directed and confined the water flows north and south of the sandbar and that the secondary channel on the south side had been closed. These insights confirm that this area would under natural circumstances be highly subjected to dynamics. Therefore, imitation of dynamics is considered suitable at this location. Third, the other areas with high hydraulic resistance contain polluted soil (Moespotsche Waard), which is preferably kept untouched to prevent the need for cleaning, or are considered ecologically very valuable because of the high age of the forest (Staartjeswaard).

The main intended contribution of CFR is to resolve the nature-safety dilemma by restoring discharge capacities while maintaining or even enhancing ecological quality.

Some CFR proponents advocate its application even without a direct nature-safety dilemma in order to restore natural dynamics in confined rivers and so to enlarge the variety in species, habitats and successive stages of vegetation. The CFR concept originates from the understanding that vegetation grows and morphological processes continuously rework sediments in a river. These processes provide the means of succession of vegetation and resetting vegetation to pioneer stages, create channels for water to flow and increase the diversity in habitats for the establishment and growth of riverine and alluvial species (Smits *et al.* 2000, p. 279, De Bruin *et al.* 1987). Morphological processes include erosion, sedimentation and grazing. In a densely populated and economically important river such as the Waal, unbridled erosion and sedimentation processes are not considered desirable. Engineering works such as groynes and dikes, but also initial low grazing intensities prevented rejuvenation to occur in the Beuningen Floodplains. CFR aims to imitate or re-initiate them and so finish the natural vegetation cycle. CFR proponents advocate that careful planning of conservation areas in time and space can be used to dose flood waves and decrease flooding risks (Smits *et al.* 2000). Typical CFR strategies include the excavation of secondary channels, lowering floodplains or resetting riparian vegetation in combination with grazing (Duel *et al.* 2001).

Before applying CFR, an area first needs to be prepared. This means to create space and enable dynamics. For instance minor embankments could be removed. The real design of CFR constitutes the identification of river dynamics and ecological processes that are to determine the ecological development of the floodplain. River flows are to be followed where possible and estimates should be made on vegetation succession and sedimentation rates. CFR acknowledges river dynamics and thus also recognizes that interventions are to be repeated over time. Repetition is needed when flood defence levels are threatened again through sedimentation or succession, or habitats become more uniform. In contrast to traditional water management, the nature of intervention can be different then in the previous ‘round’ and also the location is not fixed. The location can be chosen within a river reach level (see Geerling *et al.* 2006). The combination of interventions at a river reach level over larger time spans differentiates CFR from traditional water management.

For the Beuningen pilot, the core consisted of the design of a CFR strategy. The designing process contributed to cooperation between actors, gave insight in interests of actors and constraints set upon the designs. The following criteria, proposed by various actors in the pilot process and agreed upon by the group as a whole, were used in the decision-making process for the CFR design:

1. The design of the CFR measure should decrease the local high water levels by at least 5.6 cm, but preferably create some additional space
2. Navigational conditions should not be influenced (e.g. by change in sedimentation patterns)
3. Existing infrastructure (e.g. dikes) should not be affected by any intervention
4. Imitation of natural processes
5. Increasing diversity of ecotopes

6. No land permanently inaccessible to grazers
7. Preservation of local ecological features such as sand dunes
8. Focus on the Sandbar of Ewijk alone

These criteria represent policy guidelines on flood defence and nature development and the related generic interests of the involved actors (water levels should be at a certain reference level, natural value of the river systems should be preserved or enhanced), specific local interests of environmental managers and river managers (preservation of local values, exact water levels), the assumptions of CFR to be tested (imitation of processes), and strategies of different actors to avoid future operational difficulties (grazing, navigation, infrastructure). Obviously, trade-offs need to be made in the design in terms of type, shape, location and size of the intervention. The first three criteria appeared to be hard, meaning that they had to be met even if it would mean for instance extra vegetation removal or replacement of the intervention, which would reduce the 'naturalness' of the intervention. Due to the limited time availability and the related assumption that the involvement of more actors would complicate and thus slow down the process, together with the legal responsibility of land owners to maintain flood defence levels, particularly the operational river manager articulated the constrained to solely focus on the Sandbar.

The proposed interventions (Peters *et al.* 2005) included the excavation of a number of side channels of various shapes, where the hydraulic resistance was highest (Figure 4.4). The side channels created (semi-permanent) islands and increased the discharge capacity of the river sufficiently to compensate for the increased hydraulic resistance. The proposed intervention therefore met the hydraulic criteria. Ecological processes could partly be imitated and reinforced and local features were taken into account (e.g. reconnect to the existing former side-channel, preserve a ecologically valuable meadow). Therefore, the ecological quality and diversity was expected to increase. The intervention was decided upon in 2005, after which a process of obtaining permits (e.g. for vegetation removal, soil quality, spatial plans) and further refinements started. In 2008, which is after the research period, the first part of the implementation, vegetation removal, has been executed. The excavation of the channels is planned in 2012 when a new bridge for the adjacent highway is planned. The sand can then be used for the bridgehead.

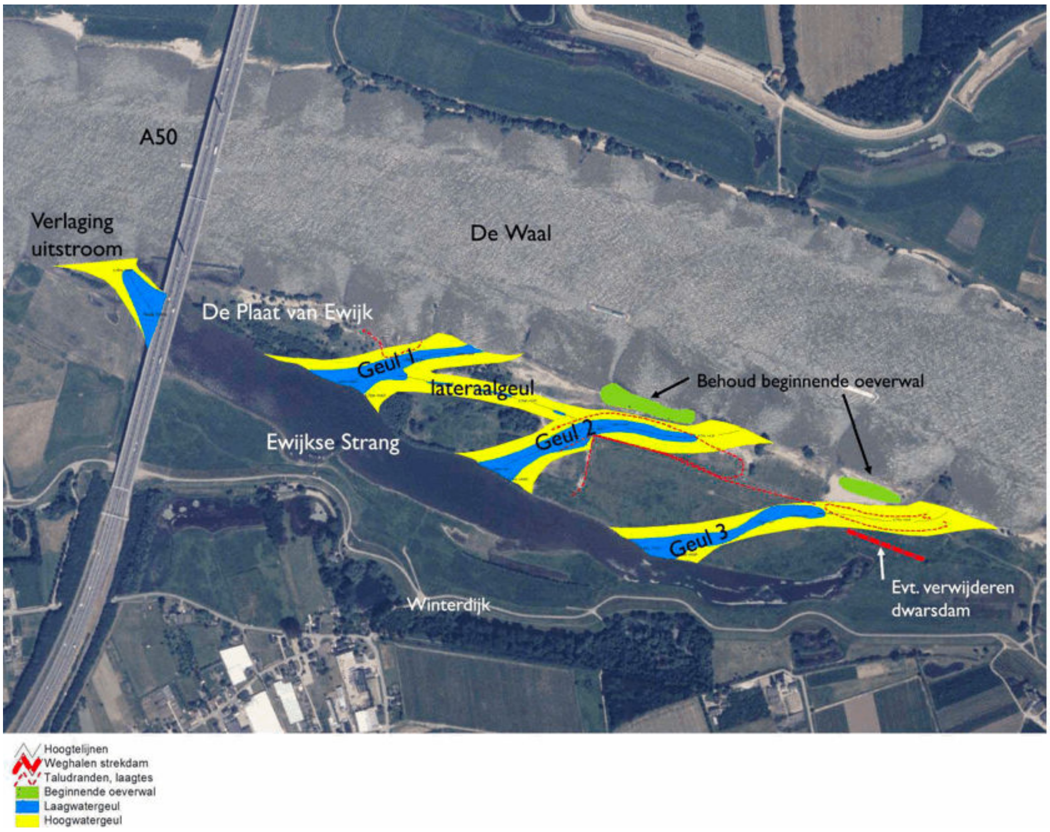


Figure 4.4: Proposed CFR intervention at the sandbar of Ewijk ('De Plaat van Ewijk'). The CFR intervention consists of three channels ('Geul 1,2,3') connecting the river with the old disconnected channel ('Ewijkse Strang') that is present in the area. Additionally a cross-channel ('lateraalgeul') and a re-connection of the old channel with the main stream on the downstream side ('Verlaging uitstroom') are planned. The design aims to create a diverse landscape with semi-permanent islands incorporating ecologically important stands of vegetation such as the natural embankments colonized by pioneering plants ('Behoud beginnende oeverwal') (Source: Peters *et al.* 2005).

4.1.3 Meeting the actors

After the identification of the discharge problem in 2004, a project team with representatives of Stichting Ark, Rijkswaterstaat, State Forestry and the Radboud University started the CFR pilot process to resolve the nature-safety dilemma, but also to further develop and demonstrate CFR. Next to the project team other actors including the province of Gelderland, the municipality of Beuningen, landowners, industries, citizens and recreants were affected and interested. In this section the actors, together with their interests and roles in the pilot project and in Dutch water management in general, are introduced.

The environmental sciences department of the *Radboud University Nijmegen* is the initiator of the pilot project. She participates in the EU project 'Freude am Fluss' and found in the floodplains of Beuningen a suitable site for application of a CFR pilot and included this in the project description. Together with Ark foundation, the university had been working on the concept for a few years. The university drives and facilitates the project. Interests are of a diverse nature and lied in the further development of the concept as a river management strategy, study of river dynamics, but also the attainment of a pilot project as it was promised in the EU project.

The daily management of the floodplains, that are largely a nature reserve, is with *Ark foundation*. Ark Foundation is not the owner of the floodplains, but has agreed with private and public landowners, particularly on the Sandbar, to manage their land. Main management tasks include the introduction of large grazers, including semi-wild horses and cattle, communication with society and education of visitors and schools. Remarkable is their view on enjoying nature in the Netherlands, that is, instead of maintaining trails for hiking or cycling, visitors ought to create their own route. Ark is not legally responsible to resolve the issue, but given the agreements, the continuation of goodwill and the possibilities for further enhancing the natural character of the floodplains, they developed CFR and participate in the pilot project. CFR fits in their way of thinking of re-allowing wilderness in the Netherlands by creating favourable conditions. In the pilot they contribute with their knowledge of the ecological values (e.g. where to design the channels exactly) and the management of the area as a nature reserve (e.g. which grazers, which contractors, accessibility for visitors). In the longer term, when the area is well established within their philosophy of semi-wild nature Ark expects to pass the management over to State Forestry. Ark sees itself as pioneers and they will continue in new areas.

Rijkswaterstaat (RWS) is the operational arm of the Dutch Ministry of Transport, Public Works and Water Management and is tasked with flood prevention and maintaining the waterway. Discharge capacities of the river are tested every five years. If safety norms are not met due to changed circumstances in the floodplain, RWS has the right and the obligation to intervene. RWS is supportive of the CFR initiative as they consider that it fits with contemporary river management (e.g. more freedom for multi-stakeholder involvement, integration of different functions), because they feel they have been ignorant themselves for years, and because in (small) parts of the floodplains they are the landowners and thus legally responsible. For these reasons and to know what is going on in the floodplains, the pilot initiative is supported in several ways (e.g. involvement, financial support). RWS is a relatively powerful player in the pilot project, because of her legislative task to ensure flood defence levels and her long-standing expertise. In the pilot, RWS functions as a 'quality control' and sets the boundary conditions for dike stability and expected morphological impact in the main channel. Furthermore, due to interpretation of the law she has strong preference for local solutions. This way she influences the design by limiting the search for CFR measures to the floodplains of Beuningen alone and so to reduce the complexity of decision-making.

The *State Forestry* manages large parts of the floodplains in the Netherlands. Given the expectation of comparable problems in other floodplains, State Forestry is interested in learning about and further developing the CFR concept instead of the traditionally and financially enforced focus on the conservation of species. They are thus a potential future user. In the Beuningen floodplains they are, however, relatively small, but they manage a critical part (Staartjeswaard – where the hardwood forest develops). Moreover, in the future it is anticipated they might take over the tasks of Ark in Beuningen.

Next to the project team other interested and affected actors include the *local and regional government*. These are involved with spatial planning and issuing permits related to nature areas, agriculture, housing and other (economic) uses of the river and its floodplains. In this case, the authorities of interest are the municipality of Beuningen and the province of Gelderland. Given that the area is indicated in the (binding) spatial plans as a natural reserve, intervening for that purpose is not problematic. However, polluted soil such as in the Moespotsche Waard might become a problem when it is to be excavated. *Landowners* are legally responsible for maintaining discharge capacities on their land and so need to take the initiative to reduce the hydraulic resistance when needed. In the floodplains of Beuningen a mixture of about 30 private and public landowners can be found. There is some agriculture and industry, but Ark represents the majority of landowners where nature management is applied. *Farmers* on the landside of the dike are somewhat reserved towards nature development as the larger presence of seeds might increase the risk of weeds on their plots. *Citizens*, and particularly *recreants* of the area, are mainly passively involved. Ark took up the task to guide recreants through the process that they will encounter in the floodplains. The removal of vegetation and the view of bulldozers is often surprising and not associated with nature development (De Groot and De Groot 2009). In a series of workshops with citizens, conducted in 2006, boundary conditions and trade-offs could be explained.

4.2 Pilot project characteristics

To describe a pilot character, six characteristics were identified in the primary analysis (chapter 2). These include the relation of the pilot to the policy and local context, the scale, innovation, knowledge orientation, special status and the actor-network. Their meaning for the Beuningen pilot is discussed in this section.

Relation to Policy- and Local Context

The pilot is well related to and influenced by policies on maintaining waterways for flood protection and navigation. This is well-established policy in the Netherlands that is supported with legal means and has political and societal support. Additionally, the pilot is well related to nature policies. Many floodplains are, or become, part of the national ecological structure, because they are considered important ecological corridors (Ministry of ANF 1990). Moreover, in floodplains 'red list species' live and so conservation is obligatory, both from a national and European point of view (Ministry of ANF 2005). Experienced water managers recognized that more space (literally and figuratively) has become available for natural processes at the river boundaries and for creativity in flood defence. Nevertheless, control and navigation remain the dominant values. The pilot project fits in the contemporary held frames that both nature and flood defence are of importance. However, policies on how to give shape to this in practice are lacking. Therefore, the pilot is situated in a policy niche.

The local dependency of the pilot is high. The influence of the different actors is reflected in design criteria for flood defence, spatial quality and navigation. Institutional characteristics (e.g. which landowners are in the project team) and cultural values are acknowledged (e.g. presence of historical factory). The design is further adapted to local biophysical circumstances, such as the presence of ecologically valuable sand dunes, but also where it is economically interesting to excavate. In terms of incidence of occurrence, the pilot was initiated as a single pilot. However, a parallel running project in a nearby floodplain (Millingerwaard) was transformed into a CFR project.

Scale

The extent to which the CFR pilot project was confined on the dimensions space, time and problem scope depends on the point of view. In terms of spatial scales, the pilot was unconfined from an operational river management and daily management point of view. For these functions, the floodplain level is a common management level. However, from the CFR concept point of view, applying a measure on a floodplain level means that the scale is confined. CFR namely best applies on a river section level (see Vreugdenhil *et al.* 2010a). The temporal scale of the pilot was confined in the sense that only one intervention was designed. Longer-term strategies, which include daily management and series of interventions, were not developed. Additionally, the project duration was defined for four years, even though in practice this turned out to be only the designing and preparation phases. The implementation, monitoring and analysis period of the pilot will be confined by the availability of additional financial means and the willingness of an actor to be the driving force. The problem scope of the pilot was confined. Actors from adjacent floodplains or with a broader work field such as the provinces were not actively involved. The pilot is not reversible in the sense that biophysical alterations can be made undone directly (e.g. a chopped tree cannot be put back). At most, after the execution it can be decided not to continue the strategy.

Innovation

The innovation is of conceptual nature. The pilot is about how to use natural dynamics in river management and so to combine flood defence and nature development. The focus is on the design of interventions. The concept is innovative for Dutch floodplain management and the problem addressed (the nature-safety dilemma) is new. However, in the design of the pilot the innovativeness has been reduced. Some experience already exists with secondary channels and concessions on the innovativeness are done to meet societal and institutional demands. The pilot can be characterised as demand-driven, because it addresses pressing questions of the manager and future user. It fits existing operational management questions on how to address nature-safety dilemmas in a more accurate way. In case the pilot would have been used as a step towards full CFR application at a river stretch over longer periods of time, then the pilot would have been supply-driven. The pilot would then have addressed future strategies for external users rather than developing innovative means for current management issues.

Knowledge Orientation
The pilot served research interests of the University, but also had to resolve operational problems and meet commitments made to European and national research funds. More strongly, research interests existed for the initiation and implementation, but were very limited with respect to monitoring and analysis. For the purpose of monitoring, no money was reserved. By the time the project finished new financial sources had to be found and a new problem owner who felt responsible for the knowledge development on this part. The stance towards knowledge development was of a communicative nature. Knowledge was developed through the interaction of different experts in ecology and river engineering, but also with professionals in operational and daily management. For this purpose, the university explicitly exercised a facilitative role. Research questions focused on different types of knowledge related to CFR design and included for instance river evolution and hydrodynamics, but also focussed on legal responsibilities, institutional arrangements and permits. The related aimed type of learning was double loop learning: values on river management were to be changed. The focus was thereby more on the concept and its design than on implementation and interaction with the context. Means to support learning within the project team include individual interactions, meetings to share findings and joint visits to the pilot site. In a broader setting, learning was encouraged through workshops in which ideas and results were discussed and the development of a handbook (see Peters *et al.* 2006).

Special Status
The pilot project benefitted from its pilot status in the sense that actors participated out of curiosity and were willing to invest resources, including time and knowledge. However, without the project, interventions would have taken place as well. Failure would not have been tolerated in the sense that then RWS would have intervened. A contrary aspect of the pilot status is that none of the actors felt fully responsible. This became most clear when the four years the university was financed were over. No one proposed to take up the leading role. The flexibility of the pilot was confined within the boundaries that were set. Within the playing field that was created, freedom existed for tailor-made solutions and to adjust designs when new insights become available for instance on soil quality and excavation costs and techniques.

Actor Network
The pilot is initiated by the Radboud University in close cooperation with Ark. They both have the role of developer and expert. Ark and State Forestry are possible future users of CFR. RWS acted as superintendent in the pilot. The actor involvement has been designed for the local pilot, but with an eye on future management by involving actors that operate at a larger scale such as state forestry and the province. The individuals were of a heterogeneous nature, from diverse layers of the different organisations. The project is financed with European and national research

funds and flood defence funds. The locus of the pilot at the interface of two separate policy fields (nature and flood defence) had its impact on the question of responsibility and accompanying funding. The management style of the university within the project team was facilitative: she created the conditions for all actors to participate and to share responsibilities. The style exercised as a group to external actors is consultative, because the initiators gather opinions about the problem defined by them that can be used for further refinement of the pilot or related issues of concern.

In conclusion, the CFR pilot project in the floodplains of Beuningen takes place in a policy niche at the interface of two policy fields and so has the opportunity to enhance IWM in practice, but also makes that no policy actor feels fully responsible for its continuation after the piloting period. The knowledge orientation is primarily focussing on design questions of diverse nature, more than on the effects of the implementation. Monitoring programs were therefore lacking in the discussions during the initial piloting period. The limited effort can be explained by the pragmatic sides of the pilot goals. Targets had to be met and the delivery of the project enabled the research agenda. An overview of the characteristics is given in Table 4.1.

Table 4.1: Characteristics of the CFR Beuningen pilot project

Project Characteristics		**The CFR Pilot Project**
Relation to policy and local context	Connection to policy	Fit within IWM paradigm, but in policy niche
	Local contextual dependency	High: design adjusted to local values and interests
	Incidence of occurrence	Twice and secondary channels are wider applied
Scale	Limitedness (space, time, problem scope)	Confined in all dimensions: Space: single floodplain Time: 4 years, Problem scope: limited actors and short term solution
	Reversibility	Not reversible
Innovation	Type of innovation	Conceptual
	Driver of innovation	Demand-Driven
	Level of innovation	Moderate
Knowledge orientation	Knowledge model	Communicative driven
	Monitoring intensity and type	Absent, focus on learning for design
	Type of knowledge	Substantive and Process, Hard and Soft
	Type of learning	Double loop
Special status	Attitude	Moderate: interest and participation, but limited willingness to take the lead beyond the pilot
	Flexibility	Moderate: within the set playing field
	Resource allocation	Site, financial means, time and knowledge made available
Actor Network	Initiator	Multi-actor: developer and user
	Participants	Multi-actor: user and superintendent actively involved, other actors less intensive
	Governance Style	Internal: Facilitative External: Consultative

4.3 Pilot project use

In chapter 2, I identified that different actors can use a pilot project for different purposes at the same and that this use can change over time. The three major types of pilot projects that have been identified are *Research, Managerial* and *Political-Entrepreneurial* pilots. More specifically, nine different uses of the pilot have been identified. The extent to which a pilot is used for a specific purpose can be visualized with the Nonagon on a scale from 0 to 5 (Vreugdenhil *et al.* 2010b). In this section the use of the CFR pilot project is visualised from a policy analyst's perspective. The development of uses over time is included by providing a snapshot at the start of the pilot at 2004 (t=0) and by the end of the initial piloting period at 2008 (t=1). At t=0 the idea for a pilot was approved by all actors, the pilot was embedded in the EU project and the project team was just installed. At t=1, agreement existed on the design and preparation activities for implementation were finalized (e.g. soil research, permits, vegetation removal), but implementation has not started yet. A policy analyst's perspective in this context means that a relatively inclusive perspective is exercised in which perspectives of all actors with design influence are included (Walker 2000). The view presented here does thus not necessarily represent views of individual actors. However, the purpose of the analysis is not to map individual's views, but to give a general sense of the use of the pilot and particularly its development.

Figure 4.5a depicts the initial Nonagon at t=0 when the pilot was initiated and the project team was formed. In terms of a research pilot, there were research interests, but this was not core to the pilot. Knowledge development was not absent but restricted to explorative questions on the translation of the concept into practice. Moreover, debates on monitoring and analysis of the functioning of the concept were lacking. The pilot was not used to evaluate policies, because the pilot was initiated on a stand-alone basis without formal connections to a policy in development.

The pilot had strong managerial interests. Problem mitigation of the nature-safety dilemma had priority within the pilot and could be considered as both the reason to conduct the pilot and the driver that enabled the execution of a pilot in the first place. Just for the purpose of CFR itself, it would be more difficult to create favourable pilot project conditions (e.g. to find a site, to create commitment). Policy implementation is not relevant because of the lack of a policy that is to be implemented. The pilot is used to initiate communication between different actors that all deal with floodplain management, but for which no body exists yet since floodplain management as an individual and yet integrated topic is new. Despite that the communicative use is not explicitly mentioned by respondents, it is considered of importance. In the process design different actors are invited to jointly design an intervention and meanwhile learn about the CFR concept. The pilot is not primarily used as an insurance to prevent failure. Rather, a pragmatic approach, particularly driven by managerial constraints limits the scale and so a certain level of insurance is present.

The third type of pilot use, the political-entrepreneurial, can be recognized moderately. First, RWS as a public body has a side goal to encourage innovation in water management and therefore contributes to the pilot project. Second, both Ark and the university hold an environmental perspective. They advocated the CFR approach for this floodplain, but also considered it suitable for wider application. Third, some aspects of the use for a political game can be recognized. For the university the project is of importance for their existence and to do research. This department depends on external money. Proposing a pilot project might help to collect resources.

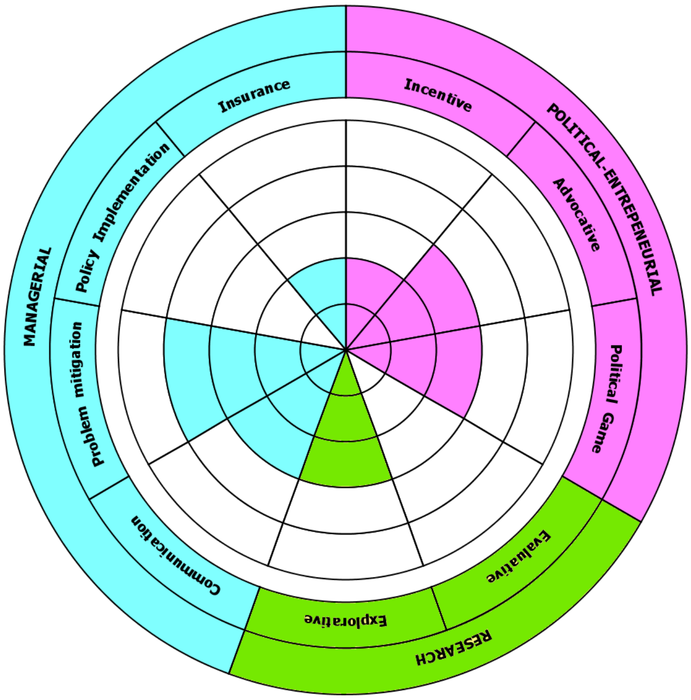


Figure 4.5a: Pilot Nonagon for the CFR pilot in the floodplains of Beuningen at t=0 from an analysts' perspective

Figure 4.5b depicts the pilot Nonagon at t=1 when the pilot has become the product of the project team. The interpretation of its use in Figure 4.6b represents the use of the pilot by the project team. The research use remains equal. Despite the slightly increased attention to the need for monitoring and the rise of questions related to future CFR application, well-defined monitoring and analysis programs are still lacking. Temporal and financial constraints force the team to focus on the pragmatic questions related to implementation and less to development of knowledge on the concept. This is also reflected in the managerial use 'problem mitigation'. This use becomes even stronger, particularly when the pilot period has ended and new financial resources can only be found on the condition that space is created in the riverbed. Other managerial uses remain similar.

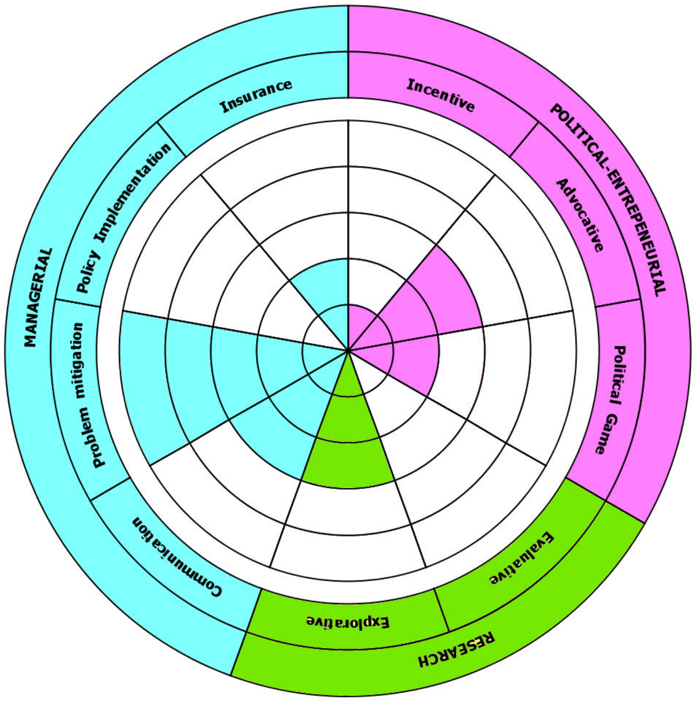


Figure 4.5b: Pilot Nonagon for the CFR pilot in the floodplains of Beuningen at t=1 from an analyst's perspective

In line, the political-entrepreneurial use 'incentive' decreases. Rather, focus shifts further to the pragmatic sides of the pilot. The need to encourage innovation reduces. The use of the pilot to collect resources still exists, but is slightly less important than at t=0, because continuation is now the main focus. The advocative use remains important, but the project team is not homogeneous in this use. Ark and the university still advocate the wider use, because they are convinced of the potential benefits of such management approaches for river systems. The other actors, and particularly RWS, remain a little critical. For them, more evidence is needed which is not available (yet). The enthusiasm for the project reduces slightly when it comes to implementation and continuation. No actor is really prepared to take over the leading role of the university who starts to have new interests. Actors are pointing at each other because of the lack of a problem owner feeling responsible and knowledgeable enough to take the lead. Nevertheless, still several workshops are held to spread the idea and CFR is included in a new project of the university.

In conclusion, the pilot can be classified as a managerial pilot, with particular interest in problem mitigation, and with strong political-entrepreneurial elements to contribute to the main goals. The political-entrepreneurial function diminishes slightly over time, whereas the managerial purposes slightly gains in importance. The importance given to research is not dominant but remains constantly present. Overall, the use of the pilot is relatively stable.

4.4 Context of the pilot project

In addition to the pilot setting as explained in the introductory section, this section highlights major contextual elements of biophysical, institutional and social-economic nature. These are distinguished from broader contextual elements that implicitly influence the pilot and are unlikely to be directly influenced by the pilot. The reason to specifically focus on the context is the influence of the context on the design and on the development of the piloting process. Additionally, understanding the contexts contribute to the recognition of effects.

Biophysical context

As indicated, the pilot is planned in a densely, but uniformly, vegetated sand bar along the river Waal that is a major navigation route for North-West Europe. According to De Bruin *et al.* (1989) floodplains are one of the few places in the Netherlands where natural dynamics can to some extent occur, within the boundaries of navigation and safety. This part of the Rhine is not restricted by dams and sluices the presence of sediments. Natural processes that do take place in the pilot site include the deposit of sand and vegetation development. However, other processes are lacking due to engineering works. These particularly include the resetting of vegetation and erosion of sand. Remnants from these river dynamics are still present, such as an old closed river arm. Infrastructures that are present include dikes and groynes. The area functions as a freely accessible nature reserve in which the main management consists of the introduction of grazers.

Institutional context

The institutional context consists of policies on flood defence and navigation that entail regulations on maintaining discharge capacities and the navigability of the waterway. The emphasis of Dutch water management on flood protection and enabling navigation imposes limitations on the pilot. These are exclusion of expected morphological impacts in the main channel and using a safety margin towards dikes. Environmental legislation requires protection of species and their habitats, but also soil studies need to be undertaken before permits can be given. Additionally, local regulations deal with functions given to land use. Local plans and the pilot need to match or adaptations are needed in one of the two. Actors in the project team were developers, and current- and future users of the concept. They were considered to have essential knowledge and resources. However, within the existing institutional arrangements, a specific actor being responsible for floodplain management is lacking. This reduces the ability to focus on a river reach level and also contributes to recurring debates during the pilot on responsibilities. In a somewhat looser form other potential critical actors, for giving permits and as future initiators, were involved.

Social-economic context

In the social-economic context, the importance given to navigation and flood defence are leading values, particularly after the high waters of 1993 and 1995. The identification of the floodplains of Beuningen as a problem area results from a stricter control on the related water law. Nevertheless, river management in the Netherlands nowadays recognizes more possibilities for other functions, because the river system has become complicated, expensive and has a reduced hydrological resilience (Havinga and Smits 2000). Furthermore, the increased attention for environmental values since the 1980's and the change in democratic values on water governance in which stakeholders ask for more transparent, accountable and participative governance make that the nature of river management has changed (cf. Vreugdenhil and Ker Rault 2009). Interviewed experienced water managers recognized a change in water management from pure technocratic to more integrated water management in the past three decades. In scientific literature some would even speak of a 'transition' (e.g. De Jonge *et al.* 2007, Van der Brugge *et al.* 2005). However, I would argue that physical and mental space became available allowing for more freedom for natural processes within the existing institutional boundaries. The discussion about whether the pilot is a 'nature' or a 'flood defence' measure and consequently from which resource it needs to be paid emphasizes that a full 'transition' did not take place. For the pilot project the mixture of values has large influence on the initiation of the pilot and the design choices that are made. Eventually, flood defence targets need to be met, either in the pilot or through additional measures. Since flood defence and navigational infrastructure are expensive and valuable, no risks are taken to harm these interests. Since all actors also value nature development, effort is put into finding ways in bringing strategies in practice. The support for the intervention derives from these values. Scale preferences of operational managers confine the search of interventions to a floodplain level (Vreugdenhil *et al.* 2010a).

Broader context

In the floodplains of Beuningen, outside the piloting area, other forms of land use exist, including housing, farming and industry. There is also a cultural site of importance. These functions are for the pilot considered as given even though at the longer term this might change because there are other policy plans for the floodplains (e.g. the development of a night harbour). In the floodplain also traces from industrial activities are present, such as old mining pits that are now open water bodies, and polluted soil. The presence thereof limits the design freedom for interventions because excavation of polluted areas is not allowed without cleaning of the soil. Adjacent floodplains are mainly used for agricultural purposes. In combination with policies and directives, such as the Water Framework Directive, Natura 2000, Space for River and the Ecological main structure, the floodplain should be considered as part of the river system as a whole instead of an isolated site. Of course, there are other actors of interest then. These include not only other local actors, such as municipalities and NGOs for nature and culture, but also actors at different administrative levels, such as provinces, ministries and water boards. In Table 4.2 the contextual factors for the CFR pilot in Beuningen are summarized.

Table 4.2: Summary of contextual factors of the CFR pilot project

Biophysical	Densely forested floodplain High sedimentation rate, but lack of resetting mechanisms
Institutional	Legislation on: flood defence, navigation, environment, local planning Project team of developers and future users Nature and safety interests are individually institutionalized
Social-Economic	Increased room for IWM, but core focus at flood defence and navigation Changing governance values
Broader context	Diverse land use functions in floodplain European and national policies (e.g. Natura 2000, space for rivers, WFD) Other local actors at other floodplains and actors at different administrative levels

4.5 Effects of the pilot project: System Responses, Knowledge Development and Diffusion

This section discusses the effects of pilot projects in terms of the response of the biophysical and actor-network system, knowledge creation and learning, and diffusion.

4.5.1 System's Responses

Biophysical response

Given that the pilot did not reach the implementation phase during the research period and within the initial project duration, no biophysical responses could be identified yet. As of date (which is after the research period), vegetation has been removed and excavation is in preparation. The expectations are that existing infrastructures (e.g. dikes, groynes) remain unaffected, flood defence targets will be met, pioneer species can settle and so a more diverse and certainly initially a more open landscape will exist. Expectations on speed of vegetation growth, which depends on grazing densities, and sedimentation rates, vary. The expected return period ranges between 5 to 20 years.

Actor-network response

A first direct effect of the initiation of the pilot project is the cooperation between the different actors in a project team. Many of the individuals knew each other already and worked together in other projects and at an ad hoc basis, for instance on the development of CFR or in joint research. However, the actors did not work together yet as a group. The type of cooperation between the different interests was also relatively new. Next to the project team, other actors entered the broader network at different moments, because they were asked for instance for advice or resources were anticipated. As such new cooperative structures developed and the interconnectedness was enhanced.

A second effect in terms of actor-network responses can be found in the crystallization of roles and development of governance styles. Given that the problem under consideration – the nature-safety dilemma – is new and adequate approaches are lacking, the different tasks, responsibilities and institutional hurdles need to be identified. During the piloting process, the actors could search for their desired role in both the pilot and in floodplain management in the longer-term. For instance, Ark positioned itself as having local ecological and daily management knowledge. They want to continue with the daily management, possibly expand practices in the future and communicate the pilot to the wider public. In contrast, they do not like to be in charge of the interventions because they lack river management knowledge. The university could profile herself as a facilitator and knowledgeable partner in several areas, but indicated to transfer tasks to operational managers after the pilot period. Eventually, they are of the opinion that the initiative should come from operational actors. RWS took up a double role: both as an outsider just to safeguard the quality of the outcomes and as participant to compensate for her own 'failure'. In this role, RWS sets the boundaries to protect its responsibilities, but also gives a certain degree of freedom to design.

The lack of implementation so far implies that the actor-network could not react to the implementation process and the achieved biophysical effects. Nevertheless, at the end of the budgeted period, a debate is initiated on who is actually responsible for the pilot (rather than for the underlying targets for safety) and has largest interest. The debate was of importance for who would further finance the pilot. The issue has for the pilot been resolved by using the post 'extraordinary expenses' from RWS, but it also implies that implementation will be postponed until they can use the sand. RWS will also finance the morphological monitoring, while monitoring for ecology is still uncertain. Despite the temporary solution in the pilot, the longer-term question of who is responsible has not been answered, particularly not because current institutional arrangements split nature management and river management.

4.5.2 Knowledge Development

Knowledge creation

As earlier identified, the focus on knowledge creation was limited in the sense that formalized monitoring programs on both content and process were lacking and were not subject of discussion during the design process. Furthermore, the delayed implementation of the intervention hindered the development of knowledge on the application of CFR in practice and on the interaction of CFR with the biophysical context and actors. Nevertheless, knowledge creation was an important aspect during the designing process. The created knowledge has been reported in the developed handbook on CFR (Peters *et al.* 2006) and in several reports.

Substantive knowledge that has been created primarily focuses on river dynamics (Geerling 2008), assumptions and applicability of CFR, ecological, institutional and hydraulic characteristics of Beuningen (e.g. Mannaerts 2004, Kater and Smits 2004), CFR guidelines (Peters *et al.* 2006), and the assessment of interventions (e.g. Peters *et al.* 2005, Vreugdenhil *et al.* 2008). Process knowledge has also been developed albeit less explicit. First, process knowledge created includes the explication of positions of different actors towards CFR and each other. This includes the understanding of who brings what knowledge and resources, who is driven by which (legal and moral) responsibilities, and who holds which values. Second, the pilot project showed that support could be developed for CFR, but also that there were process hurdles. These include the limited willingness to take the lead and the misjudgement about the time it takes for discussions and acquiring permits. Third, studies on the concept showed that the choice to solely focus on the sandbar limited the concept. Both the reasons underlying this focus, and the relative influence of actors, became explicated. Arguments were based on habits and on beliefs in 'good governance'. 'Good governance' was in the eyes of the operational manager the hydraulic effectiveness of interventions (financial), the managerial ease (time) and the preservation of responsibilities to resolve the issue with the landowner (fairness). As a consequence of limiting the spatial and temporal scales, the pilot and the CFR concept have been limited. Potential other options were in an early phase excluded and future management, including the repetition of measures over time in a larger area, is not arranged for (Vreugdenhil *et al.* 2010a). The limitations in scalar perspectives show that the CFR concept is now adapted to the existing institutional context in search of the way with least institutional resistance, rather than following all assumptions of CFR.

In terms of hard and soft knowledge, the substantive knowledge identified above is of a hard nature, but also part of the process knowledge is of a hard nature. Examples include the resource availability and insight in required permits. Of a soft nature are the experiences in designing, personal experience towards nature (De Groot and De Groot 2008) and the influence of scale preferences on the design. Additional soft knowledge can be recognized in actors getting familiar with elements that are usually outside their scope (e.g. subtlety in design, discussions on millimetres), in feelings towards CFR in practice and in governance styles, but also in 'group chemistry' to achieve results that cannot be achieved individually. Another type of soft knowledge is the recognition that no actor felt really problem owner of the pilot. The question arose whether the pilot is flood defence or nature development and consequently which source needs to finance the strategy. Instead, project obligations and the 'threat' of RWS to intervene in the area drove the continuation of the pilot. Related hard knowledge is that current institutional arrangements appeared to be incapable to take IWM one step further and support CFR. They require dividing flood defence and nature development.

The last distinction is between contextual dependent and more generic knowledge, or the applicability of the knowledge. Pilot projects are in general particularly strong in developing contextual knowledge on the functioning of the concept in practice. Since the project has not been implemented and monitored, this is not the case for this pilot so far. However, contextual dependent knowledge that has been identified include for instance an inventory of biophysical and institutional characteristics on the floodplains (e.g. soil quality, ownership), interactions between project team members, limitations for CFR deriving from the area (e.g. infrastructures, industry, ecologically valuable places) and permits that are needed. Examples of less context dependent knowledge include the preferences in level of operation of different actors, developed attitudes of involved actors towards CFR, and insight in permitting processes and related hurdles (e.g. polluted soil, binding spatial plans). The debates on responsibilities and financing or barriers for IWM, such as the boundaries deriving from institutional designs, are even more generic aspects of knowledge applicable to Dutch floodplain management.

Table 4.3: Summary developed knowledge in the CFR pilot project

		Process	*Substantive*
Context-dependent	*Hard*	- Actor interests and resources - Permitting process - Safety as a driver	- Inventory characteristics floodplain - Assessment interventions
	Soft	- Generally positive attitudes towards pilot - Lack of responsibility for pilot - Interpretation of good governance and habits limits scale choices	- Experience in designing
Generic to Dutch river management	*Hard*	- Distinction nature and safety in institutions: of Institutions incapable to support IWM - Potential added value floodplain manager	- River dynamics - Assumptions and guidelines CFR
	Soft	- Development of attitudes towards CFR	- n.a.

Learning

What has been learned relates to the created knowledge described above, but not all actors learn everything. The extent of learning depends on how actors interpret information, their role in the process, which information they receive and which limitations are imposed on them (Weiss 1977, Muro and Jeffrey 2008, Bhatt 2000). Learning across the involved actors has been an important aspect of the CFR pilot. This was reflected in the designing process in which joint designs took place and in the development of the handbook. In a broader setting, learning was supported through national and international workshops with guests from different administrative and organisational layers, the use of media (newspapers, radio), scientific publications and educational programs.

All participants indicated they have learned from the pilot project. This included experience with designing CFR and with process aspects such as cooperation in the project team and first order learning on for instance calculating methods. Additionally, second order learning on re-thinking values towards CFR and its use for IWM in Dutch water management could be identified. Actors could further explicate their role in floodplain management. Values have not radically been changed, but were reconsidered and adjusted. The mechanisms for learning included both formal learning, through input from research that has been undertaken during the pilot, and social learning through interactions in the project team. Social learning was considered to have a crucial role. Without the interactions between the project team members, CFR would not have been applied. Domain- and location specific knowledge would be lacking, views on river management and roles within that would not have been changed and resources would not have been made available. Additionally, through social learning mutual understanding about each other's practices has been created (e.g. how hydrodynamic models work, what is process nature), and new debates could be opened (e.g. who is responsible).

Not all actors learned the same. This can be best reflected in the tension that developed between pragmatism (limited scale) and idealism (full scale) and the remaining skepticism of the concept 'being a nice package to achieve the same' or 'gardening', and the emergence of doubts related to the level of complexity for daily management. For instance, for the operational river manager, the large number of landowners, interpretation of regulation and hydraulic effectiveness fostered the idea to limit the pilot to the floodplain level. Additionally, RWS clearly indicated that the structure Ark provides (representing a large number of landowners) enables implementation of concepts like CFR. Interacting with 30 individual landowners would be time consuming. Opposition of one landowner would be sufficient to limit CFR possibilities. RWS's idea would be to have one representative per stake to keep the field clear. Furthermore, existing legal and financial instruments proved to be incapable of dealing with the new situation. RWS understood that for CFR changes are desired. Other actors agree on this, but take a step beyond. Particularly the university would argue for new floodplain organizations or embody floodplain management with bodies that cohere with river stretch levels, such as the province. These bodies themselves do not consider that entirely unrealistic but it is still many steps ahead. To Ark the major learning points are, besides engineering insights, that they have an important position in the process. Additionally, when CFR is implemented, emotions conquer with ratio. One responded replied as: it causes a bit of pain to see the machines'. For State Forestry, one of the major learning points is the change in valuing dynamic nature. This is a process to which the pilot rather contributes than make a significant change. The change is hindered by institutional structures that encourage species conservation. In contrast to actors in the project team who learned in detail about CFR application in practice and arising hurdles and opportunities, to external actors the pilot is primarily an introduction to CFR.

4.5.3 Diffusion of the pilot project

Diffusion refers to the transformation of the learned into action. Diffusion is described in terms of the patterns, nature and channels. Additionally, the exercised diffusion strategies are discussed.

Patterns of Diffusion

Despite the pilot not being implemented yet and so evidence from the pilot is lacking, some diffusion can be identified:

1. Millingerwaard. The Millingerwaard is a floodplain in the Waal river, east of Nijmegen. This area shows similarities to the floodplains of Beuningen: It has been developed as a nature reserve, but discharge capacities decreased and so intervening is necessary to re-establish reference conditions. Ark is also here the daily manager, RWS the superintendent and State Forestry the potential future manager. Furthermore, two private industries are located here. Institutional settings are thus comparable. A project had already been initiated before the Beuningen pilot, but this has been transformed into a CFR project because of the experience with the Beuningen pilot. The implementation of the Millingerwaard project took place in 2005/2006, which is thus before Beuningen.
2. WaalWeelde. After finalizing the project term of four years, the university and the province initiated a project that aimed for developing a proposal for a policy program that would serve as an alternative to the 'Space for River' program (REF). In the WaalWeelde proposal, an alternative way of design and management of the Waal river was proposed, with more focus on spatial quality and plans developed by local actors and yet achieving flood defence targets. CFR has a small role in the plan of WaalWeelde. Whether it will be used is unclear.
3. Education. Insights deriving from the research that has been done within the framework of the pilot project could be used by the university for their environmental management master's program.

The diffusion pattern of the CFR pilot in the floodplains of Beuningen is depicted in Figure 4.6. The diffusion into the Millingerwaard can be characterized as dissemination into a management project with comparable scalar characteristics. The diffusion into WaalWeelde can be characterized as institutionalization. Contextual conditions (biophysical, but particularly institutional because different actors at various administrative levels were aimed for) have changed by changing scales at all dimensions. The extent of institutionalization is very low. Only when WaalWeelde would be approved by politics, the concept would be embedded into institutions. This still does not mean there is a guarantee for implementation, because CFR is not the only option managers could choose from in WaalWeelde or other policies. When WaalWeelde is not approved, it might still function as inspiration for water managers and spatial planners. The diffusion into education cannot be depicted in Figure 4.6 since it is purely about knowledge and lacks any form of implementation.

The Beuningen project did not diffuse in the EU project of which it was part. Projects in Germany and France were determined in advance and did not change as a result of Beuningen. Additionally, institutional questions that are present in the pilot and the idea that CFR has the ability to bridge separately institutionalized functions and so contribute to IWM are most likely not diffused after the pilot. Actors return to 'daily business' and CFR gradually disappears from the debate.

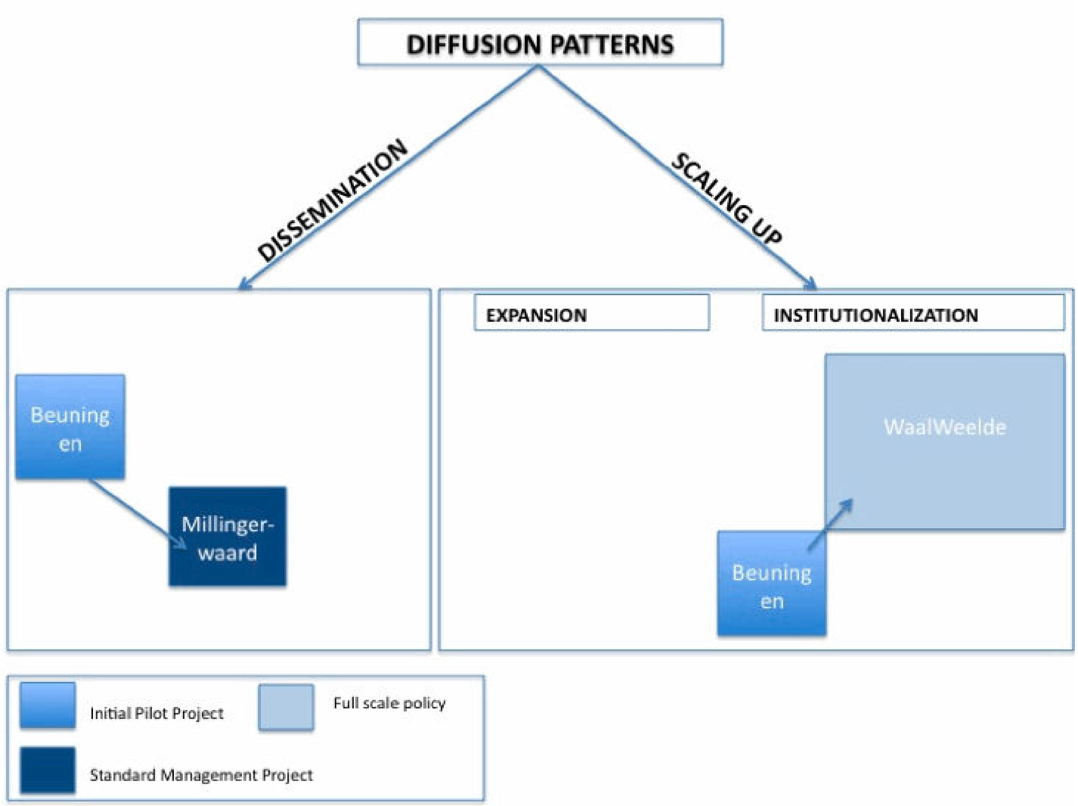


Figure 4.6: Diffusion patterns of the CFR pilot project in Beuningen. The pilot is disseminated to the Millingerwaard as a standard management project and is in an institutionalization process in WaalWeelde, although this is still in very initial phases.

Nature of diffusion

What is being diffused contains both hard and soft elements. Artefacts did so far not play any role of importance in the pilot and so this is not of interest for diffusion. The only technologies used were well-established. The contractor might use the experience of chopping in swampy areas for comparable situations. At the core of diffusion lies knowledge: both hard and soft knowledge are diffused. Most obvious is the CFR concept and the assumptions or beliefs that it can contribute to IWM and to nature-safety dilemmas specifically. The Millingerwaard project and Beuningen could cross-fertilize in terms of knowledge, because many of the same actors were involved and use experience from gained in one project for the other (e.g. identification of elements to be conserved, designs, reactions of recreants). In the WaalWeelde project, values on open planning processes in which the traditional river manager maintains the role of superintendent instead of designer were diffused. Furthermore, developed relationships (e.g. between university and province) could be intensified.

Channels of diffusion

The used channels of diffusion were internal for the Millingerwaard project. Actors involved in the Beuningen pilot also developed the Millingerwaard project. However, roles in terms of project leader and driver of the project were different (e.g. Ark had a more prominent role, the university was only passively involved). At a more generic level, diffusion of the concept across the involved organisations and other organisations took place through the involved individuals supported by the handbook. The channels of diffusion to the WaalWeelde project are mixed internal-external. The university is the driver again of the WaalWeelde project, but increasingly the province takes up a leading role. The passing on to a governmental body should secure continuation. Particularly when it becomes a policy program, the channels become further externalized. External actors such as municipalities and water boards are expected to pick up the CFR ideas.

Diffusion strategies
Two main strategies to support diffusion have been identified. The first is in the line of knowledge spread. Design principles and experiences have been included in the handbook that has been spread amongst practitioners during field trips and workshops, in which the pilot and associated knowledge has been presented. The second type of diffusion strategy focuses on the institutionalization of the concept in WaalWeelde. Despite the achievement to have the plan discussed in parliament as a strategy, the withdrawal of the initiators was too early and local actors as the targeted users might be not the right ones for diffusion of CFR. Local actors do not have the scope and knowledge to apply CFR. A policy advisor indicated that 'passing CFR on to the province, the actor with the best fitting scope, is still a few steps ahead'. So far, CFR has a limited role in river management.

4.5.4 Summary of the effects of the CFR pilot in the floodplains of Beuningen

In conclusion, an overview is given of the diverse effects of the pilot project Beuningen in Table 4.4. Most notable effects include the creation of support based on theoretical studies and cooperation in the design alone, the defence of project partners and the emergence of institutional questions when the initial pilot period ends.

Table 4.4: Effects of the CFR pilot project summarized

Effect type		**Identified effects from CFR pilot in Beuningen**
Response	Biophysical system	Removed vegetation Response unclear due to late and partial implementation
	Actor-Network system	*Relations:* installation project team; crystallization of roles for nature-safety dilemma *Resources:* Site, knowledge, people *Governance style:* Open consultative (setting the playing field) and facilitative in project team
Knowledge Development	Creation	*Substantive/ Process:* CFR guidelines/ Ownership issues, permitting, governance styles and cooperation *Contextual/ Generic:* Inventory characteristics Beuningen/ preferences in level of operation, barriers for IWM *Hard/ Soft:* biophysical knowledge, activities to be done/ shared problem perception, designing skills, feeling towards CFR in practice
	Learning	*What:* Experience in CFR application, adjustment values, explication of roles *Type:* First and second order *How:* Formal learning, Social learning, Experiental learning *Who:* project team: positive towards CFR, but tension between limited- and full scale proponents External: introduction to CFR
Diffusion	Pattern	*Dissemination:* Management project *Scaling up:* Attempt for institutionalization through proposed policy program
	Nature	*Artefacts:* - *Hard knowledge*: CFR assumptions and interventions *Soft knowledge:* design experience, governance styles
	Channel	*For dissemination*: internal *For scaling up*: internal-external

4.6 Synthesis

The analysis of the CFR pilot provided a view of a pilot project. To encourage critical discussion on this pilot project and pilot projects in general, the chapter finishes with a discussion on the evolution of the pilot and highlights some factors and mechanisms of importance in this evolution.

In summary, the CFR pilot project in the floodplains of Beuningen was about the first implementation of a conceptual, demand-driven innovation. The pilot had two major goals. The first was to resolve the practical, but new, problem of not meeting safety demands in a nature reserve, while approaches are lacking. The problem in Beuningen provided a platform to achieve the second goal. This was to apply the CFR concept and demonstrate the possibilities to renaturalize confined river systems and so to contribute to a change in river management perceptions. Research aspects focused on the design and assumptions, more than on the functioning of CFR in practice. The pilot has been customized to fit operational river management scales, but therefore lost some of its innovativeness and it did not address more fundamental institutional questions. Within the pilot period, the pilot has not been implemented. Nevertheless, the pilot already showed diverse forms of effects, some of which longer lasting than others. For instance, knowledge has been developed on the concept and the design for Beuningen, and diffusion could be identified in the transformation of an already ongoing project, inclusion of knowledge in education and institutionalization efforts.

4.6.1 Piloting process

The evolution of the pilot can best be discussed by the recognition of different stages a pilot goes through. These include after the pilot initiation i) process design, ii) design of intervention iii) implementation, iv) monitoring and analysis and v) diffusion. The different stages are discussed here, even though the identification of stages does not mean that a pilot goes through all stages, let alone in a sequential and singular manner.

Pilot initiation and design stages

Part of the pilot initiation is the idea development and project proposal. Ark had first coined the idea several years before the pilot, because it would fit their management philosophy. In their cooperation with the Radboud University and RWS, who identified the safety problem in the specific location, it came to a pilot project proposal as part of a research program. The pilot and the site were thus not independent from each other. In the process design, a strong focus existed on cooperation and joint development of the design of the pilot by developers and future users. This was not done beforehand. Actors could bring in their resources and position themselves for instance as quality control setting the playing field. In this setting, discussions identifying major limitations for CFR and more generally for IWM arose and knowledge on CFR could be further developed and presented in a handbook. Nevertheless, design choices for the intervention were made, such as the location focus and type of measure. These choices, in combination with the emergence of new knowledge on water levels and modelling and permitting processes, again influenced the further pilot: not only in the decision on the intervention but also in the extension of the preparatory stage and later in the representativeness. Since the pilot did not achieve to reach implementation in the original piloting time, most of the piloting period covered these initial stages. Due to the focus on the intervention design, a monitoring and analysis program were neither included in the pilot proposal nor in the pilot design.

In conclusion, in these stages:

- the pilot benefitted from the pilot status to collect resources, including the availability of the site, time and knowledge support
- the pressure to meet policy goals was a strong driver for initiation and development of the concept, however, it also reduced the innovativeness
- the emergence of new knowledge delayed the process
- the institutional gap between nature and safety and the consequent barrier for IWM had been highlighted

Pilot implementation and monitoring and analysis stages

Both pilot implementation and monitoring and analysis stages have not been reached during the analysis done for this thesis (Note that during the printing of the thesis implementation is taking place). For implementation this is unintentionally, but monitoring and analysis were initially not explicitly included in the project design. Nevertheless, much knowledge has been produced on related issues. After the original pilot period, the search for new money to continue the project highlighted that the responsibility for floodplain management in combination with ownership of the concept was lacking. Enthusiasm to take the lead was low. Interactions across different organisational levels and the pressure to meet flood defence targets, contributed to keep the process going.

In conclusion, in these stages:

- the ending of the initial subsidy highlighted the issue on lack of responsibility and ownership
- flood defence as a driver for floodplain management was highlighted

Pilot diffusion

Despite the pilot not being implemented and thus not monitored and analyzed, at least three forms of diffusion have been identified. Most tangible is the transformation of another project into a CFR project. Next, efforts were put in WaalWeelde and CFR was acknowledged as a policy option, but diffusion at the longer term is still very uncertain. Reasons include that the river manager still has some reservations and also doubts exist about the added value for ecology, particularly if implemented at strictly confined spatial and temporal scales. Third form of diffusion is the inclusion in educational programs. Diffusion took primarily place through internal channels. Diffusion worked because of comparable institutional settings (the new CFR project) or when it was entirely in the hands of the initiator (education). For the longer term, the transfer to more external actors is necessary, particularly from the viewpoint of the university and Ark, in order for the concept to survive independently.

In conclusion, this stage highlights that:

- evidence from the pilot was not conditional for diffusion
- the process design contributed to the internal diffusion
- diffusion depended on internal actors
- early withdrawal of the initiator reduces chance of transfer of ownership
- institutionalization is not only a form of diffusion, but also contributes to further diffusion

4.6.2 Factors of influence

In this last section factors that have influenced the pilot project are discussed. In Table 4.5 an overview of the three main categories of factors is given. The section finishes with a short discussion on possible management actions to influence the pilot.

Table 4.5: Overview of influential factors

Factors enabling the pilot project	- Practical problem without existing solution as a driver - Status
Factors steering the pilot project	- Open character of the design process - Emergence of new knowledge - Scale perceptions - Reduction of complexity - Pragmatism
Factors influencing diffusion of the pilot project	- Lack of ownership and responsibility - Non-matching concept and existing institutions - Open character process - Dependency on internal actors/ initiator

Factors enabling the pilot project

The pilot project could be initiated because there was a practical problem that had to be resolved while no existing approach existed yet and the idea was and so the river manager was prepared to support the project with time and knowledge. That the pilot thereby profited from its status becomes clear in the limited willingness of future users to take the lead. However, since it is a pilot, all actors were prepared to participate and invest resources such as time and knowledge. This was conditional for the design and later adoption of the concept.

Factors steering the pilot

The open character of the process, whereby users, developers and quality controllers jointly developed the design of the pilot influenced which criteria were used. The combination of expertises enabled understanding of the concept and its design trade-offs and so the development of the handbook. Moreover, the cooperation was conditional for developing an approved proposal. Without the inclusion of all actors not sufficient knowledge would have been available. In the piloting process, new knowledge became available, for instance on the calculation of hydraulic roughness or permitting processes. This has led to the reformulation of the policy targets to be met and so to adjustments in the design. Additionally, it contributed to delays in the process, which again meant that the pilot could not be implemented in the initial framework. The search for new money meant that new criteria could be added, namely in the planning when the sand could be used by RWS.

The scale preferences highly influenced the design of the pilot. Particularly the preference to focus on floodplain level, which derived from arguments on fairness and efficiency, reduced the innovativeness of the pilot. Instead of focussing at large spatial and temporal scales, a local intervention was chosen from the start. Other options were not explored and the representativeness of the pilot project for full CFR was reduced. Related is the preference for a low level of complexity. The presence of an organisation like Ark contributes to this since they represent the majority of landowners. Negotiations with individual actors would have been more difficult to achieve a floodplain wide intervention. The pragmatism in the need to resolve the flood defence problem and in the scale choices influence both the direction and continuation of the pilot project.

Factors influencing the diffusion of the pilot
Ownership of a conceptual innovation is conditional for its diffusion, particularly if it is not yet institutionalized. The break after the initial pilot period whereby the discussion arose on who was responsible clearly showed this. Pragmatism enabled continuation of the pilot, not the full belief in the concept. The development of ownership needs time, which was not sufficient so far. Additionally, when institutional structures support the concept the adoption is made more easily. Current institutions appeared to be unable to deal with the nature-safety dilemma as one issue. Finances had to be split, responsibilities were unclear and the existing permit system is not designed for dynamic situations. Accordingly, despite the IWM paradigm, barriers exist within the institutional system to support IWM and adopt a related approach such as CFR. Another form of ownership in case of floodplain management is the landownership. Landowners are powerful in deciding whether they want to cooperate. Since landownership is often scattered, the development of joint plans is more difficult.

The open process as discussed above, not only influenced the design of the intervention, but also contributed to a joint experience that served as the basis for the diffusion to the Millingerwaard. Related is the importance of internal channels for diffusion. All diffusion took place whereby internal channels were the driving force. Early withdrawal for various reasons (e.g. change in jobs) when the concept still needs their support, leads to smaller chance of diffusion.

Some recommendations for pilot initiators

1. Inclusive project proposal. In the project proposal, monitoring and analysis were lacking. This also received little attention during the piloting period. Only after this period means were looked for. This creates uncertainty for this aspect. In the project proposal some diffusion strategies were included (e.g. the organization of workshops), but a longer-term strategy has not been included. However, the study shows that short-term diffusion is not sufficient and that early withdrawal does not contribute to diffusion. **Action:** If the goal is to develop knowledge and diffuse the concept, an inclusive project proposal should be made. This means that knowledge creation and long-term diffusion strategies in the project planning so that these actions and necessary resources are secured. Additionally, indicate who is responsible for these actions.

2. Joint design from the start. The pilot was particularly strong in the design of the pilot. Initiators had a facilitative role, which they could because they were no stakeholders. Moreover, designs were not made on beforehand. Both users and developers contributed and so shared experience was build. The case shows the influence and therefore the importance of early actions and the eye for future users.

The presence of links between operational and strategic levels contributed to a broad spread and to keep the process going. **Action**: Create an open process from the start with developers and users at both strategic and operational levels.

3. Series of pilot projects. The pilot showed that due to the pragmatic aspects and the dependency on the river manager, the innovativeness of the pilot has been reduced. This contributes to the recognition of the concept by users, because it better fits their institutional structures. However, it might also hinder more radical innovation of the institutional system since the pilot does not address the more fundamental question and so the debate on what is desirable in this respect is not held. **Action:** To meet both the pragmatic pilot goals and to open more fundamental debates (e.g. who could take up the task of integrated floodplain management), a stepwise approach could be applied. This means that the pilot would be part of a series in which innovativeness is gradually increased and actors and institutions can adjust if desired.

4. **Attain land ownership.** For the purpose of CFR a river reach level of influence would be beneficial. To accommodate this, different options should be explored, including the buying or managing the land under one organisation. The rule that free-coming land may not be bought should be re-discussed to enable anticipation. Additionally, in early stages of the pilot, diverse options should be explored. Early exclusion by confining scales to avoid managerial complexity reduces chances for CFR.

5.

Ecological Floods in Polder Altenheim

The pilot project on Ecological Floods that was conducted in Polder Altenheim in the Upper Rhine between 1989 and 1996 is used as the second case study. Like the CFR pilot, the pilot project on ecological floods in Polder Altenheim deals with combining nature and safety in river management. In contrast to the CFR pilot, this pilot project is fully implemented and is included in national policy plans. The framework presented in chapter 3, including the characteristics, use, context and effects of pilot projects, is applied to analyse the pilot project. This provides a second example of the nature and functioning of a pilot project in floodplain management, allowing the development of additional and complementary insights. The chapter closes with a discussion on the piloting process and some preliminary insights regarding the factors directing the process.

5.1 General pilot project description

5.1.1 The pilot area and the problem at hand

Polder Altenheim is a 520 hectares floodplain of the river Rhine, located in the Upper Rhine section in Baden-Württemberg in Germany. This is immediately south of Strasbourg between the 278.3 km and the 284.0 km of the Rhine (Figure 5.1). Polder Altenheim is used primarily for recreation, forestry and agriculture. At the time of the initiation of the project, Polder Altenheim no longer acted as a temporary river during floods owing to the modification works executed in this section of the Rhine. In the 19th century the meandering and braided river was reduced to a relatively straight river with one main channel. Dikes decreased the number and extent of floods and made the area safer for habitation and more attractive for agriculture and forestry. Groynes ensured that the river could be used for transportation up to Basle all year round. In the 20th century major changes were induced by the Treaty of Versailles, in which France was conferred the right to divert water from the Upper Rhine to produce energy (GwD SO/HR 1997). The Grand Canal d'Alsace and 10 barrages were constructed for this purpose, disconnecting floodplains from the river. For Polder Altenheim specifically, the construction of the

Kehl/Strasbourg dam in late 1960's for hydropower purposes led to its disconnection from the main channel.

As a result of these interventions, the hydro-morphological dynamics in the Upper Rhine have been reduced greatly, both within the main channel and in the floodplains. Besides to the increased prosperity induced by the interventions, there were also negative effects. Natural floodplain habitats and floodplain-specific species were lost. Forestry activities exacerbated the problem of the settlement of exotic species as economically valuable, but non-native, tree species were planted (Armbruster *et al.* 2006). The shortening and straightening of the river and the loss of floodplains, enhanced rather than attenuated the flood wave of the Rhine River, increasing the risk of flooding.

Figure 5.1: Map of the Rhine basin and the different sections, including the Upper Rhine (Oberrhein). Polder Altenheim is located just south of Strasbourg (Source: Ullrich, Threedots available on http://www.rheinangeln.de/html/der_rhein.html)

In reaction to the increased flood risk, France and Germany agreed in 1982 to restore safety levels to the level before the installation of the barrages, which was an annual chance of the occurrence of floods exceeding 1/200. A combination of several measures was conceived to achieve this. Initially, the idea was to create a large retention area with a capacity of 50 million m^3 south of Breisach. Retention areas can be used to reduce flood peaks by diverting water from the main channel at the appropriate time using constructed inlets and outlets. Such a retention area could be developed by building a dam or by lowering the floodplain. However, both options were not satisfactory. Only half of the necessary capacity would be achieved even if negative effects such as seepage should be prevented. Accordingly, the river authorities developed a plan that involved a number of smaller retention areas. One of these areas is Polder Altenheim. Polder is the name used for former floodplains, disconnected from the river by dikes, but which can potentially still store water during floods. To allow retention of water during floods, the area had been split in two by a dam, and inlet and outlet structures had been installed (Figure 5.2).

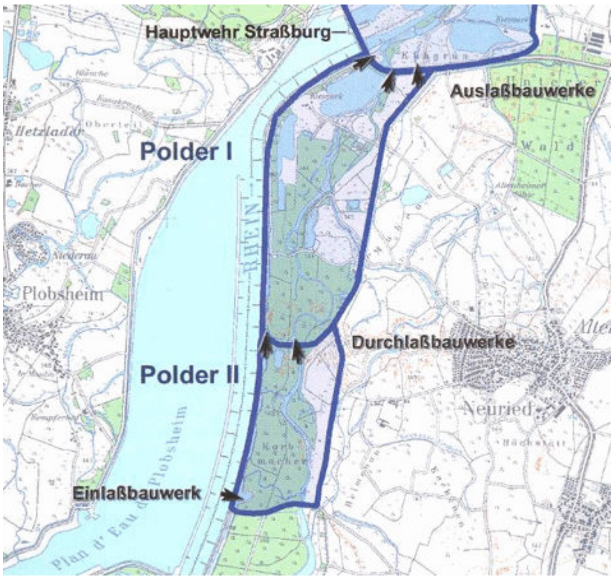


Figure 5.2: Polder Altenheim has been split into Polder I and II to control the floods. The main structures include an inlet, outlet and a passage (GwD SO/HR 2000).

5.1.2 The pilot: The Ecological Floods concept and the pilot design

The first use of Polder Altenheim as a retention area in 1987 provided two major lessons. First, the water level that had to be retained in the polder was much higher than it would ever have been under natural flooding conditions. Second, the species present in the area were not typical wetland species and were therefore vulnerable to floods. As a result of the flood many trees died and wildlife perished. Societal pressure (e.g. newspaper headings with 'government kills wildlife' [Bild 18-3-'87]) the political focus on natural values, and the legislative requirements regarding the ecosystem forced the river authorities to change their plans. They decided that engineering and ecology had to be integrated and started developing the Integrated Rhine Program (IRP). Besides an increase in the number of retention areas, the IRP proposed that 'Ecological Floods' (*Oekologische Flutungen*) would be applied in these areas (GwD SO/HR 1997). The concept of Ecological Floods had been developed by the World Wildlife Foundation (WWF), prior to its inclusion in the IRP.

Ecological Floods (EF) are floods designed to imitate natural inundations in floodplain areas where the natural hydrodynamics have been restrained. The idea underlying EF is that by restoring floodplain-typical abiotic characteristics and dynamics, semi-natural conditions in floodplains will return allowing typical floodplain habitats to develop and floodplain species to re-establish (GwD SO/HR 2000, Landesanstalt für

Umweltschutz 1999). These vegetation species tolerate inundation and do not die back when flooded for a short period of time. Furthermore, wildlife present in the area will also habituate to floods. The use of small volumes allows them to learn which areas remain dry which routes to take to safety (Siepe 1994).

Polder Altenheim functioned as a pilot project for EF, prior to installation of the other retention areas within the IRP. To achieve a near-natural state, the flood regime in the area had to be synchronized with the discharge regime in the river Rhine. A lower limit was set by the demands of hydropower generation of EdF (Électricité de France). The upper limit derives from the time needed to drain the polder so that it can be used for retention of very high discharges from the Rhine i.e. as an emergency retention polder should this be necessary. The inlet and outlet structures used for retention were also used for EF. The ecological flooding regime that was developed for Polder Altenheim (Table 5.1) ranges between the upper and lower limits (2800 m^3/s and 1550 m^3/s respectively) and exhibits interim steps from minor, small to large flood, depending on the discharge in the Rhine River. At the time of the monitoring, 48% of the floodplain was covered by forest, 20% by water and 15% is under agriculture. This means that when a large ecological flood occurred (step 3 in Table 5.1), some 80% percent of the forest was covered and about 45% of the total polder area was inundated (Landesanstalt für Umweltschutz 1999).

The duration and frequency of the ecological floods varied greatly over the years. Fifty-one ecological floods occurred in the period from April 1989 until December 1996. Thirty-one of these EF’s were minor (step 1), twelve were small (step 2) and nine were large (step 3) (Table 5.1). The research and monitoring period lasted from 1993 to 1996. In this period, 31 ecological floods took place. Seventeen of these (55%) were minor floods (step 1), eight (26%) were small floods (step 2) and six (19%) were large floods (step 3). The number of days when flooding occurred varied between 6.0 and 83.5 in the monitoring period. Two floods were of particular intensity: in 1995 a large flood (step 3) of 38.5 days occurred, and in December 1996, a 5-day flood with a discharge of 80 m^3/s took place as an extra test. This exceeds the stipulated maximum of 60 m^3/s for a step 3 flood (Landesanstalt für Umweltschutz 1999). In accord with the decision to link the ecological floods to the discharge of the Rhine, the ecological floods occurred primarily in winter (December, January) and from May to July. If the lower limit at which an EF could occur were reduced to 1000 m^3/s, the number of days of flooding would increase to a maximum of about 100 flooding days per year (GwD SO/HR 2000).

Table 5.1: Flooding regime in Altenheim (GwD SO/HR 2000, Armbruster *et al.* 2006)

Q Rhine (m^3/s)	Q polder (m^3/s)	Step	Process in polder
0 < Q < 1550	0		-
1550 < Q < 1900	5-25	1	Water runs through existing and former channel present in floodplain
1900 < Q < 2200	29-45	2	Small inundations, 10%-30% coverage of forest
2300 < Q < 2500	44-60	3	Large inundations, 30%-80% coverage of forest
2800 < Q < 3800	20		Water runs out of polder to provide maximum volume for retention, but deep water bodies remain filled
Q > 3800	< 150		Retention; whole area flooded

In 1996, Baden-Württemberg approved the IRP. At the time of this research, two out of the thirteen appointed areas have been configured as a retention polder with ecological flooding. Configuration of the other areas has been delayed due to resistance from inhabitants and local politicians.

5.1.3 Meeting the actors in Polder Altenheim

Multiple actors have been involved, both directly and indirectly, in the EF pilot project in Polder Altenheim. The intensity of their involvement, their means and the duration of their influence all differ. The main characteristics of the different actors and their roles in the pilot project are presented in this section.

The *regierungspraesidien of the Land Baden-Württemberg* make the project designs for the IRP and implement policy objectives. Polder Altenheim falls within the area of regierungspraesidium Freiburg. The *Ministry of Environment* of Baden-Wuerttemberg coordinates and finances water management strategies, including the IRP. The ministry considers EF as the only method available to prevent ecological damage caused by retention. In their eyes Altenheim demonstrated that EF works. The *IRP agency (Oberrheinagentur)* is a special agency founded in 1995 by the Ministry and Regierungspraesidium to further develop the IRP. Different disciplinary specialists, including ecologists, engineers, chemists and lawyers, cooperate within the agency. Following the obligatory environmental impact assessments, the *Landkreis* provides the necessary permits. During the piloting period, these were not required. The *LUBW* is a governmental organization that supports the ministry and regierungspraesidien with applied research and advice. The *LUBW* considers EF as an improvement to, and a condition for, the IRP and would even go beyond the current EF design (e.g. increase the frequency of floods, reconnect floodplains with the river), if this were plausible in the short or medium term. Existing infrastructures and demands (e.g. of hydropower generation by EdF) do not allow this.

In addition to the actors developing the IRP and EF, actors could be distinguished that were affected by, and participated in, the pilot project. The *municipality of Neuried* (of which Altenheim is part) considers EF to be beneficial. EF provided a 'green image', and quality of recreational activities (e.g. fishing) improved. Additionally, they have been compensated for damages and losses. After the first use of Altenheim for retention, c*itizens* and the *media* were vociferous in demanding adaptation of the plans, bringing media attention and public pressure to bear. EF could then be implemented relatively easily in this polder. A survey showed that citizens of Altenheim are quite satisfied with EF (Stoll 2006). In their eyes, the recreational quality has increased and the anticipated negative effects could be prevented or compensated. Concerns existed about potential damage to houses through seepage, and about mosquito plagues. In polders in which EF was initiated much later and is currently being implemented, citizen opposition against EF is much stronger. A '*Burgerinitiative'* has been founded and court cases have been initiated. Citizens agree that flood protection needs to be improved, but they do not agree with the ecological flooding method. They expressed that from their point of view, EF causes negative societal and ecological impacts in their area of interest, which exhibits characteristics different from Altenheim. The EdF (*Électricité de France*) sets the minimum discharges necessary for hydropower generation. Only discharges above this threshold are available for EF. These demands for a minimum flow serve as pre-conditions for EF measures.

Lastly, EF affects both public and private landowners. Introduction of the EF concept has a major impact on the *Forestry Department*. The area was actively used as a production forest. The Forestry Department actively contributed in the pilot project to the ecological development of the area by replacing some of the commercially valuable, exotic trees with native flood-resistant species. As such, the Forestry Department was able to address its ecological goals to some extent. However, they also suffered a diminished income owing to less valuable harvests and additional losses owing to damage to trees. *Farmers* can be affected negatively by EF, due to flooding of their land and or seepage damaging their crops. Nevertheless, they were perceived to be cooperative. Damage cannot be prevented, but they are compensated for losses. The number of farmers in the inundated area in Polder Altenheim is limited as it is primarily covered by forest.

5.2 Characteristics of the pilot project

In this section the character of the EF pilot project in Polder Altenheim is determined. The pilot project is described in terms of the six characteristics that were identified in the primary analysis (chapter 2). These include the 'relation of the pilot to policy and local context', 'the scale', 'innovation', 'knowledge orientation', 'special status' and the 'actor-network'.

Relation to policy and local context

The pilot project is clearly embedded within a policy program that is under development: the IRP. Flood defence goals were defined for the entire state and ecological flooding provided the only means of undertaking retention within the requirements of existing environmental legislation. Existing legislation prohibits ecological damage due to flooding. Additionally, the idea of increasing the number of polders and of implementing EF in all of the polders was in existence when the pilot project was initiated. The pilot project contributes significantly to the achievement of policy goals (Polder Altenheim provides circa 10% of the planned retention volume) and therefore lies at the core of policy-making. The pilot project acted to test the concept of ecological flooding in practice, as required by the IRP, so the local contextual dependency is high. Different interactions between the pilot and its context occur. These include interactions between the ecological floods and existing land use in the Polder, between the quality and quantity of the inflow (Rhine water) and the ecological quality in the Polder, and between different stakeholders. The pilot is conducted as a single pilot project.

Scale

Whether, and how, the pilot project was confined in terms of space, time and problem scope is subject to interpretation at any one time. One can argue that the pilot was confined in all dimensions or in none. In operational river management floodplains are commonly used as management units and Polder Altenheim is not significantly different in size from the other twelve polders defined in the IRP. From this perspective, the pilot is not confined in the spatial dimension. However, from an ecological restoration, river basin management, or IRP point of view, implementation of the ecological flood concept on a single floodplain means that the spatial scale has been confined. Altenheim represents 'only' 10% of the total retention volume envisaged in the IRP. In terms of temporal scale, no clear end-point has been defined for the pilot project and no deliberate decision has been made to continue with EF in Polder Altenheim as a routine management strategy. Nevertheless, the monitoring period was clearly defined (from 1993 to 1996) and this can be viewed as the piloting period. The pilot project seems not to have been confined in terms of problem scope at the time. All relevant disciplines and issues of interest were included. However, societal developments occurred during and after the pilot project. In retrospect the pilot can be viewed as having been confined in scope as some societal complexities were initially not recognized nor acknowledged (e.g. the risk of damage to housing by seepage). In conclusion, given that the purpose of the pilot project derives from the IRP, I consider the scale of the pilot to be confined in all dimensions relative to the IRP.

The second aspect of scale, the reversibility, applies to the pilot Polder Altenheim in the sense that the flooding scheme can easily be adapted and even curtailed. The biophysical environment need time to recover, but can in principle return to the reference state. The pilot is not reversible in policy terms. The previous policy (inundation of dry floodplains) has no legal basis and was not favoured politically. The installation of the engineering works (inlet- and outlet structures) necessary for retention is non-reversible in the short to medium term as these are long-term investments.

Innovation
The innovation EF is of a conceptual nature, but is highly dependent on technological structures. The pilot can be considered demand-driven, because it was developed to contribute directly to the attainment of policy objectives and was requested by river managers. The level of innovation was moderate to high at the time of piloting. The concept EF was initially developed by the WWF, but had not yet been applied in practice, making the pilot innovative for all of the involved actors. Although the basic assumptions had been developed and were accredited in the scientific literature (e.g. Amoros *et al.* 1987), the biophysical and social responses to different flooding regimes within a specific area were completely unknown. The degree of innovation in testing was constrained by the upper and lower limits imposed on the possible inundation regimes. The innovation required in the design and installation of the supporting technical structures was limited as these were already relatively well understood by engineers.

Knowledge Orientation
The stance towards knowledge development exercised within the pilot is of an expert-driven nature, meaning that ideas are developed by experts and that 'expert-knowledge' is developed. This stance is also reflected in the actor participation and governance style. In later stages of the IRP, the stance moved more towards open, communicative. The importance given to knowledge development is high, as demonstrated by the intensity of the monitoring program that ran from 1993 to 1996. Results were documented and the transferability of lessons was reflected upon (e.g. Landesanstalt fur Umweltschutz 1999, GwD SO/HR 2000, Armbruster *et al.* 2006). Prior to this, in the period 1989 to 1993, no consensus existed between ecologists and engineers on the usability of EF and no monitoring program was installed. During the monitoring period, the area was flooded 31 times. Six large floods occurred (step 3, 60 m^3/s), and one very large flood (80m^3/s). The biophysical responses to the flooding regime, developed by trial and error, were monitored. Ecological, hydrological, forestry, water and soil quality insights were developed. The knowledge orientation lay primarily on developing substantive, hard knowledge, both contextual and generic, on the interactions between rivers and floodplains. Later, more attention was paid to external effects such as mosquito plagues, seepage, strategies to deal with these effects and the development of compensation schemes. The installation of the IRP agency, together with interdisciplinary cooperation, contributed to the development of soft knowledge, but soft knowledge was not subjected to monitoring nor made explicit. The pilot project aimed for single loop learning (about the EF concept), and implicitly also for double loop learning and gaining experience (about values and problem perceptions) particularly through the installed interdisciplinary team.

Special Status
The special status of the pilot is regarded as moderate in terms of the expressed attitudes, additional flexibility and increased resource allocation. Initially, EF gained much political support, but engineers and foresters were sceptical. The EF application in Polder Altenheim was enabled despite this scepticism, because it was a pilot

project. The pilot project enabled and encouraged creativity in the design and in the implementation process, because a new approach was allowed. A tailor-made design could be developed that included flooding schemes, farmer- and forest relocation and compensation schemes. Flexibility in design was moderate due to limitations put in place by technology, agreements on hydropower needs and local conditions for the timing of the ecological floods. The hunters were against EF in spring, because it would affect the growth of young animals. The farmers were against EF in summer, because it interfered with their harvest and harvesting activities. The foresters were against EF in autumn and winter because they harvest then. One could say that flexibility was bought by compensation for foresters and farmers. Flexibility in the process was moderate because of the pre-planned inclusion of EF in the IRP. Lastly, the allowance for failure was also limited. Tolerance towards failure existed in the sense that there was room for testing flooding schemes, but failure of the concept of EF as strategy in the IRP was not tolerated by the developers. They believed in their concept and EF was considered the only available means to enable IRP implementation. Consequently, potential threats to the success of the EF concept were not acknowledged initially and not recognized until solutions were found. The relatively easy access to resources, including commitment, financial resources and later the installation of the IRP agency, despite the initial objections of engineers, are indicative of the moderate special status.

Actor Network

The pilot was initiated by the regierungspraesidium. They are responsible for river management in Baden-Württemberg and found the concept promising for the IRP. Yet, diverse actors still had to be convinced and questions had to be answered. Initially, the pilot was the focus of an engineering-ecology debate. As the project progressed, an increasing number of scientific disciplines became involved. Potentially affected actors including farmers and the mayor of Neuried (the municipality to which the Polder belongs) became involved, although in a less active way (e.g. for developing compensation schemes, image building). Developers as current and future users of the concept were also involved. The governance styles exercised are considered mixed. The governance style towards other relevant government agencies (i.e. forestry department) can be characterized as cooperative. The knowledge and cooperation of these agencies was considered essential for the management of the forest and for the design of the new forest. A consultative or even authoritative style was exercised towards affected stakeholders (e.g. municipality, farmers). The boundaries within which room existed for discussion were set by the river authorities. Strategies for building actor support included the relocation of farms and changes in flooding intensity. When this was not possible, compensation schemes were developed. Finally, an authoritative informative governance style was exercised towards citizens, recreants and mining companies. These actors were informed of the plans, potential risks, adjustments in behaviour needed and were provided with guidelines (e.g. conditions for gravel mining, forbidding hunting).

In conclusion, the pilot project Polder Altenheim derives from policy-making, involves a conceptual innovation and has a strong focus on knowledge development. The knowledge developed is limited to substantive and hard knowledge. Due to the importance for the IRP and the trust of policy-makers in the concept and the multi-disciplinary approach, the flexibility for diffusion is somewhat limited. An overview of the characteristics of the pilot project is provided in Table 5.2.

Table 5.2: Characteristics of the pilot project Polder Altenheim

Project Characteristics		**Polder Altenheim**
Relation to policy and local context	*Connection to policy*	At policy core Part of IRP (10% retention volume)
	Local contextual dependency	High
	Incidence of occurrence	Single
Scale	*Limitedness (space, time, problem scope)*	Confined in time (1993-1996), space (single floodplain) and problem scope (unforeseen issues not included)
	Reversibility	Reversible in concept, not in technology and policy
Innovation	*Type of innovation*	Conceptual
	Driver of innovation	Demand-driven
	Level of innovation	Moderate to High (functioning and effects unknown, but limited by socio-economic constraints)
Knowledge orientation	*Knowledge model*	Expert-driven
	Monitoring intensity and type	High intensity (1993-1996) Systemic monitoring on ecological impacts
	Type of knowledge	Substantive, Hard Knowledge Soft and Process knowledge in IRP agentur, but is not formally included
	Type of learning	Single-loop
Special status	*Attitude*	Allowance for creativity, moderate for conceptual failure (risks hidden)
	Flexibility	Moderate in design (EdF) and process (IRP)
	Resource allocation	Relatively easy: monitoring, political commitment
Actor Network	*Initiator*	Government agency (regierungspraesidien): Designer, current and future user together
	Participants	Multi-disciplinary
	Governance Style	Mixed: consultative, cooperative and authoritative

5.3 Use of the pilot project

A single pilot project can be used for multiple purposes at the same time. Every actor has their own reasons for participating (Raven 2006) and these reasons can change over time. Moreover, every actor has a different perspective upon the use of the pilot project. Perspectives are shaped by the roles of actors in the process and their backgrounds. Given the actor- and time-dependency of perspectives, a shared view of the use of the pilot Polder Altenheim does not exist. The purpose of this analysis is not to map each individuals view, but to give a general sense of the use of the pilot and particularly its development over time. A policy analyst's perspective is exercised to allow the development of a fairly comprehensive view on the use of the pilot project. As a policy analyst, one attempts to include perspectives from all actors (Walker, 2000). Two snapshots are generated of the pilot use: one at the initiation of the pilot in 1993 and one in 2007, when the process of full scale IRP implementation takes place. The perspectives on the use of pilot project Polder Altenheim are visualized in the Pilot Nonagons of Figure 5.3. In the Nonagons, the extent to which a particular use is present in a pilot project is indicated.

At t=0 (installation of the pilot project), the pilot project was used both to make an early evaluation of the policy program IRP and to implement the IRP. The focus lay on how EF, and which form in particular, could be useful for the implementation of the IRP. The EF concept was considered relatively well developed, just not yet practiced. Based on the evidence deriving from the pilot, policies would be developed further before being rolled-out. The use of the pilot project for policy implementation is affirmed by the fact that Polder Altenheim represents 10% of the total retention volume to be achieved within the IRP. In addition to the two main uses of evaluation and policy implementation, the pilot was also used as a response to the negative reactions on the initial retention use. This purpose can be classified as a political game (to improve public relations). Additionally, the pilot was used to encourage communication between engineers and ecologists and to resolve the problem that the polder could not be used for retention as long as environmental requirements were not met. The pilot was used slightly to explore the concept itself, independent of the policy, and for advocacy purposes. In the beginning stages, the advocacy was primarily internally focussed towards engineers and not to the broader audience. External actors were simply confronted with the implementation. The use as insurance was limited and it was not used as an incentive.

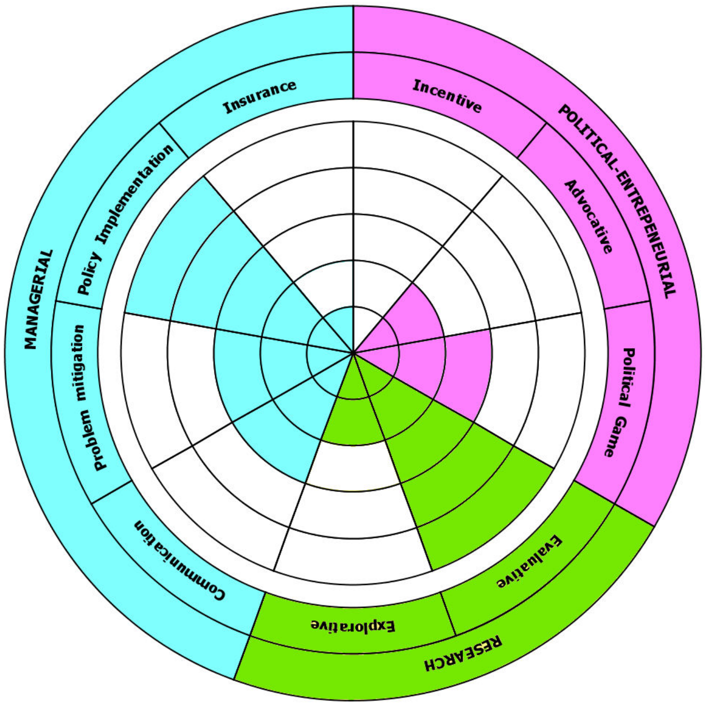


Figure 5.3a: Pilot Nonagon for Polder Altenheim at t=0 (initiation of the pilot project)

At t=1, which is when attempts were made to implement the IRP fully, pilot project Polder Altenheim moved from being a pilot project to routine management. Nevertheless, the pilot project still had a clear role in the water policy process of Baden-Württemberg. The project is still used for policy implementation, but is now also used explicitly for advocative and communicative purposes. In the meantime, EF was approved as the strategy to be followed within the IRP. Attempts were made to implement EF in the other twelve areas. However, this went less smoothly than civil servants had hoped. Large societal resistance developed. Pilot project Polder Altenheim was used as evidence in convincing these actors of the concept of EF. Additionally, the project is used to open up communication between different disciplines. For this purposes, the interdisciplinary team 'IRP Agentur' was founded. Government advisors also recommend using the project to open communication with societal stakeholders. The use of the pilot as a means of solving the retention problem remains relatively constant over time. Its use as a policy game shifts. First, the pilot was used for public relations management. In 2007 the pilot is used to keep EF on the political agenda and to support the Minister of Environment who needs to defend the policy. Another major shift is in the reduced attention for knowledge development. The goal of knowledge development is considered to have been achieved. Evaluative and explorative uses therefore lose their value. So, overall the pilot uses reduce over time and those that remain become more explicit. The pilot project moved from a predominantly research/ managerial pilot to a political-entrepreneurial/managerial pilot.

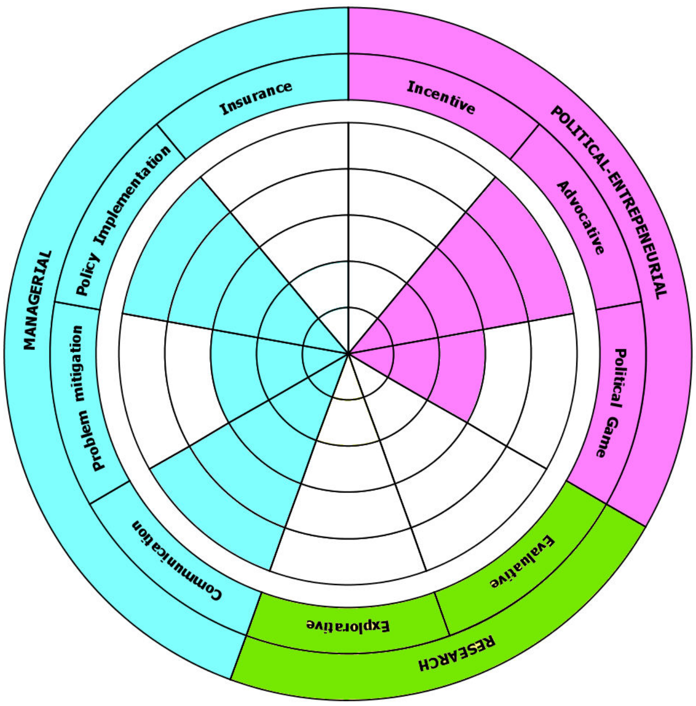


Figure 5.3b: Pilot Nonagon for Polder Altenheim at t=1 (implementation of the IRP)

5.4 Context of the pilot project

Polder Altenheim has a long history within river policy and management even before the EF pilot project was initiated. Disconnection from the main river channel, changes in land use, reduced flood defence levels, failed flood protection restoration efforts, political (both national and from EU) and societal pressure for ecological restoration preceded and led to the development of the EF pilot. In this section, the contextual elements influencing the pilot are discussed further.

Biophysical context

Polder Altenheim is an uninhabited former floodplain. At the time of pilot initiation the polder was mainly used for forestry, agriculture and recreation. In the direct proximity are the towns of Neuried and Altenheim. Further downstream are the larger cities of Mannheim and Karlsruhe. The Rhine has been engineered in this section to serve navigation and hydropower. This caused the floodplains to be disconnected from the main stream. To restore flood protection levels, retention areas were indicated in the IRP. The targeted retention volume of the IRP is 167 million m^3. The contribution of Altenheim with 17.6 million m^3 is therefore significant (GwD SO/HR 2001). In implementing EF, the supportive structures needed for using the area as a retention space can also be used. From a technical point of view there is no difference between the two types of intervention, although the structures would be used more often for EF. The configuration of the structures means that the discharges can only be raised in a stepwise fashion. EF is applied when discharges are between 1550 m^3/s and 2800 m^3/s. If the Rhine discharge exceeds 2800 m^3/s, the polder needs to be emptied to allow for emergency retention. When discharges exceed 4000 m^3/s, the polder is used for retention. About 20% of the polder area is covered by existing water bodies. These are first filled further when applying EF. Under higher discharges, forested areas are flooded. Forests cover about 45% of the area of the polder. When the pilot was initiated, the quality of the soil and water was disputable, because of remaining effects from the period when the Rhine water was of low quality. The effects of EF on the water and soil quality are highly dependent on the quality of the Rhine water, which is influenced by upstream pesticide use and wastewater outlets.

Institutional context

Polder Altenheim is part of the Hochrhein section for which the IRP was developed. The main policy program related to polder Altenheim is the IRP, developed by the Ministry of Environment of Baden-Württemberg. The central aim of the IRP is to restore flood protection to the levels prior to the construction of barrages. Accordingly, flood protection was combined with the maximum possible preservation and restoration of alluvial landscapes of the Upper Rhine (GwD SO/HR 1997, Oberrheinagentur 1995, Oberrheinagentur 1996). The two main measures in the IRP consist of the construction of polders and dike relocations. These were complemented with the construction of weirs and the 'emergency operation of power stations' (i.e. reducing the flow through power station canals by diverting the flood through the old Rhine bed). The construction of polders, like polder Altenheim, meant that former floodplains could be used as retention areas during floods. In contrast to polder construction, dike relocation meant that the riverbed was enlarged permanently. Dike relocation was not planned in the upstream part of the Upper Rhine, because the presence of dams limited the efficacy of dike relocation for both flood defence and ecology.

In the IRP practically all uninhabited have been indicated for retention, 13 in total. The places most vulnerable to flooding are the cities of Karlsruhe and Mannheim. Use of the polders would contribute particularly to their protection. Actors of importance for Polder Altenheim include the municipality of Neuried, the forestry department, inhabitants and of course the Ministry of Environment. The substantive knowledge and project management function lies with the interdisciplinary team 'IRP Agentur', founded for the IRP. The ministry is a clear proponent of EF. They regard EF as a promising instrument to fulfil environmental protection legislation and flood defence planning. Other actors are willing to cooperate, although they have doubts deriving from economic or social arguments (e.g. reduction in the commercial value of the forest, damage due to seepage). Approval and inclusion of EF in the IRP means that the twelve other indicated polders will have to deal with EF as well. Local actors such as municipalities, mayors and citizens differ per polder.

Since the River Rhine is of high importance for Western Europe, many bilateral and international agreements and EU directives have been developed. Examples of international agreements initially influencing the pilot include the treaty of Versailles, the 1982 Franco-German treaty, and the Rhine Action Plan (RAP) in which it was decided to improve water quality. As the pilot progressed, the EU Bird and Habitat directive and the EU Water Framework directive further influenced the IRP by supporting ecological revitalisation of the Rhine. Additionally, during the pilot period, conditions for obtaining permits changed. For instance, Environmental Impact Assessments and public participation are obligatory nowadays, whereas at the initiation of the pilot project Polder Altenheim they were not considered necessary. In terms of decision-making, the decision for the IRP and EF could be made relatively autonomously by the government. Limitations for EF derived from international agreements (EdF) and national policies (preparation for retention). Without these restrictions, the area could be flooded at lower discharges (from as low as 900 m3/s) and thus could be flooded more often and for longer periods. Instead of circa 60 days per year, the area could then be flooded 100 days per year. To change these conditions, political international debates are needed, but for the purpose of the IRP these conditions were considered as given.

Socio-Economic Context

The pilot, or rather the policy in which it is embedded, shows a development from ecological ignorance to perceived added value and the inclusion of ecological values in policies. All interviewees agreed that in the 1980's a strong 'green attitude' existed that promoted and enabled integrated water management and the inclusion of ecological goals in policy. These inclusive ideas gained weight when EU directives were put in place. Local actors were also supportive of ecological enhancement. For instance, EF provided the municipality with a 'green image' and the advantages of EF were recognized and stressed (e.g. improved recreational quality). Despite the increasing recognition of the importance of ecology, EF as it is designed in the IRP, is always implemented in addition to the flood defence measure of retention. One interviewee described the approach as 'a package deal'. The main function of EF, and its legal basis, is namely to enable retention rather than ecological restoration per se. Nowadays, climate change insights provide additional argumentation to stress the need for increased flood defence and the role of EF therein (GwD SO/HR 2007).

The limited ecological focus of the river authorities was manifested by their easy acceptance of current infrastructures as given. For instance, an alternative measure to ecological flooding is the relocation of dikes. From an ecological perspective this is interesting, because flooding then occurs concurrently with high discharges and associated high water levels in the river. However, in the southern part this measure is not considered feasible because of the use for hydropower.

An interviewee indicated that the plans are considered to be robust (they exist over 20 years) but the process to implement them has changed. Initially, the flood defence program was strongly engineering dominated and no communication and understanding between different disciplines existed. In combination with little experience with floods, warnings about negative ecological impact were not taken seriously. With the decision to focus on integrated water management, ecologists, and later people with other disciplinary backgrounds, became part of the project teams working on the IRP development. The consequent learning processes enhanced integration. Autocratic decision-making was accepted during the time of IRP development. This allowed for what would now be considered limited communication with other actors regarding the potential negative impacts such as seepage and mosquito plagues. Then, this enabled the continuation of the project. Nowadays, more community involvement is desired, partly in reaction to the increasing community opposition to EF in the new polders. This has led to stagnation of the process with no resolution in sight as yet. For many of the actors in the new areas, EF is considered an add-on to flood defence and not a 'package deal'. Direct flood defence measures are accepted more easily. Moreover, the areas are considered to differ biophysically, supporting the argument that EF cannot just be transferred (interview president Bürgerinitiative Breisach). Mayors and politicians are generally supportive to the citizens and so reject and are susceptive about EF.

Another process value indicated by interviewees relates to disciplinary background. For instance, the LUBW develops knowledge for the government, but feels that research backgrounds seem to be a factor of importance in influencing the authorities' acceptance of recommendations. Indeed, advice on physical issues in which the LUBW is trained is accepted, but advices on social issues are less easily accepted. Additionally, for EF to be implemented, land must be available. If it is publicly owned land this is usually less of an issue then when it is privately owned. In Altenheim, the majority of the land is publicly owned (forestry), although some land is privately owned. Landowners, and particularly small entrepreneurs, can have an emotional connection to their land and hold to their own ideas of how they would like to use it. This is not necessarily in line with what the authorities are planning.

Table 5.3: Context of the pilot project Polder Altenheim

Biophysical context	• Disconnected floodplains of the Upper Rhine • Forests, water bodies, agricultural land • A-typical floodplain species
Institutional context	• Driver is flood protection • Limits from Hydropower needs • Part of IRP (10% volume) • Responsibilities Ministry of Environment • From disciplinary to interdisciplinary approach
Socio-Economic context	• Importance of navigation • Use for forestry, recreation, agriculture • Support for 'greening' policies • Societal pressure for change • Acceptance authoritative government
Broader context	• Franco-German treaties • Change in legislation, EU influence • Change in relation government-citizen

5.5 Effects of the pilot project

The design, implementation and analysis of the pilot project have had their influence on water management in Baden-Württemberg. The contributions of the pilot project can be recognized in the response of the biophysical and actor system, in knowledge development and in the diffusion of the pilot. In this section, the effects of the pilot project on these aspects and thus on water management in Baden-Württemberg are discussed.

5.5.1 Systems' Response

Biophysical response

The application of EF in combination with forest management and the installation of engineering works has altered the structure and functioning of the polder, including land cover, ecological quality and infrastructure (GwD SO/HR 2001). First, typical floodplain species returned. Their numbers increased due to favourable habitat conditions. The species that returned include several fish species, birds like kingfishers and amphibians. Flood prone forests have been replaced by floodplain typical species. Since the natural processes (succession, rejuvenation, settlement of floodplain typical species) were combined with active forestry management (chopping, planting), the replacement process went relatively fast. Second, the wildlife were 'trained' to deal with floods, according to interviewees. The animals learnt the routes to dry places or developed strategies to survive during floods. According to ecologists, unprepared animals, young animals or eggs in ground nests do drown during flooding, but the ecosystem recovers quickly. Many nests are replaced soon after the floods. Third, soil conditions have changed from dry to wet. The re-established fluctuations in groundwater levels influence the settlement of vegetation and soil life. Soil pollution was not detected. Fourth, despite the renewed fluctuations in groundwater levels, fluctuations are not as extreme as they would be under the natural situation because of the presence of the dams. Fifth, enhanced discharges contributed to higher oxygen levels in the surface water of the Polder, but also to the development of steep banks in which for instance kingfishers breed. Sixth, water quality in the polder has improved because sludge from the period before the construction of the dam could be flushed out. Significant pollution has not been identified during the monitoring period. Moreover, the reduction in intensity of agriculture improved water quality conditions further (e.g. less use of fertilizers). Damage to crops as a result of flooding occurs in summer, damage to trees takes place year round. Seventh, slight sedimentation of sludge has been observed. This occurs near the water bodies where discharges are low. Short periods of eutrophication have been observed (GwD SO/HR 2001). Overall, as a consequence of the biophysical changes, the area can now accommodate flood retention and meet legal criteria for ecosystem protection and enhancement. This means higher flood protection levels can be achieved.

In addition to the ecological effects, biophysical effects that directly influence citizens have occurred. These include the increase in mosquito populations, seepage potentially affecting houses and the reduced accessibility of the area. Mosquito populations and seepage were dealt with later in the pilot project through the introduction of additional policies. The use of the polder for retention implies that the polder is not accessible. The expectation is that this occurs for ten days every ten years on average. During minor and small ecological floods (steps 1 and 2) the polder is accessible most of the time. Only existing water bodies are filled to the brim with water. During large ecological floods (step 3), the polder is largely inaccessible.

Actor-Network response

As discussed in the section on context, the pilot project Altenheim is part of a longer water policy history on flood defence. Therefore, an active actor-network was already in place. However, changes could be observed in the nature of actors already in the network and the entrance of new actors during the pilot project.

First, new disciplines were involved in the pilot project and started to cooperate, which they had not done previously. This initially happened within the circle of already participating actors (regierungspraesidium and LUBW) (t=0). By the end of the monitoring period when the IRP was approved (t=1), the multi-disciplinary cooperation was institutionalized in the form of the IRP Agentur. Ecologists, engineers, jurists and chemists jointly developed the IRP. The IRP Agentur as an independent body that was later dismantled.

New actors that entered the network because of the EF pilot were the Forestry Department, NGOs and to a lesser extent local farmers and the municipality of

Neuried. Recreants and citizens were also part of the network but did not have an active role in designing the pilot project. The river authority and its advisory agency (LUBW) were the developers and the current and future users of the concept. The municipality, recreants, citizens and farmers are users of the area and potentially affected actors. Citizens in the nearby towns were satisfied with the results (Stoll 2006), but only after their concerns were dealt with and even then opinions differ. Major motivations to participate in the pilot included the search for a means to implement flood defence measures, the presence of a policy window for ecological restoration, serving public goals, image building and compensation. Within the pilot different governance styles were developed and exercised towards different actors, including cooperative, consultative and authoritative. In all cases the river authority set the boundaries of the playing field. Over time, particularly when implementing the IRP at full scale, governance styles became more consultative and cooperative towards all actors, including citizens. Debates about the preferred style remained strong.

Seemingly, little opposition existed within the pilot after the initial scepticism of engineers. Questions and dilemmas arose, but these were dealt with within the existing actor-network. Examples include i) the economic benefits of forestry versus serving ecology, was dealt with by distinguishing between the flooding frequencies of areas and by matching tree-types, accompanied by compensation schemes for loss of income, ii) risks of mosquitoes and seepage were dealt with by KABS (mosquito control organisation), ground water control by lakes and pumps, and monitoring, iii) the timing of floods, because in every period of the year one or another group felt disadvantaged (e.g. hunters, farmers, foresters), iv) the reduction of risk of flooding by reducing agricultural intensity and the prevention of building in the polder. However, perceptions differ. Some interviewees indicated that mosquito plagues were ignored or hidden initially and not acknowledged. However, this was resolved before it became a big issue. Others indicated that the renewed forestry schemes did not represent the views of all foresters, as officially communicated. In summary, the actor-network as a result of the pilot is depicted in Figure 5.4.

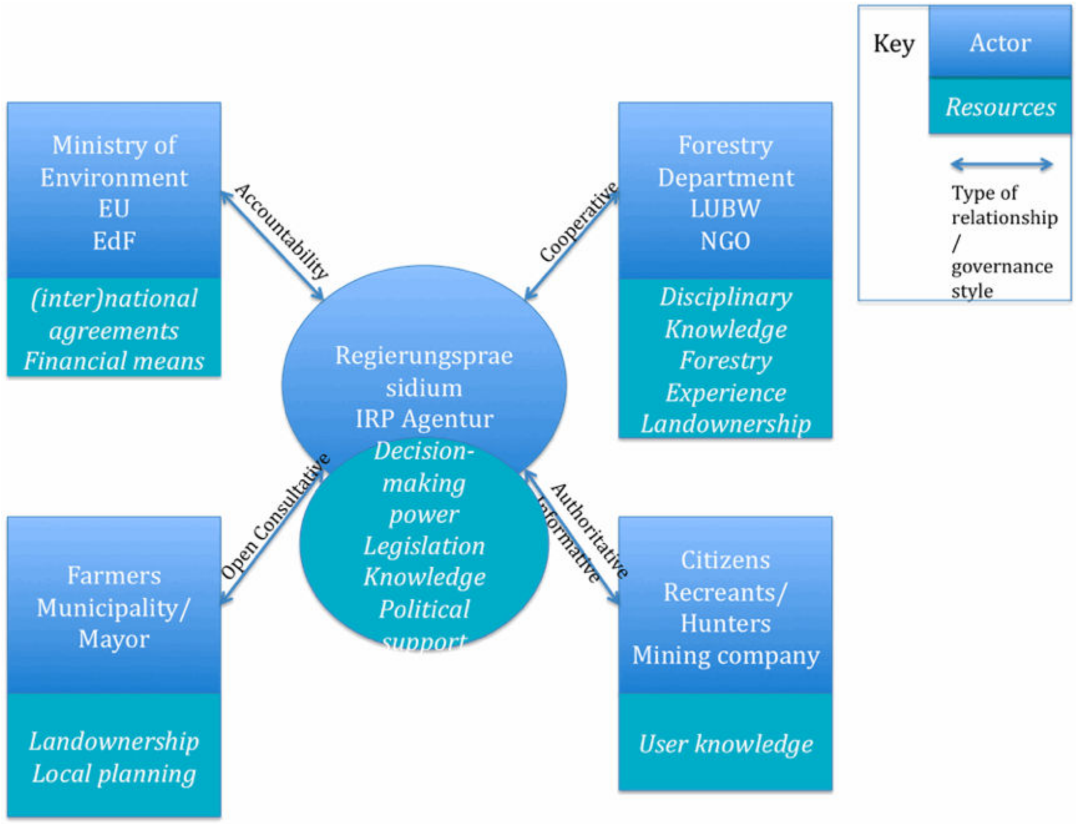


Figure 5.4: Actor-network as a result of the piloting process: Regierungspraesidium and the later new established IRP Agentur are at the core of the network. They hold different types of relationships with the different actors. Major resources of all actors that are used during the pilot are indicated.

5.5.2 Knowledge Development

Knowledge creation

Within the pilot project, systemic monitoring took place during four years, based on which new substantive and hard knowledge could be developed. The Ministry of Environment analysed and reported the knowledge in 'Auswirkungen der Okologischen Flutungen der Polder Altenheim' (GwD SO/HR 1999). Areas of analysis included: household water, surface water conditions, ground water conditions, vegetation, wildlife, soil and general reflections.

Findings on household water, surface and groundwater and soil include insights in the difference between the natural floods and the regulated floods within EF (e.g. intensity/ water level, frequency and duration) and the causes for this (presence of a threshold, technological limitations, limiting EF to 60 m3/s), effects of the flood regime on inundation (step 1: filling existing water bodies (65% of flooding time), step 2: flooding of water bodies (21% of flooding time), step 3: inundation of maximum 45% (14% of flooding time)). The revitalisation of groundwater level dynamics was limited by the Strasbourg dam. EF enabled erosion and sedimentation patterns to return in limited way. A potential risk identified for the long term is the dam stability due to water level fluctuations. Since the Rhine water quality during the pilot period was better than the Altenheim surface- and groundwater quality, with one exception, the water quality in the polder improved. Findings on vegetation include the relation between water velocity and damage to trees. As expected, floodplain typical species (e.g. European oak, poplar, grass) were undamaged and rejuvenation processes could start. Real softwood forests could not develop, because of the limitated flooding frequency. Hardwood forested areas were not inundated and the fluctuations in groundwater level were not sufficient to have a real influence. Insights on fauna include the identification of the relation between habitat conditions, land use (e.g. reduction of agricultural intensity) and settlement and the ability to reproduce. Year-round floods were found to be necessary to prevent nesting in vulnerable areas. The chances of survival of wildlife increased as they developed strategies for escaping, when hiding places were present and when people were not present on the dams to watch the floods. Non-native species survived in the higher areas. The anticipated threats to species survival were found to be invalid. Policies on mosquito control were shown to be effective. Overall, the piloting actors considered the goal of preparing the flora and fauna for floods to have been achieved. However, they also recommend an increase in the intensity and frequency of floods to enhance the effects and reach areas that are currently not flooded.

Process knowledge has not been formally evaluated and reported. Nevertheless, insights in integrated water management and cooperation between different disciplines and interests were developed during the pilot. Process knowledge has been developed on forest management (e.g. replacing, distinguishing between flooded and non-flooded areas), agricultural management (e.g. exchanging land, encouraging reduction in intensity to reduce pollution and to create connections between subareas), the image building of municipalities ('green image') and how to develop compensation schemes. The multidisciplinary cooperation has been formalised by the inclusion of different disciplines in the process. Much of the process knowledge, particularly with respect to governance styles, insights in values and problem perceptions and experience in working together, was of a soft nature. It only became explicit when the diffusion process was initiated and contextual, elements changed because of the change in time and place. The hurdles to diffusion that arose forced actors to reflect on the pilot and its transferability. Consequently, soft knowledge was explicated.

With respect to the contextual dependency of the knowledge, the monitoring primarily concerned the functioning of EF in Polder Altenheim. Contextual knowledge includes the specific responses in Altenheim to the implementation of EF, such as the occurrence of certain species, the water and soil quality and inundation maps. Additionally, the relation between the river authority and local actors is contextual. Within the given area and timeframe informative styles towards a broader audience were considered favourable. In the analysis, the transferability to other IRP areas is also discussed and so a more general level of the knowledge is indicated (GwD SO/HR 1999). This more generic knowledge includes 1) influence of limitations put on EF on ability to imitate intensity, frequency and duration of flooding 2) relation between Rhine water quality and the ground- and water quality of the polder, 3) relation between EF and resettlement of floodplain typical species, 4) relation between presence of floodplain typical species and negative ecological impacts resulting from inundation. At an even more general level, scientific literature acknowledges the importance of hydro-morphodynamics of river systems for ecology and vulnerability (e.g. Siepe 1994, Buijse *et al.* 2002, Van der Grift 2001, Baptist *et al.* 2004, Middleton 2002). However, that the level to which knowledge can be generalized is contested is explicated by the 'bürgerinitiative Breisach'. This citizens' organisation is concerned with EF implementation in Polder Breisach. In their eyes the polders are of a different nature. Whereas Altenheim is naturally a wet area, Polder Breisach is not. Consequently, much less knowledge from Polder Altenheim can be transferred than indicated by the Regierungspraesidium. This implies that the generic nature of the knowledge, or the representativeness of the pilot, is contested. With respect to process knowledge, relationships between river authorities and the forest department and their developed forest strategies are relatively generic in the sense that they continue to exist throughout the IRP.

The knowledge developed within the pilot is summarized in Table 5.4. Attention has primarily been paid to the development of hard, substantive knowledge. Additionally, the generalizability within the IRP is contested.

Table 5.4: Knowledge developed in the pilot project Polder Altenheim

		Process	*Substantive*
Context-dependent	*Hard*	- Compensation Schemes - Landownership - Forest Management - Agricultural Management - Multi-disciplinary cooperation	- Difference natural floods and EF - Flooding schemes - Effect EF on morphology, soil, species - Usability technological structures - Mosquito control program
	Soft	- Image building - Working between disciplines - Insights in disciplinary values, governance styles	-
Generic to IRP	*Hard*	- Coping strategies - Generic Actor network	Relations between: - external constraints and EF schemes - Rhine water quality and (ground) water quality polder - EF and resettlement of floodplain typical species - presence of floodplain typical species and negative ecological impacts resulting from inundation
	Soft	- Relationships within government - External governance style	Experience with the concept

Learning
Knowledge creation and learning are closely interlinked. Together they contribute to knowledge development. The created knowledge can be recognized when it is learnt by at least one actor. For evaluating learning the focus is on who has learned what.

The primary learning focus within the pilot was the confirmation of expectations and assumptions on river functioning and on the extent to which imitation of flooding in a controlled environment is possible. Interviewees from government agencies and NGOs indicated that the effects of the practical implementation went beyond expectations. The major learning point for them was the ability of EF to enable the flood defence purposes of the IRP and so the readiness of the policy to be rolled out. From the earlier experience in retention they had understood the need to increase the number of polders to 13 to reduce the pressure per polder. However, despite the strong conviction within government of the added value of EF, the belief was reinforced that EF always comes in a package deal. Restoration on its own is unlikely. Additionally, they learned that the existing limitations deriving from hydropower are hard constraints that set the playing field even though reducing the lower limit would be favourable for the IRP. Only part of the knowledge was focussed on initially, both intentionally and unintentionally, and so everything was not learned from the start by government agencies. This concerned external effects, including seepage and mosquitoes, particularly. For foresters, major lessons included the developed relations with river managers and developing floodplain specific forest schemes. For the municipality, the pilot showed the increased recreation quality (particularly for fishing) and the ability to use the developments for image building. All actors gained experience in multiple ways, for instance in how to apply EF, how EF impacts several aspects including floodplain restoration and liveability, and in working together with people with different backgrounds. The consequent learning about the complexity and uncertainties of water systems meant a fundamental change for some. Learning about soft aspects, such as how to communicate or the impact of a single seepage-damage event on the trust between government and citizens, occurred.

Levels of learning include both single-loop and double-loop learning. Instrumental changes include for instance the development of the flooding regime within the given constraints and its impact on the polder. Double loop learning constitutes changes in values and problem perceptions. For the river authority, the learning process leading to changed values and problem perceptions occurred before the monitoring period, during the initial development of the concept and policy program. This was a result of the initial disaster and occurred through the learning from each other in the interdisciplinary work. One respondent indicated that initially 'Engineering and Ecology were two separated worlds that did not communicate and understand each other', but before the pilot they started to cooperate and learn from each other. Later, other disciplines became involved as well, contributing to learning. Within the pilot, values were developed regardingpotential risks (e.g. seepage, mosquitoes). For other involved actors learning occurred throughout the pilot, both by jointly developing strategies (e.g. on forestry, on compensation) and by experiencing impacts (e.g. on recreation and liveability).

However, while diffusing EF the nature of learning and who learns what changed. Local actors such as private land owners, municipalities, citizens and recreants change when the location of the project changes. In the new areas these actors did not experience the initial learning and brought in new perspectives. The experiences and interpretations developed earlier, such as the quality of recreation and the importance of inaccessibility during floods, were disputed. 'Evidence' was no longer accepted as evidence. A major lesson for both authorities and local actors was the recognition of changed power positions and dependencies and the meaning of democracy. Citizens proved to be potentially very powerful in blocking government intended processes. The consequent learning processes became more focussed on the interactions between biophysical and societal systems and broader complexities became apparent. The initial learning process can be characterized as institutional social learning and learning-by-doing, while during diffusion public social learning processes dominated.

5.5.3 Diffusion

The extent to which pilot knowledge is adopted and used in different areas or times is the diffusion of pilot projects. The patterns, nature and channels of diffusion of Polder Altenheim are discussed in this section, complemented with the exercised diffusion strategies.

Patterns of diffusion

Observed diffusion of the pilot project Polder Altenheim include:

1. Inclusion of EF in the IRP. In thirteen former floodplains throughout the state BW that have been indicated as flood retention areas, EF is planned. The problem scope enlarges in these new areas because local interests become of larger importance. With respect to actors, except for the local actors, cooperation continues, also in the form of the IRP Agentur.
2. Continuation of EF in Polder Altenheim. After the ending of the monitoring program and the approval of the IRP in 1996, the pilot smoothly turned into standard practice. Geographical and institutional scales remained comparable, but the temporal scale increased although this was not made explicit.
3. Implementation of one other area as a Polder at full scale (Sollingen/Greffern) and preparation of one more area as Polder (Breisach). This is second order diffusion, since it goes through the IRP and not directly from the pilot.

Interest in the underlying assumptions on natural functioning of rivers and its use for flood protection came from other river basins (Elbe) and countries (Japan), but the extent to which this can be related to EF in Polder Altenheim remains a grey area.

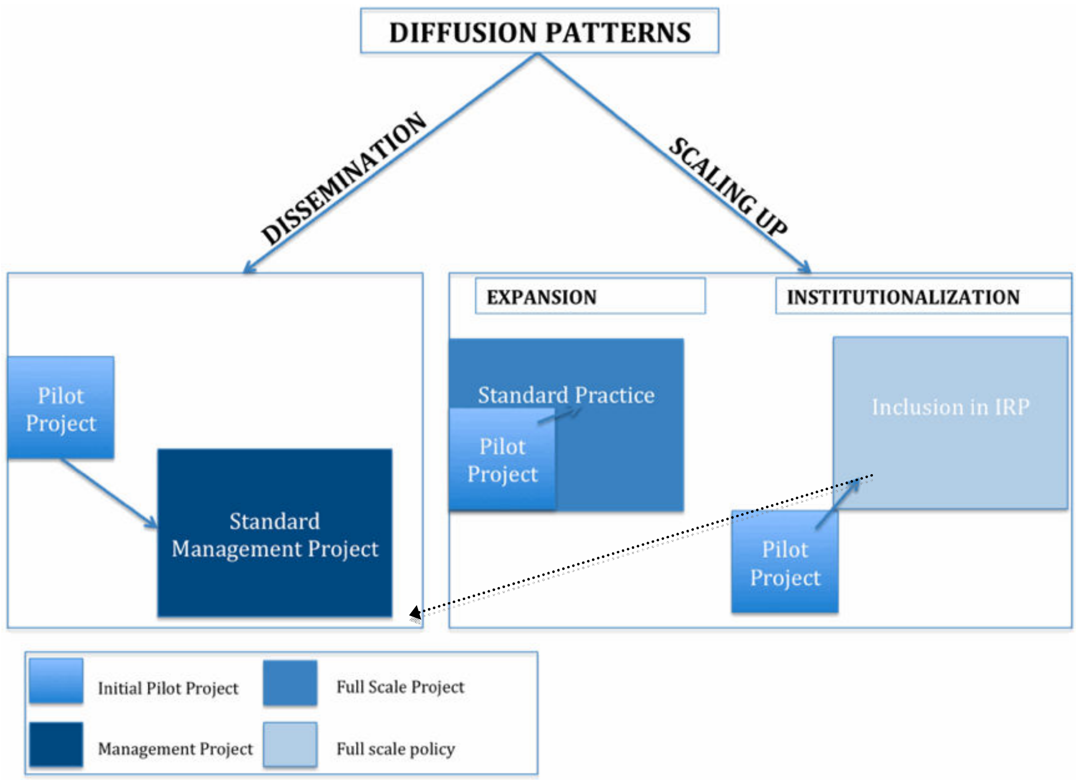


Figure 5.5: Diffusion pattern of the Polder Altenheim pilot project: Scaling up through institutionalization in the IRP and expansion of Polder Altenheim (full lines). Dissemination at the operational level as a second order diffusion pattern of management projects induced by the IRP (dotted line).

In Figure 5.4 the diffusion patterns are visualized. The more complex second order diffusion pattern (in this case the dissemination) is also indicated. Less direct patterns and unclear cause-and-effect relations (e.g. diffusion to the Elbe) have not been indicated. Additionally, the figure falls short in indicating the extent and level of diffusion. For example, of particular interest in this case is the duration between the IRP approval (i.e. diffusion at policy level) and implementation of the second and third project (i.e. diffusion at practical level). At the moment of study, which is more than 10 years after the IRP approval, only 2 areas (Altenheim and Sollingen/Greffern) have been implemented. Institutionalization into the IRP is also a much stronger form of diffusion than the dissemination to other river basins. This difference cannot be depicted adequately in Figure 5.5.

Nature of Diffusion

The nature of what is being diffused from pilot project Polder Altenheim constitutes the EF concept and supportive knowledge on flooding schemes, Rhine discharges, ecological processes and strategies to deal with risks, but also of expectations regarding EF implementation and related forestry management. Additionally, knowledge on artefacts (e.g. inlet- and outlet structures) for EF is diffused. Overall, the knowledge that is being diffused is of both a hard (e.g. flooding schemes) and a soft nature. Soft knowledge includes experience, which is recognizing situations and knowing instinctively what to do (Flyvbjerg 2001), and relations that have developed between different actors. For instance, different actors continue to share values, problem perceptions and the conviction of the appropriateness of EF for the IRP. Some of the experience is diffused through the formation of the IRP Agentur.

Channels of Diffusion

The channels of diffusion were mainly internal. The pilot was well embedded in the policy context and in agencies that also developed and approved the IRP. Consequently, the diffusion went through the actors that were involved in the pilot. They continued with EF by further developing and implementing the IRP. The same holds for the expansion of Polder Altenheim into standard management practice. However, for the implementation of the new areas diffusion occurs through mixed internal-external channels. Internal channels include the river authorities and other relevant governmental agencies and NGOs. External channels are the local actors such as municipalities, citizens and landowners. However, the emphasis still lies with the internal channels.

Exercised diffusion strategies

Strategies for diffusion were initiated at an early stage, even before the monitoring period. During the decision-making process for the development of the IRP the idea to apply EF in all retention areas already started to grow. Consequently, the future targeted areas were clearly indicated. To anticipate diffusion, transferability of the insights deriving from the monitoring program was indicated in the report on the pilot (GwD SO/HR 1999). The involvement of future users was partially covered by including forest service and NGOs. Continuation was expected to be safeguarded by the formation of the IRP Agentur. Additionally, strategies to deal with the expected risks or hurdles for diffusion were developed within the pilot. Primarily these included mosquito control and developing compensation schemes. Not included in early stages, were local future users, both because they did not play a role in Altenheim and because the policy climate did not request this.

During diffusion, the existing strategies turned out not to work because major opposition arose, particularly from the local actors. In reaction, discussions are going on within the river authority to apply moderation processes. In Polder Breisach, joint development has led to a stepwise introduction of EF, with a five yearly evaluation cycle with a decision moment as to whether to continue and intensify EF or not. The step-wise introduction is both regarded as progress within a stagnant process and as a loss of benefits, and potentially problematic for the IRP. Additionally, moderation is considered time-consuming and therefore no longer used. Additional strategies to enhance diffusion include the use of Altenheim as an example in communication, letting local actors, including the mayor, present their opinions on EF and the effects on the community, finding out about perceived risks and disadvantages, and further strengthing coping strategies such as seepage and mosquito control, and buying land when landowners leave. At a national level, diffusion is encouraged trough the LAWA, which is a body that exchanges knowledge between the different states. Additionally, the EU is mentioned as a motor for continuation of these types of projects and research.

In summary, the different types of effects established by the pilot project Polder Altenheim are listed in Table 5.5.

Table 5.5: Overview of the main effects of the EF pilot project in Polder Altenheim

Effect type		**Identified effects from pilot Stellimatten**
System's response	*Biophysical*	- Resettlement floodplain species - 'Externalities' (mosquitoes, seepage)
	Actor-Network	- Relation type: from single-actor to interdisciplinary cooperation; during pilot supportive network, after pilot opposition - Resources: site, cooperation, governmental support - Governance style: Consultative internally, Informative externally
Knowledge	*Creation*	- Substantive/ Process: Fit with legal requirements, Effects EF, Flooding regime/ Multidisciplinary approach, governance styles, forest management - Contextual/ Generic: local ecosystem responses, relations between actors/ limitations EF, EF mechanisms - Hard/ Soft: Coping strategies; EF mechanisms/ change in democratic values and engagement, experience in EF
	Learning	- Interdisciplinary working and insight in complexity social-ecological system (government) - Beyond expectations (government, NGO)/ added value (municipality, recreants) - Externalities and how to resolve (government) - Dispute on 'evidence' (pilot participants and non-participants)
Diffusion	*Pattern*	- Dissemination: 2 other polders - Scaling up: expansion of polder Altenheim to permanent project; institutionalization into IRP; institutionalization IRP Agentur (temporary)
	Nature	- Artefacts: support structures - Hard knowledge: Flooding regimes, KABS, forestry and agriculture management - Soft knowledge: Internal relationships, experience
	Channel	- For dissemination: internal-external - For scaling up: internal

5.6 Synthesis

In summary, the pilot project Polder Altenheim was about a conceptual, demand-driven innovation that was first applied at a specific location to resolve and develop knowledge about particular policy controversies. The pilot developed from a research/ managerial to a managerial/ political-entrepreneurial pilot. Main effects included the establishment of ecological restoration in Polder Altenheim, the development of a network that is supportive towards EF and the development of knowledge on the implementation and functioning of EF. The pilot project itself was considered as successful, and substantial diffusion, both narrow and broad, was achieved, particularly in terms of the expansion and the institutionalization in the IRP and the IRP Agentur. However, the second order diffusion, the implementation at the operational level, is a slow and difficult process. In this final section, the evolution of the pilot and factors influencing this are reflected upon to learn more about pilot project dynamics.

5.6.1 Piloting process

The evolution of the pilot can best be discussed by the recognition of different stages a pilot goes through. These include after the pilot initiation i) process design, ii) design of intervention iii) implementation, iv) monitoring and analysis and v) diffusion. The different stages are discussed here, even though the identification of stages does not mean that a pilot goes through all stages, let alone in a sequential and singular manner.

Pilot initiation and design stages

For the initiation of the pilot, the combination of environmental legislation, the recent Sandoz disaster and societal pressure from mass media caused policy makers to adopt the EF concept and to bring theory and practice together. The controversy between ecologists and engineers showed that a single actor is no uniform entity and that internal dynamics, particularly within leading actors, can influence the pilot as well. The cross disciplinary approach, the pilot status and the choice to deliberatively not to communicate all risks contributed to keeping opposition relatively low. As a consequence of the controversy, the monitoring and analysis period had been delayed for four years, but it could take place. Additionally, one became aware of the need for multi-disciplinary cooperation in integrated water management. This understanding formed the basis of the institutionalization of multi-disciplinary work in the IRP Agentur. A last aspect of importance is the position of the pilot at the core of the policy-making in combination with the demand-driven development (the developers were also the users) and consequent focus on diffusion. This position enabled the recognition and inclusion in the IRP. On the other hand, these conditions reduced the innovativeness of the pilot to make it fit with the policy.

Implementation and Monitoring and Analysis stages

In the implementation and monitoring and analysis phases of the pilot, an intensive knowledge program has been put in place. This has led to the understanding of the implementation and functioning of the concept and the conviction of river authorities of the correctness of the approach and as the only policy option. As a result, the IRP that included EF was approved immediately after the pilot (1996). The support, or absence of opposition, from external actors enabled this decision. Support may have been encouraged by compensation schemes, resolving problems and communicating advantages. That this is not a guarantee for implementation is shown in Polder Breisach. For implementation to occur, external actors should either have some feeling of ownership or neutral. During the implementation and monitoring not all aspects, particularly in terms of external effects, had been paid attention to from the start due to ignorance and strategic considerations. However, the occurrence of one unforeseen event (in this case damage from seepage) made that additional measures were taken, but also that external actors became aware of the risk, which reduced their trust in authorities. This influenced not the pilot itself, but it did influence the diffusion. Lastly, the pilot had been designed to fit a particular space and time and fitted the institutional, socio-economical and biophysical context, or 'the zeitgeist' of green movement and acceptance of authority well. The authoritative and comprehensive decision to implement EF in the entire IRP could only be made because of the zeitgeist according to the interviewees.

Diffusion stages

It was in the diffusion phase, and then particularly during the implementation of the IRP, that difficulties arose. The main reason for this is the change in context, particularly in terms of democratic values, and the lack of recognition thereof by the authorities. It became clear that local actors of the new areas did not directly accept plans developed by the government agencies. Retention was relatively well accepted, but EF was not. The program was however already fully developed. Issues of concern that authorities thought were covered (e.g. mosquitoes, crop damage, flood risk control), not valid (e.g. pollution, concern for wildlife) or being marginal (e.g. reduced accessibility) appeared to become arguments in the discussion. New strategies had to be developed for the diffusion. Citizens were willing to invest time in the project individually or through 'citizens initiatives'. Landowners were not prepared to move or sell their land. Additionally, institutional rules changed (e.g. the need for EIA permits and compliance to EU directives). Citizens engaged other actors such as politicians for their support, discussed with authorities and used legal instruments. In essence, due to changed democratic values citizens request for engagement and transparency. The complexity of the issue thus increased, which makes a process more time-consuming. However, instead of recognizing the change in context, both the governance style and the content were directly transferred from the Altenheim pilot to other areas. The reason this development was not recognized came from the belief that all disciplines and interests were well covered within the IRP Agentur. Citizens were expected to follow automatically and building relationships with them was therefore not considered needed. In short, the effectiveness and legitimacy of an exercised governance style are thus related to the socio-economic and institutional context and associated ideas on democracy. If the context and governance style are not compatible, difficulties in the process may be expected.

Despite the idea that everything had been done to take away risks and make a step towards opponents for EF in Polder Breisach (e.g. in the joint development of a stepwise introduction), negative feelings about the diffusion process remained. Essentially, the goals of both coalitions did not change (full EF versus no EF), while both felt they made major compromises and that this was not understood. Arguments were namely of a different nature even though they seemed to deal with the same topic. Therefore, no constructive debate could take place. Instead, the developed 'evidence' appeared to be subjective and interpreted according to beliefs. Particularly different interpretations with respect to the relation between ecological improvement and communal benefits appeared to exist. Arguments and perceptions on the intensity of disturbance to daily life and recreational quality of citizens were considered by authorities as emotional arguments and therefore not valid. Moreover, the arguments could be replied to with seemingly objective arguments. For instance, used arguments included that inaccessibility is 'just a few days per year' and that 'recreational quality has improved because conditions are more natural, forestation activities are more hidden and fishing conditions improved'. Particularly the presentation thereof as facts jeopardized the communication according to interviewees. Another major reason for a different interpretation of evidence derives from the limited representativeness in biophysical conditions: Altenheim was a former wet floodplain, while Breisach was a dry floodplain. Next, flood defence was considered as a means to establish ecological enhancement. The question had shifted from which level of restoration is needed to make the area 'flood proof' to how to implement EF. This level was not debated according to citizens. The idea that all decisions were already made does not contribute to a constructive debate. As of date (2008), within the government the discussion continues of how to address and engage citizens and to develop pride amongst them versus the efforts this takes and limited results so far.

5.6.2 Factors of Influence

In this last section factors that have influenced the pilot project are discussed. In Table 5.6 an overview of the three main categories of factors is given. The section finishes with a short discussion on possible management actions to influence the pilot.

Table 5.6: Overview of influential factors

Factors enabling the pilot project	- Legislation - Societal/ Media pressure - Fit with Zeitgeist - Integrating ecology and engineering - Locus: at policy core, inclusion of users
Factors steering the pilot project	- Strong boundaries - Selective communication - Encouragement: compensation and image building - Unforeseen effects - Interdisciplinary approach and institutionalization thereof
Factors influencing diffusion of the pilot project	- Intensive and trusted knowledge program - Contextual dynamics and ignorance thereof - Different interpretations of evidence and representativeness - Belief in concept/ lack of alternative - Building coalitions - Land ownership - Institutionalization

Factors enabling the pilot project

The pilot could be initiated as a result of high societal pressure, presence of legislation that requires ecological protection and the absence of legal instruments that require ex-ante analysis (e.g. EIA's). Ecology benefitted from this. Moreover, the fit with the 'Zeitgeist' enabled the pilot to be developed. The merge of the separate worlds 'ecology' and 'engineering' enabled engineers to, despite their scepticism, to agree on the initiation of the pilot. The locus at the policy core provided large policy- and user support and a sense of urgency.

Factors steering the pilot

The course of the pilot has amongst others been influenced by the choice to selectively communicate or ignore possible risks. As such, strategies to omit these risks could first be developed after which they could be communicated as being under control. Early communication thereof could have harmed trust in EF, although this strategy is very risky in harming the trust in government. Unforeseen effects caused the developers to find new strategies to deal with these. Next, actors experiencing negative impacts were compensated and positive aspects highlighted. Consequently, their support was build. Of large influence in the design of the pilot were the boundaries that were externally imposed (e.g. limitations from hydropower interests). During the course of the pilot, diverse disciplines came to be involved, which was very innovative at the time. Consequently, different aspects were paid attention to and integrated water management was facilitated.

Factors influencing the diffusion of the pilot

The main reasons EF was fully included in the IRP and that interdisciplinary work was institutionalized in the IRP Agentur were the developed trust in the concept and perceived lack of alternative. The intensive knowledge program that increased the trust in the evidence supported this. During the pilot the context changed significantly. Particularly citizens' involvement and their values on democracy changed. The reason this had a large influence on the diffusion was that it was not recognized and not acted upon. The internal focus as a result of the institutionalization of the interdisciplinary work and the consequent thought that 'everything was covered' fostered this. When diffusing the pilot, new actors became involved who did not share experience and had different perceptions on the 'evidence' and transferability. In combination with the lack of trust in government they created coalitions and used legal powers to support their point of view. As a result, government had to find ways to deal with this. Stepwise approaches were developed instead of full EF implementation. For the government, the lack of land ownership caused that they could not easily implement actions they wanted. Overall, these factors show the institutionalization paradox. Institutionalization facilitated further planning of EF and interdisciplinary work and formalized support. However, institutionalization also caused that flexibility to adjust to local circumstances got lost and focus remained internal, which hindered implementation.

Diffusion strategies

To enable diffusion, diffusion strategies need to be exercised. These should include an actor analysis of both current and expected future actors to identify their role, values and preferences in both content and process. Adjustments in the process (particularly the in governance style) and in the content should be made to find a balance in the new institutional and socio-economic context. Additionally, these strategies need to be started as early as the pilot itself, in order to build relationships and establish joint experience with future users. This is needed to create understanding of each other and of the innovation, which is conditional for its adoption. On the other hand, early diffusion strategies pose a dilemma both from a developer as from an external actor point of view. Developers cannot include all potential future actors and their concerns, for both pragmatic and uncertainty reasons, while potential future stakeholders lack interest for the pilot. Intensity should therefore increase over time. This case study also provided an example that a certain level of closeness (i.e. not communicating all risks) can be beneficial, particularly if the risks can meanwhile be omitted.

6.

Revitalisation of the Stellimatten, Basel

The pilot project on revitalising floodplains used as recharge areas functions as the third case study for this research. The pilot project was conducted between 2000 and 2003 in the Stellimatten, Basel. The pilot project combined, similarly to the previous two case studies, nature development with another major societal function in river management. In this case the societal function is drinking water production, whereas in the previous two cases the societal function was flood defence. The pilot project differs in its nature from the Altenheim case, but shares with the Beuningen case its initiatation by a university and its weak ties with existing policies. In terms of process, this case study is illustrative of a different and extreme evolution. Unlike Beuningen, it has been implemented fully, yet little (positive) diffusion occurred. The actors were disconnected from each other because their learning was of a destructive nature. In summary, this chapter demonstrates the application of the framework to a third example, characterized by negative developments for all actors.

6.1 General pilot project description

6.1.1 The pilot area and the problem at hand

The Lange Erlen, within which the Stellimatten are located, is an open floodplain area of 600 hectare located between the Swiss towns of Basel and Riehen and the German town of Weil am Rhein (see Figure 6.1). The Lange Erlen are floodplains of the Wiese river, which is a tributary of the Rhine. The confluence is circa 5 kilometers downstream. As an urban floodplain, the Lange Erlen is used intensively for recreational purposes (e.g. hiking, swimming, zoo), but also for –organic- farming and forestry. Principally, however, it serves as an important drinking water production site. Around 50% of the drinking water for Basel (200,000 inhabitants) is produced here by the Industrielle Werke Basel (IWB). Since 1964, water is taken from the river Rhine to artificially recharge groundwater tables. The water is filtered by rapid sand filtration and pumped intermittently (10 days flooding, 20 days dry-out) into 11 sub-areas with a total area of 13 hectare. The water is purified primarily during the passage through the natural humus top-layer and the topmost 2.5-3.5 m layer of the aquifer, consisting of gravel and sand. The water is extracted from the aquifer at one of the 13 wells (see Figure 6.2 for the purification process). This is a long-standing and proven method of producing drinking water that is unique in Europe (Rüetschi 2004). All interviewees agreed that the area had remained undeveloped despite many plans to build housing estates and industries over the past decades owing to its drinking water production function. The recharge areas are forested, primarily with exotic species such as poplar, and are ordinarily not accessible to the public. The pilot project site of Stellimatten is a small (0.5 hectares) recharge area in the north-eastern corner of the Lange Erlen, adjacent to the border with Germany.

Figure 6.1: The Lange Erlen surrounded by Basel in the south, Riehen in the east and Weil am Rhein (Germany) in the north. There are 11 recharge areas and 13 wells of the Industrielle Werke Basel (source: adapted from IWB). The pilot project site ('Stellimatten') is located in the northeastern corner

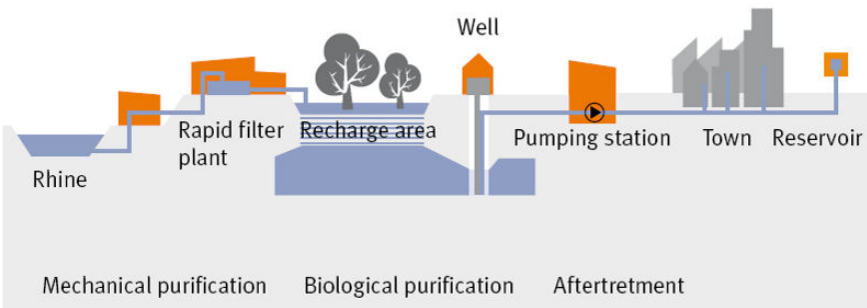


Figure 6.2: The water production process used by the IWB in the Lange Erlen (source: IWB)

6.1.2 The pilot project: the revitalisation concept and the pilot design

Like many other rivers in Europe, the Wiese River was canalized. Consequently, the area subject to flooding was reduced and average water levels in the main channel are higher than they were prior to canalization. The floodplains dried out, atypical substrates developed and exotic (i.e. non-floodplain) species established themselves on the floodplains (Rüetschi 2004, Wüthrich *et al.* 2001). Additionally, the natural recharge of the groundwater by floods from the Wiese ceased. However, to allow continuous extraction and purification of the groundwater for use as drinking water, the groundwater table needs to be recharged. Owing to the disputable water quality of the Wiese, since 1964 water has been abstracted from the Rhine River and transported to the floodplains for use in recharging the groundwater reservoir. This practice has reduced the ecological quality of the floodplains further over the years. As the Wiese water quality has improved significantly over the past few years, the idea of revitalising the floodplains by using Wiese water to recharge the groundwater emerged. The expectation was that the ecological quality of the floodplain would improve, because the natural surface water - groundwater interaction could be partially restored and flooding by the surface water from the Wiese River could possibly be achieved more frequently.

The University of Basel initiated a three-year pilot project (2000-2003) to test this idea. In the testing period, unfiltered Wiese water was let into the area, instead of filtered Rhine water. The area was flooded for 14 days with 40 $l.s^{-1}$, followed by a 14-day dry period. Additionally, exotic hybrid poplar trees were removed and small ponds were dug (2-3 m. diameter, 1 m. depth). Finally, the area was made accessible to visitors via a nature trail (*Auenpfad).* It was anticipated that these interventions would promote the establishment of indigenous species, including the growth of typical reed vegetation and the colonization of the area by amphibians and aquatic insects. Seeds and eggs of indigenous species present in the Wiese water could settle in the testing site. However, using Wiese water is not without risks. The low discharges and the presence of wastewater treatment works upstream in Germany make the Wiese water more vulnerable to pollution than Rhine water. If the Wiese water were polluted, the groundwater could become polluted affecting the drinking water wells. To reduce this risk, a confined recharge area with non-critical wells was chosen for the pilot project. Additionally, water quality monitoring equipment was installed at the drinking water well locations in the pilot site that could potentially be affected by the flooding of the area with water from the Wiese River. A control station was installed in front of the inlet to monitor potential pollution and prevent water use in such an eventuality. Extensive monitoring and analysis of monitoring data for various water quality parameters, ecological quality, and the acceptance of different actors, including citizens, was undertaken.

6.1.3 Meeting the actors

As indicated, the project was initiated by the *University of Basel*, or more precisely by an alliance of three different departments in a core team: Hydrogeology, Physical Geography and Social Geography. Indeed, the project was initiated from different disciplines with the intention of including different perspectives and issues. The pilot project was embedded in the framework of the 'Man-Society-Environment' (MGU) research program. The MGU framework strives to conduct scientific research from which society can benefit directly. So, the project was initiated to study the feasibility and the economic, ecological and social effects of floodplain revitalisation in an urban environment (Wüthrich *et al*. 1999). The expectations on the part of the university were that 1) the ecological conditions of the floodplains would improve, 2) drinking water production could be maintained or even exercised in a more cost-effective way by reducing the transportation costs for water from the more distant Rhine and 3) the area would be attractive to visitors. The university took a leading role in designing the project and managing the monitoring installations. The resources the university contributed to the pilot project comprised methodological and disciplinary knowledge.

The university invited several actors to participate in a *steering committee*. The steering committee consisted of several agencies of the Canton Basel-City including the Industrielle Werke Basel (IWB), Amt fur Umwelt und Energie (AUE), Tiefbauamt des Kantons Basel Stadt (TBA) and the Amt fur Wald and the Hochbau- und Planungsamt Hauptabteilung Planung (HPA-P). Additionally, the cities of Basel and Riehen were represented on the steering committee (Knall 2006). In Switzerland, governmental layers include national, regional (Canton) and local (City), so in the steering committee regional and local actors were involved. The role of the steering committee was to reflect on the project and to check/review proposals. By specifying the boundaries they could set the playing field of the project. In addition to these committee tasks, different agencies also had individual tasks, interests and responsibilities in the project.

The *Industrielle Werke Basel (IWB)* is the drinking water producer for Basel. They use the Lange Erlen as a production site. The IWB is a governmental organisation that is financially sound, although the decreasing water demand poses a threat to long-term investments. They are considered to perform a vital function for the city and both citizens and policy makers consider them as reliable. The IWB is also the landowner of the Lange Erlen. Despite initial moderate scepticism towards the project, the IWB provided a test area for the project, made data from the laboratory available, and facilitated joint analysis of the data from the pilot by the laboratories of the IWB and university. The IWB has extensive knowledge of ground water recharge and drinking water production for Basel. The IWB focuses on limiting any risk that threatens their core task: drinking water production. The *AUE* (Amt für Umwelt und Energie) of the Canton Basel-City is tasked with controlling ground water quality in the region and issues permits for any works affecting ground water. However, the norms of the AUE are less stringent than those of the IWB and so their influence is limited. The *TBA* (Tiefbauamt des Kantons Basel-Stadt) is responsible for flood management and led the project, which ran at the same time, aimed at restoring the course of the Wiese River. Examples of activities undertaken in this project include the replacement of concrete banks by soft structures and the increased allowance for lateral erosion and sedimentation dynamics. The *Amt für*

Wald manages the forests in the Canton including those in the Lange Erlen. They maintain the health of the forests and screen plans that might affect forests. The forests in the Lange Erlen mainly consist of poplars that are suitable for forestry purposes. Replacing the poplar forests would imply a loss of income from forestry, but could also increase the ecological health of the floodplain. *HPA-P* develops spatial plans for the region. In conjunction with the (German) city of Weil am Rhein, the HPA-P developed a plan for the landscape park Wiese for the Lange Erlen area. The AUE, TBA and HPA-P form the environmental authorities who were all initially moderately positive towards the pilot project measures (Knall 2006). The *municipalities of Basel and Riehen* are located next to the Lange Erlen. Their citizens intensively use the area for recreation and depend on it for drinking water.

In addition to the actors participating actively in the project, there is another group of affected actors. *Recreational users and citizens* were passively involved in the pilot project through surveys and by informing them using explanatory panels located on the nature trail. They were encouraged to visit the previously closed area. Additionally, *floodplain users* in the Lange Erlen, but not in the pilot site Stellimatten, are also affected or might themselves affect the water quality. These actors include (organic) farmers, NGOs, waste water treatment plants in Germany and the zoo. The attitude of farmers towards the measures is a mix of positive and negative, while nature organisations are mainly positive (Knall 2006, pp 99).

Despite the seemingly broad group of actors, the main dynamics took place between the University of Basel and the IWB. Consequently, both the interviewees and the available documentation clearly concentrate on the emerging conflict between these influential actors as the major outcome of the pilot project (e.g. Knall 2006, Wüthrich and Geissbühler 2002). For this reason, most of the discussion in this chapter focuses on the interests, perspectives and actions of these actors in the pilot project. Opinions and perspectives of other actors participating in the steering committee or otherwise involved in the project at 'in-between' positions, were used to provide a broader view of the process.

6.2 Pilot project characteristics

In this section the character of the pilot project is described based on the six characteristics that were identified in the primary analysis (chapter 2). These include the relation of the pilot to the policy and local context, the scale, innovation, knowledge orientation, special status and the actor-network. In addition to establishing the character of the pilot, the results contribute to a cross-comparison of the case studies.

Relation to policy- and local context

The pilot has been inspired by and fits within the line of thinking of the regionally developed plan for the 'Landscape Park Wiese'. Additionally, it coheres with national policies encouraging sustainable development. The pilot can therefore be considered to be aligned with the themes within existing policies and plans, but a formal connection is lacking. The pilot is neither part of a larger policy program, nor part of a series of pilots and so is conducted as a single pilot in the policy periphery. For the IWB, floodplain restoration is not a core task. However, they have a strong influence on the pilot as it takes place in their domain and might affect their tasks. Moreover, the concept applies particularly to the circumstances in the Lange Erlen (urban area, water quality, drinking water etc.). The local contextual dependency is thus high.

Scale
The extent to which the project was confined in the dimensions space, time and problem scope is well defined for the Stellimatten pilot. In terms of spatial scale, the pilot only covered 0.5 hectares, encompassing one of the thirteen recharge areas in the floodplains. The time horizon was confined to three years, which made it clearly a temporary project. The problem scope was also confined. Risks potentially playing a role in a full-scale operation were not included in the pilot design or only included in a limited fashion. The pilot project was considered to be reversible because the operational management could easily be returned to the reference situation of using Rhine water again and closing off the recharge area. Obviously, the reversibility refers to the biophysical elements of the project, and does not apply to the relationships developed.

Innovation
The innovation is primarily conceptual in nature. The focus lies on the revitalisation of the floodplains in recharge areas used for drinking water production by introducing semi-natural inflow regimes using local water. The concept is innovative for the area and for all of the actors concerned. The focus of the innovation was not on technology. The supportive technologies already existed, although they had not been used for this purpose before and only the IWB was familiar with them. The level of innovation is therefore considered to be moderate to high. The pilot is characterised as supply-driven rather than demand-driven. The concept was developed ‘externally’ and aimed to change practices in the longer term, rather than in response to a request to addressing existing practices in a more effective and efficient way.

Knowledge Orientation
The pilot project was initiated primarily for research purposes. Experts developed the pilot whose focus was on substantive knowledge. A monitoring program was put in place with the purpose of knowledge creation. Research questions developed in advance were instrumental in determining the form of the monitoring program. Both biophysical and social developments were monitored. Since the background of the majority of the involved actors and the perceived critical hurdles were in the biophysical sphere, however, this aspect received most attention. Process and soft knowledge also received some attention from researchers (e.g. Freiberger 2007). The intensity of the monitoring was lower than expected, because the operational functioning only occurred in one year out year of the three-year period of the pilot. Laboratories joined forces to develop knowledge on the biophysical outcomes of the pilot project and diverse researchers studied the pilot project. Accordingly, the focus

of learning lay with single loop learning (regarding the concept), but double loop learning was also aimed for (value changes).

Special Status
This pilot project benefitted highly from its status as a pilot project. Interviewees indicated that without this special status no project would have occurred. The temporary character of the project and the associated reversibility, as well as the focus on a trial and error approach were considered convincing criteria for conducting the pilot project. Failure of the concept was permissible, in principal, although this applied less to the researchers than to other project participants. Adjustments to the pilot based on ongoing insights were possible. For instance, the flooding could be stopped or delayed at any moment if quality standards were not met, or the pilot area could be extended to the nearby forested area. Additionally, the possibilities for local refinements such as the nature trail or inclusion of relief adjustments indicate that the flexibility of the pilot was high. Resources provided to the pilot as a result of its special status include the site allocation, data and laboratory availability, and the provision of manpower.

Actor Network
The pilot was initiated by the University of Basel and was financed by the MGU. The University was primarily interested in research, but also had an interest in the follow up should the pilot prove successful. The MGU required direct societal benefits in addition to scientific quality. As a future user, the IWB was actively involved. River managers and permit issuers were involved in a steering committee. Other actors, such as German counterparts, who might be of interest for scaling up, were not included. The governance style (in this case one could better speak of a management style) exercised by the university was intended to be cooperative and constructive through the use of joint analyses and the formation of a wide steering committee in which the actors could meet regularly to discuss the project. However, other involved actors perceived the style negatively as closed consultative. Towards citizens a closed consultative style was exercised. Information was provided and feedback gained using surveys.

In conclusion, the pilot project Stellimatten represents the supply-driven testing of a conceptual innovation, initiated from research interests and conducted in the policy periphery. Different actors held different ideas on the possibility of full-scale implementation of the concept. Nevertheless, the pilot project benefits highly from its confined scale in time, space and problem scope and the experimental attitude associated with being a pilot project. An overview of the characteristics of the pilot project is given in Table 6.1.

Table 6.1: Characteristics of the Stellimatten pilot project

Project Characteristics		**Pilot Project Stellimatten**
Relation to policy and local context	*Connection to policy*	In periphery: no formal connections, but aligned with the thinking of existing public policies, not core to IWB
	Local contextual dependency	High: strongly dependent on IWB core tasks, pilot designed for conditions in Lange Erlen
	Incidence of occurrence	Single
Scale	*Limitedness (space, time, problem scope)*	Confined in all dimensions: Space: 0.5 ha., Time: 3 years, Problem scope: Excluding risks
	Reversibility	Reversible in terms of operational management
Innovation	*Type of innovation*	Conceptual
	Driver of innovation	Supply-driven
	Level of innovation	High to moderate
Knowledge orientation	*Knowledge model*	Expert-driven
	Monitoring Intensity and Type	Moderate/ High – well formulated research questions, but only 1 year data Both natural and social science monitoring
	Type of knowledge	Substantive and process, hard and soft (emphasis on hard)
	Type of learning	Single and double loop
Special status	*Attitude*	High: no pilot without special pilot status, allowance for conceptual failure
	Flexibility	High: adjustments during pilot and possibility to intervene
	Resource allocation	Making pilot possible: site, technologies, hours, laboratory
Actor Network	*Initiator*	Single actor and developer: University
	Participants	Multi-actor: user actively involved, supervisors in steering committee
	Governance Style	Intended cooperative and consultative within project team, closed consultative towards citizens

6.3 Pilot project use

As earlier explained, actors can use pilot projects for different purposes at any one time and these multiple purposes can also change over time. The main pilot project use types include research, managerial and political-entrepreneurial. In this section, a policy analytical perspective upon the pilot project Stellimatten is adopted allowing the inclusion of all actor perspectives (Walker 2000). Consequently, a comprehensive view of the mix of uses of the pilot at both the start in 2000 (t=0) and at the end in 2003 (at t=1) is developed. The Pilot Nonagon is used to visualize the distribution over the nine different uses distinguished within the three main types. This visualization does not necessarily represent the views of individual actors. Instead, the purpose of the analysis is to provide a general sense of the use of the pilot and particularly of the changes in its use over time, its development. In the cross-comparison with the other case studies, this supports insights on which type of pilot project encourages which type of development. In Figures 6.3a and 6.3b the extent to which each of the nine identified pilot uses is considered to be present at that time is indicated.

At the outset (t=0), the pilot was strongly and relatively straightforwardly positioned as a research initiative. Research questions regarding the effects of restoring the interaction between river water and the floodplains on ecology, drinking water production and recreation were to be answered. The importance placed on knowledge development as expressed in the resources allocated to the project confirms this explorative use of the instrument 'pilot project'. All actors affirmed that they viewed the project in this way. As the pilot was conducted in the policy periphery (section 6.2), it was not of an evaluative nature nor was it used for policy implementation. Additionally, no direct existing problems had to be mitigated. For the university, the collection of evidence meant that the pilot project could have relevance for broader implementation of the concept. At the same time, the choice of the IWB for the particular location and the risk control built into the pilot made it less representative for broader implementation. Due to the double goals of the actors and design choices the pilot had some aspects of a political game. Results could potentially be used to advocate their point of view, but advocation was not yet a prominent use. The emphasis was on the design, with some communication through a new actor alliance, as well as pilot implementation and knowledge development. The insurance function of the pilot was very important because the innovation could only be implemented and tested owing to the confined scale, risk control measures and the reversibility of the pilot.

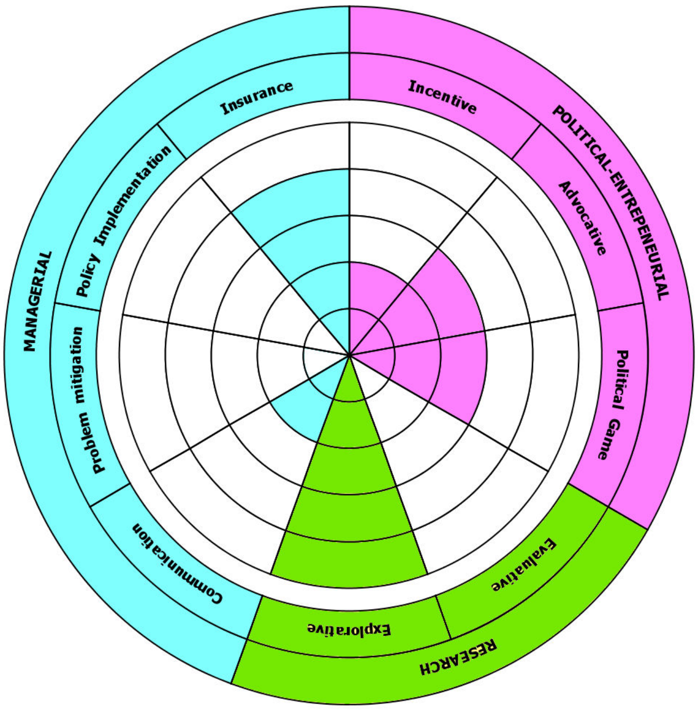


Figure 6.3a Pilot Nonagon for the Stellimatten at t=0 (initiation of the pilot)

At t=1, in 2003 when the pilot project ends, the use of the pilot has changed. It is still an explorative pilot, but the importance of the explorative use has reduced because the inundation and the monitoring have ceased and most results have been produced. Instead, the advocative use has increased drastically with the university advocating application of the concept throughout the Lange Erlen. To the IWB, the university has played a manipulative game by not expressing their true intentions regarding the concept and by not acting together with them. To the university, the IWB participated to deal with societal pressure and made manipulative design choices. As a consequence, contacts have been broken and the pilot project is used to both get the issue of revitalising the floodplains off and on the agenda. Arguments are 'the pilot is not representative' and 'the risks are too large', but also that 'there is no negative consequence' and 'it would be a missed chance not to continue'. For both of these actors the pilot project thus functions as a political game. To the university, the IWB is no longer a good partner with whom to innovate and cooperate. Accordingly, the communicative use stops. Since the relations have worsened to the level that the representatives of the IWB and the university no longer communicate and the project has ended, the use as incentive also no longer applies. The insurance function remains until the end. So, overall, the pilot develops from a predominantly research-oriented pilot with strong managerial aspects into a predominantly political-entrepreneurial pilot.

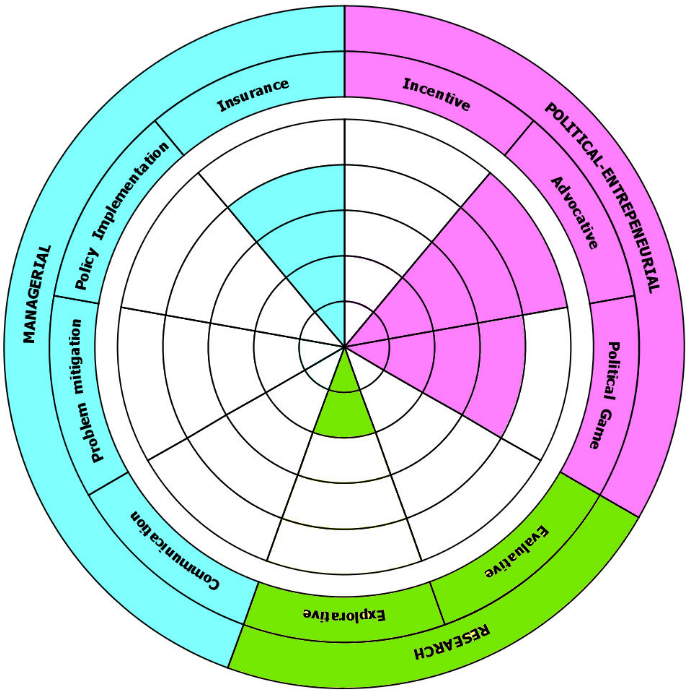


Figure 6.3b Pilot Nonagon for the Stellimatten at t=1 (end of the pilot)

6.4 Context of the pilot project

The pilot project on floodplain revitalisation in the Stellimatten is embedded in a specific biophysical, institutional and socio-economical context. The contextual elements mentioned briefly in section 6.1 that influence the pilot project are discussed in this section.

Biophysical context

The Stellimatten is a small sub-area of the Lange Erlen floodplains. The land use of the Lange Erlen is mixed, but from the point of view of the pilot project drinking water production is the leading land use. Pumping stations and wells have been installed in the drinking water production recharge areas. Although ground water recharge took place with Wiese water between 1912 and 1964, it was subsequently replaced by slightly pre-filtered Rhine water (Wüthrich *et al.* 2001). The Stellimatten is a relatively uniform forested recharge area. Under routine circumstances, a regime of 10 days inundation with pre-filtered Rhine water followed by 20 dry days is applied. In the pilot study period, a regime of 14-days inundation with unfiltered Wiese water followed by 14 dry days was adopted. In the pilot project, more landscape relief features were introduced and vegetation was cleared to give species naturally present in the Wiese water the chance to establish. Under normal circumstances the pilot study site is not accessible to visitors, but during the pilot project recreational access by citizens was possible.

The Wiese River is 55 km long and drains from the Black Forest. The Wiese has been canalized by using stone and concrete to fix the riverbed. The main stream was disconnected from its floodplains for flood protection reasons using dikes and barriers. As a result of recent restoration works, some of the morphological dynamics of the river have re-established. The average discharge is 11 m^3/s but this can quickly increase during winter with the 1 in a 100-year flood reaching discharge volumes of 350 m^3/s and more (Wüthrich *et al.* 2001). Low ground water levels and decreasing snow cover in the mountains cause water levels to drop in summer. As a consequence, the water is of disputable quality in summer. A major flood occurred as recently as 2000 (storm 'Lothar') also affecting the water quality. The Rhine water quality has improved after the Sandoz disaster in 1986 when Rhine basin policies were put in place. However, over the last years, the quality of the Wiese water has improved as well and is not far from the Rhine water quality (Amt für Umwelt und Energie 1998).

Institutional context

As early as the 1960s plans were developed to restore the Wiese floodplains to a typical floodplain landscape (Knall 2006). Other plans for housing and industrial development of the area were also proposed. However, political priority remained with the production of drinking water, preventing alternative development and no other plans were implemented. In 1996, the Wiese floodplain was declared a natural reserve and a nature development plan for the Wiese and specifically for the Lange Erlen was developed. In 1998 the German-Swiss plan for a 'Landscape Park Wiese' was developed (Canton Basel-City 1999). This plan proposed several interventions in the Lange Erlen to enable the urban functions of recreation and enhance the ecological quality. A first pilot project started in 1999 to restore the course of the Wiese. This was led by the TBA. However, pollution of the drinking water wells present in the Lange Erlen caused the project to close down in 2000.

The Stellimatten project is a second pilot project in the area, initiated by the University of Basel. The university was an external actor in relation to the policy plan, and was inspired by earlier research of in the area (Rüetschi 2004) and had to comply with the requirements of the financer that there should be direct societal benefit. The pilot was thus in line with existing regional policies, but was not officially part of it. At national levels restoration and revitalization developments were encouraged. This contributed to the allocation of resources that included not only financial resources, but also physical (the site) and technical (e.g. equipment) resources, knowledge from different sources and disciplines and time. The IWB as water producer, land owner, owner of laboratory facilities and knowledge was the main partner with much influence and decisive power. The steering committee shows that in terms of process design the pilot is well embedded in the regional institutional setting with actors from different cantonal agencies. Nevertheless, given the stricter regulation from the IWB, the real influence came from that side.

Socio-Economic context

Knall (2006) demonstrated that the attitudes towards river restoration and floodplain revitalization were generally supportive, although differences in support can be found between different interests and the Stellimatten project. The actor attitudes were driven by the social and economic interests in the floodplains (i.e. drinking water production, recreation, agriculture). From a research, planning, recreational and environmental point of view the pilot plans were viewed positive, from a drinking water production point of view it was skeptical and from agriculture somewhat mixed. For the university the pilot was of importance to conduct research, but was also seen as a project in which ecology, economy and society could easily benefit. Convincing opponents and placating proponents was therefore considered beneficial for development of the socio-ecological system and for safeguarding future research. For the IWB the pilot fell outside the scope of their core activity. Rather, concerns existed about risks to water quality from using Wiese water and to a lesser extent from visitors in the recharge area. The main perception for the IWB was thus risk aversion. External pressure from the long existing plans and research interests made the IWB support the pilot with her resources. Additionally, the reversibility of the project and the design choices made to meet the concerns (e.g. pilot site and installation of a control station) convinced the IWB. So, there was support for a single project, but not for permanent management change.

Broader context
The Wiese River runs mainly through Germany. Only the last 4 km run through Switzerland where the river flows into the Rhine. The Lange Erlen, including the Stellimatten, is situated in Switzerland, but is bordered by Germany. Policies in Germany and from the EU therefore influence the situation in Switzerland. Particularly of importance with respect to risk for water quality is the presence of industries and waste water treatment plants upstream in Germany that use the river for drainage purposes. Due to their location in Germany, the influence of Swiss authorities is limited. However, when the unreliable water quality of the Wiese is to be dealt with as a major hurdle for floodplain revitalization in the Lange Erlen, the issue becomes an international issue. At this moment initial political procedures have been started to request to start discussions with German counterparts.

In a somewhat broader Lange Erlen context, agriculture, safe water discharge and forestry are socio-economic functions that are of importance in addition to drinking water and recreation. Flood defence structures provide the boundaries for the pilot (Wüthrich *et al.* 2001, p101). Other actors at a somewhat larger distance of the pilot include local and regional politicians, German upstream towns and industries, farmers, sports clubs and other users of the Lange Erlen. Politicians can have a decisive role in diffusion of the pilot in the Lange Erlen by supporting safety for drinking water and flood defence. Currently, there is a strong political support for the IWB because of the vital tasks she performs and the sound economic policy. In Table 6.2 the main contextual elements are summarized.

Table 6.2: Main contextual elements of the pilot project Stellimatten

Biophysical context	- Stellimatten: forested recharge area, during pilot project 14/14 day flooding/drying scheme using Wiese water, landscape relief features, opened to visitors - Lange Erlen: drinking water production infrastructure, limited ecological value, exotic species - Wiese: engineered river, vulnerable to contamination
Institutional context	- Fits within plan Landscape park Wiese - University as initiator, IWB as main and guiding partner - Steering committee: governmental organizations - Resources: permits, land ownership, knowledge, equipment, political support
Socio-Economic context	- Core values: safety, drinking water, research - Perspectives towards pilot: positive (environment, research, innovation), skeptical (risk, outside scope), and mixed
Broader context	- Floodplain for recreation, agriculture, forestry, discharge - Political and international dimensions

6.5 Effects of the pilot project: Responses, Knowledge Development and Diffusion

Despite the negative feeling afterwards of the pilot participants and the ending of the pilot, the pilot initiative did have effects on diverse aspects of the Wiese management. These can to different extents and durations be recognized in the response of the biophysical and actor system, in knowledge development and the in diffusion of the pilot. In this section the effects of the pilot project had are discussed.

6.5.1 Systems' Response

Biophysical response

As a result of the pilot project, interactions between groundwater and surface water have to a certain extent been restored during the testing period. The biodiversity of the area improved because vegetation such as reed, amphibians and insects benefitted from the change in water regime and habitat conditions. After the piloting period when the interventions stopped, remnants remained. Field visits in 2008 showed a clear difference in vegetation with other recharge areas. However, no monitoring took place anymore so developments and the presence of specific species is unknown. The outlet to the adjacent area to which the pilot was extended still functioned.

The water quality of the used Wiese water improved because of the horizontal transport through the reed vegetation stands. The groundwater extraction wells and thus the production process were not significantly affected by the pilot project duration (Wüthrich *et al.* 2001). However, even though the water quality parameters including dissolved oxygen concentrations, temperature, pH, total ammonia, microbial pathogens and dissolved organic carbon, showed no significant change, the project duration was too short to definitively determine the impacts of the use of Wiese water according to participants. For example, in the reference situation the wells under study (no. 8 and 9) showed varieties from nitrate and phosphate of over 100%. This implies that to directly relate variations to the use of Wiese water is difficult. Data from the laboratory from the IWB, interpreted by the university, showed that between 2000 and 2001 little change in the wells was identified. In both wells some parameters even showed some improvement in contrast to the situation just before the pilot project. Temperature rise was subscribed to seasonal change. The only negative identified effect at this point in time (2001) was the temporarily increased turbidity of well no. 9. Additionally, particularly the development of dissolved organic carbon (DOC) is uncertain because it shows an initial increase and a later decrease.

Actor-network response

A first effect of the initiation of the pilot project is the development and activation of the core team that develops and executes the pilot and of the steering committee that does the quality control. The actors needed each other's resources to conduct the pilot. For instance, the university owned knowledge on the system and the concept. The IWB owned land, measurement equipment, local knowledge, political support and financial resources. The AUE had legal powers with the permits. However, since the pilot project was framed in such a way that it did only moderately meet the interests of the actors in the steering committee, the dependency was mainly one-way from the university on the others. In addition to these main actors, other potentially affected actors entered the network. These relationships were weak, but some became of importance when interests were affected and when the core of the network increasingly involved them (e.g. by requesting for political support).

Despite the formation of the network and increasing intensity of the relationships, the quality of these relationships did not improve during the pilot. The main actors held different expectations and started to distrust each other. Scepticism towards each other and the concept grew. More than different interests, a real conflict arose, with its climax in a blaming and naming game. The IWB was blamed for being conservative and not open for innovation, while the university was blamed for being environmentalist. They were expected by the IWB to 'remain neutral' and to not have societal goals. This distanced the actors even further and closed doors for negotiation. Instead of developing shared values, actors decreased their negotiation space and had no common points anymore (see Figure 6.4). Eventually, all interactions were cancelled. The goal to bridge different ecosystem functions was therefore considered as being not achieved. Disputes about interests are a plausible reason for cancelling cooperation, but the rise of a conflict is one step further. The person in an intermediate position indicated the cause to be the bad personal relationships between project leaders who both had comparable personalities in perseverance and (lack of) flexibility. Other actors in the steering committee also indicated it as a tough process and that they were 'happy that it was over'. Some relationships remained though, for instance between individual researchers and civil servants. For future projects, the IWB and university found new project partners.

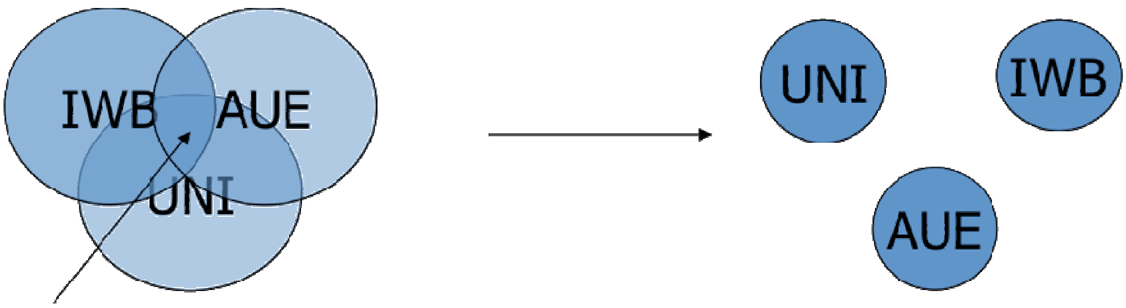


Figure 6.4: Decreasing negotiation space between actors has led to the lack of common ground

As indicated in section 6.2 the exercised management style was intended to be cooperative and constructive towards the steering committee and closed consultative towards citizens. However, the management style was perceived to become more and more authoritative informative as the pilot progressed. Particularly the development and presentation of follow-up plans halfway was perceived as being produced in solitary without giving chance for cooperation. In return, the IWB used its power to exercise an authoritative decision by not allowing for further revitalisation works and also not further negotiate.

6.5.2 Knowledge Development

Knowledge creation

Knowledge creation was an important aspect of the pilot project, certainly in the initial stages. Formulated research questions played a guiding role throughout the monitoring and analysis stages. Later in the pilot, when other purposes became more dominant, knowledge creation was sometimes of secondary importance. In this section I discuss which knowledge is created. Thereby I use the distinctions between substantive and process knowledge, contextual and generic knowledge, and hard and soft knowledge (see chapter 2.5).

Substantive knowledge that has been created and expressed by Wüthrich *et al.* (2001) includes knowledge on Wiese water quality and on the effects of floodplain revitalisation with Wiese water on ecology and geohydrology. With respect to the use of Wiese water for the wells, no significant change in water quality could be identified. In some cases even a slight improvement could be identified. The filtration through the soil layers is therefore considered sufficient. However, the testing period was too short and the reference data too blurred to give definite answers to what is the impact and what is natural variation. For instance, the Wiese water quality has improved since the 1980s, but short variations in concentrations require an entry control to prevent pollution in the floodplains. This might imply that the recharge practice needs to be interrupted regularly. The horizontal filtration improved as a result of reed vegetation development that encouraged absorption and sedimentation. Technological knowledge that has been developed includes the understanding of the turbine and monitoring equipment.

The creation of process knowledge was also explicit part of the pilot project, although it had not the main attention. Knall (2006) identified the extent of support of different actors for the pilot before and after the process. She identified actor preferences on potential diffusion sites within the Lange Erlen and the wider Basel region. For instance, citizens and environmental authorities were generally supportive of the project and the associated changes in the landscape, whereas farmers had mixed opinions. The IWB became more during the course of the pilot more negative. The research conditions were not considered appropriate and the area became more polluted due to littering. The negative attitude thus particularly related to the scaling-up, more than the pilot itself. Relationships first tightened before they became looser. Knall (2006) concludes amongst others that i) the influence of the pilot goes beyond the directly involved actors, ii) general interest in restoration has increased iii) boundaries and difficulties have been expressed and iv) that failure of the process in terms of relationships and future prospects can be subscribed to the escalation of the conflicts on goals resulting from poor process attitudes. Little understanding existed for the interests of the others, expectations were different and roles with respective responsibilities were unclear. Less knowledge has been created on the expressed expectation of economic benefits of the concept for the IWB or as Vreugdenhil *et al.* (2009b) later identify how differences in perceptions guide the pilot (risk perception versus research interest and conviction).

Much of the knowledge discussed above is highly context-dependent. Effects on ground water quality near the wells, ecological development in the pilot site and specific actor acceptance are contextual. However, related more generic mechanisms can also be identified such as the effects of unfiltered water on a floodplain instead of pre-filtered water because it contains more seeds and eggs, or monitoring practices. Equally, attitudes towards the pilot have been measured, but also more generically on floodplain revitalisation in the Lange Erlen.

Lastly, the created knowledge can be subdivided in hard and soft knowledge. The hard knowledge created has been explicated in articles (e.g. Wüthrich *et al*. 2001, 2002) and PhD dissertations. These deal with both geohydrology and the relation between acceptance and participation (e.g. Rüetschi 2004, Knall 2006). The soft knowledge is partly of explicit and partly of implicit nature. Explicitly created soft knowledge includes for instance the experience with the technologies, methodologies and inundations, but also the support for increased aesthetics and leisure quality. Implicitly developed soft knowledge includes the relations between actors. The distance between the actors increased, the extent to which values were shared diminished, and perspectives upon other actors were expressed (i.e. blaming and naming). This knowledge was surprising. The university expected that with the pilot opponents could be convinced. IWB expected that after the pilot the agenda could be closed. Other examples of soft knowledge include experience in designing floodplain revitalisation concepts in urban contexts, possible reactions to certain communication strategies, and possibilities for diffusion. Soft knowledge becomes apparent in for instance interviews, but complete representation is difficult. Individuals are not always aware of certain experience or cannot express it clearly since it is inherently embedded in them.

The knowledge developed within the pilot is summarized in Table 6.3. It shows that the focus of knowledge was spread over process and substantive knowledge, but also that contextual and hard knowledge were dominant over generic and soft knowledge.

Table 6.3: Knowledge created in the Stellimatten pilot project

		Process	Substantive
Context-dependent	*Hard*	- Actor roles and interests - Actor interdependencies - Reach of influence of the pilot - Actor acceptance/ support of the pilot	- No change in water quality near wells - Ecological enhancement - Supporting technologies
	Soft	- Importance of attitudes for process - Relation participation and acceptance	n.a.
Generic to Lange Erlen	*Hard*	n.a.	- Water quality Wiese - Effects of revitalisation with unfiltered water on ecology floodplains - Monitoring practices
	Soft	- Attitudes to floodplain revitalisation - Development bad relationships main actors	- Experience with technologies and inundations - Experience in designing

Learning

Learning and knowledge are closely interlinked. Learning occurs on the basis of created knowledge, but not all actors learn everything. In this section it is discussed which actor learned what. This depends on how actors interpret information, their role in the process and which information they receive (Weiss 1977, Wenger 1998, Bergman and Coxon 2005). Learning was in the pilot project facilitated through interim publications in local academic journals, PhD. theses and three-monthly meetings with the steering committee.

The primary learning focus within the pilot was on the interaction between Wiese water and its floodplains and on the influence thereof on drinking water production. A clear difference in interpretation of knowledge and consequent action can be identified here. For the university, the increased absorbing capacity of the pilot area because of the growth of reed vegetation allowed for higher inlet capacities. Consequently, extending the pilot was argued for. Overall, the results showed for the university that use of Wiese water as an alternative to Rhine water was a good strategy. Based on this interpretation they argued that the pilot could be applied to other recharge areas in the Lange Erlen. In contrast, for the IWB, general findings on for instance ecological enhancement were not surprising. This was already known in literature (Knall 2006). Additionally, the in their eyes poor research design (e.g. short piloting period, not addressing issues of concern) caused that the insights of impacts of Wiese water on the wells were uncertain. For them issues of concern included uncertainty in the quality of Wiese water due to variable discharge and presence of wastewater treatment plants upstream. The IWB learned that risks were even more emphasized due to the increased littering by recreants and the increased chance for pollution. The non-critical location of the site contributed to the idea that the results, for as far as they were considered convincing, were not easily applicable to other sites that were more at the core of the production process. Therefore, the

IWB did not support dissemination to other sites. During the piloting period instead, when the IWB was still open for trial and error, spatial expansion of the pilot was supported. The AUE indicated they were supportive towards the idea of revitalisation. They approved the results from the pilot, but did not really advocate the concept. The AUE did not consider it their domain and resources (hours) were scarce for the project.

Process knowledge that had been made explicit in the studies became primarily available for science in dissertations and articles. The soft process knowledge that involved actors developed, highly influenced the development of the pilot. Actors more clearly identified their opinion towards floodplain revitalisation in the Lange Erlen. They gained insight on interests of different actors and on how they affect each other. The learning with highest impact was can be conceptualized as *destructive social learning*. Instead of *constructive social learning*, in which actors jointly build problem perceptions (e.g. Muro and Jeffrey 2008, Pahl-Wostl 2006, Mostert *et al.* 2007), actors drifted apart. Negotiation space was reduced, conflicts over problem perceptions were developed and ultimately relations were cut off. The core team and the IWB were no longer on speaking terms. Interviewees indicated that in their perceptions the main causes for this were the flaws in communication, the personalities of the project leaders and the lack of willingness to listen, learn and negotiate. More knowledge exchange could have taken place between the core team and the steering committee, but also between the members of the steering committee. Additionally, the university started to develop plans for follow-up in which the other actors did not feel included enough. There was a desire for joint and slow planning. The tension between the actors was reflected in the person with an intermediate role who communicated between IWB and the University. Despite his relatively free role, he was not trusted. When explaining the point of view of the one to the other, he was considered as an advocate by the other and vice versa. Accordingly, lessons of members of the steering committee included the need for an open and flexible planning and improved quality of the communication with all actors.

6.5.3 Diffusion of the pilot project

Diffusion is the application of the developed knowledge to other areas and periods or inclusion in institutions. In this section, the patterns, nature and channels of diffusion of the Stellimatten project and the exercised diffusion strategies are discussed.

Patterns of diffusion

At first glance little diffusion has taken place. The project has finished, installations removed, the area closed and actors stopped the cooperation. Moreover, the relationships between the different actors worsened throughout the pilot. Currently no contact exists anymore between the different actors. However, some diffusion can be identified, particularly when holding a broad definition:

1. During the pilot project, the pilot area has been expanded. Water was let out the pilot site towards a nearby forested area in order to connect the areas. This expansion was however only temporary. When the pilot stopped, also this expansion was stopped.
2. The university has started a new pilot project in another urban floodplain of the River Birs. The university first made a proposal for disseminating the pilot within the Lange Erlen, but this was not possible at this point in time. Therefore, the university decided to continue research activities in an area where other actors are active and particularly where there is no critical infrastructure. The idea of floodplain revitalisation with unfiltered river water remained. Knowledge about methodology and ecological mechanisms that were developed in the Stellimatten project could be used and refined.
3. Floodplain revitalisation has -at least temporarily- been part of the policy debate. According to Knall (2006) the general interest in restoration has increased and went beyond directly involved actors. Politicians showed their support to IWB. Currently, some discussions between the different municipalities on the Swiss and German side of the border to remove or improve the wastewater treatment plants are ongoing. This might in the future give a renewed opening for reconsidering floodplain revitalisation.
4. The not working together, at least in the short and middle long term, can also be considered diffusion, albeit in a negative way. This choice has been explicitly made based on the bad experience in the pilot.

The diffusion patterns into a new pilot in the Birs River and temporal spatial enlargement in the Lange Erlen (diffusion 1 and 2) are depicted in Figure 6.5. The figure shows that the diffusion pattern consists of both dissemination and scaling up. The dissemination is however not a copy of the initial pilot. The concept and research approach could be used, but the contextual conditions have changed (Wüthrich *et al.* 2006). Particularly the complexity of the problem has been reduced as a result of choosing a site with non-critical infrastructures. In terms of temporal and spatial scale, the size is comparable to the initial pilot. The scaling up is on the spatial dimension, but not temporal, institutional or problem scope. Different biophysical processes might start to play a role. Uncertainties on for instance the impacts on wells and acceptance increase. Additionally, it is only of a temporary character. Scaling up through institutionalization does not take place. Diffusion patterns 3 and 4 are of a tacit character and can therefore not be visualized in Figure 6.5.

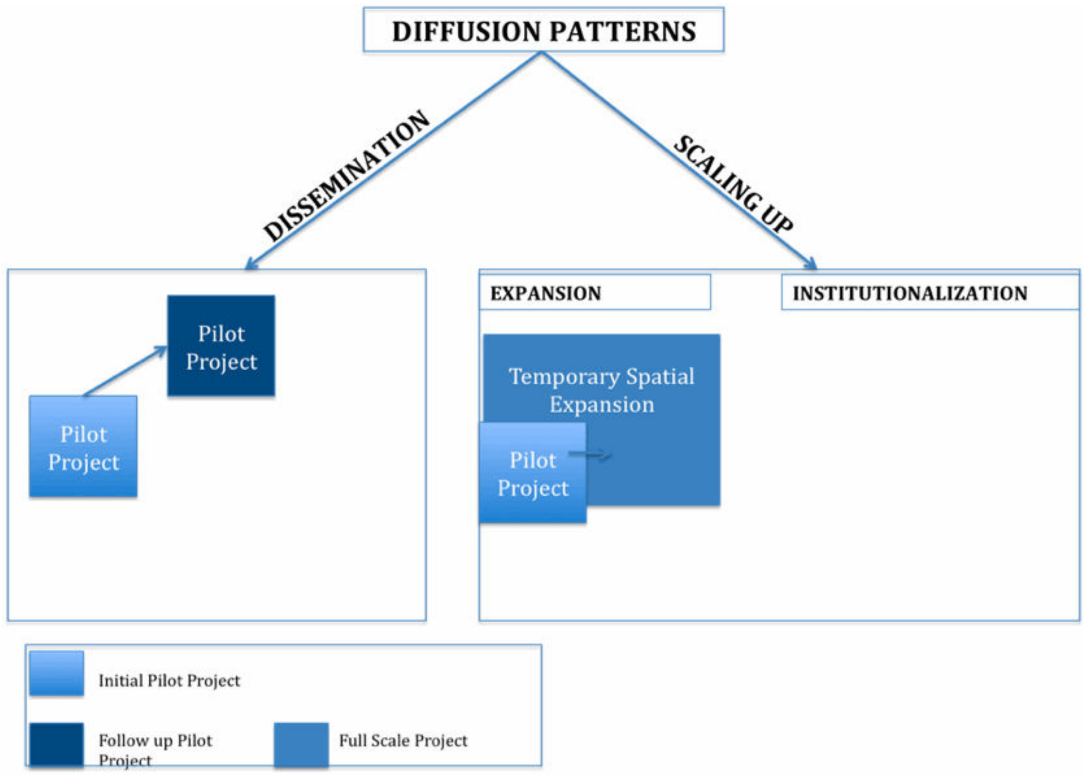


Figure 6.5: Diffusion pattern of the Stellimatten pilot project: Dissemination and Scaling up through temporary Expansion

Nature of Diffusion

The nature of what is being diffused contains both hard and soft elements. Artefacts are only limited subject to diffusion. The control station is not available for diffusion. This is also not needed because of the less precious conditions in the new pilot. More simple structures such as outlets could be used for the new pilot project. Hard knowledge diffused included the floodplain revitalisation concept, research questions and monitoring procedures (Wüthrich *et al.* 2006). Given the initial focus of the project on floodplain revitalisation practices, much of the knowledge developed and diffused is related to revitalisation. Soft knowledge diffused includes awareness on potential tensions in urban floodplains and potential impacts of participation means on acceptance. For the expansion, experience in the pilot area, same structures (e.g. turbines) and expectations on effects on water quality have been used. In the policy debate, particularly hard knowledge on principles of revitalisation and biophysical difficulties associated to it has been diffused. Diffusion of soft knowledge is of less importance, because the politicians were not directly involved in the pilot. The pilot was used as an example and provided the reason for debate. Diffusion on future cooperation includes both hard and soft knowledge. Experience in cooperation, the developed feelings and the stance towards diffusion of the concept influence the diffusion decisions. The duration of this diffusion is unknown. Five years after the pilot it still lasts. Note that this aspect of diffusion is not visible if only looking at 'successes' of diffusion.

Channels of Diffusion
The channels of diffusion for the scaling up were internal. All actors involved in the pilot participated in the enlarged pilot. For the dissemination to the new pilot an internal-external channel was used. The university developed the plan and asked the concerned landowner to participate. As such, the number of actors knowing about floodplain revitalisation in urban contexts broadened. The inclusion of floodplain revitalisation in the political debate is mainly external, because politicians were external to the pilot. Nevertheless, internal actors fed them in their search of support. The diffusion for non-cooperation was internal between involved actors.

Diffusion Strategies
The cooperation with the IWB and to a lesser extent the initiation of the steering committee was conditional for initiation of the pilot project. At the same time, this potentially contributes to diffusion because of the learning taking place. Nevertheless, the network was not intentionally designed for this. During the piloting period two diffusion strategies could be identified. The first was the planning, based on pilot results, to expand the pilot. The second was the development of the plan to implement the concept throughout the Lange Erlen floodplains. This failed. Moreover, this planning is considered one of the main reasons for the conflict. After the pilot, the university exercised a more successful diffusion strategy. A new study pilot was planned in a less complex situation in the Birs. Additionally, politicians have been requested to initiate negotiations with the German neighbours. This appeared to be a very slow process. So, the university as the initiator conducted some diffusion strategies, but often late and not of the right nature (e.g. not inclusive enough). My impression was that all actors were truly disappointed about the process. The university was convinced they made a contribution to society, whereas the IWB felt they were excluded. In a more cooperative fashion and slow pace, more room would have existed for progress. Next to the university, the IWB exercised a strategy to diffuse the idea that the concept was too risky. The message was clearly communicated to politicians.

6.5.4 Summary of the effects of the Stellimatten pilot project
In conclusion, the pilot project Stellimatten had diverse effects. An overview is given in Table 6.4. Most notable effects include the ecological rehabilitation during the piloting period, the debate about the interpretation of the 'evidence', differences in the focus on perceptions (social contribution versus risk), and the destructive social learning process.

Table 6.4: Overview of the main effects of the pilot project Stellimatten

Effect type		Identified effects from pilot Stellimatten
System's response	*Biophysical*	- Ecological enhancement (vegetation, amphibians) - No/ Limited impact on drinking water well
	Actor-Network	- Relation type: Initial tightening of relations, later decreasing negotiation space; - Resources: landownership, knowledge, equipment, political support; - Management style: from (intended) open cooperative to authoritative informative
Knowledge	*Creation*	- Substantive/ Process: ecological response, impact on wells/ actor attitudes - Contextual/ Generic: quality at wells, relationships/mechanisms groundwater-surface water interactions - Hard/ Soft: geohydrology/ increasing actor distance
	Learning	- Understanding biophysical system (university) - Illuminating risks (IWB) - Experience in revitalisation and participation (university) - Positioning towards floodplain rehabilitation (all) - Destructive social learning (all) - Flaws in communication processes (steering committee)
Diffusion	*Pattern*	- Dissemination: new related, although less complex, pilot in another area - Scaling up: Temporary expansion
	Nature	- Artefacts: Structures - Hard knowledge: revitalisation concept, intervention and measurement methodologies - Soft knowledge: relationships, experience on potential threats, expectations
	Channel	- For dissemination: internal-external - For scaling up: internal

6.6 Synthesis

In summary, the pilot project on floodplain rehabilitation by controlled inundation of unfiltered Wiese water in the Stellimatten recharge area was about a conceptual, supply-driven innovation. The concept was first applied at this location to study the possibilities of ecological restoration, the impacts on drinking water production and the societal support. The pilot developed from a dominantly research pilot initiated by the university to a dominantly political-entrepreneurial pilot. The special pilot project status and accompanying confined scale enabled the initiation of the project. Main effects included the ecological enhancement of the pilot site, measurement results that showed no impacts on the nearby wells and experience in monitoring and technologies. Eventually, the project escalated into a blaming and naming game and ended up in breaking contacts. However, some more positive forms of diffusion could also be identified, including the continuation of research in a non-critical site and initial explorations of politics to negotiate with upstream towns in Germany. In this final section, the evolution of the pilot is reflected upon and factors of influence discussed.

6.6.1 Piloting process

The evolution of the pilot can best be described by the different stages a pilot goes through. These include, after the pilot initiation, i) process design, ii) design of intervention iii) implementation, iv) monitoring and analysis and v) diffusion. In this section, the different stages are discussed.

Pilot initiation and design stages

The initiative for the pilot project derived from the University of Basel, who based the idea on earlier research in the area and on insights in the improving quality of the Wiese water. The university was strongly convinced that if it would work, it would be beneficial for economy, ecology and society. To give the pilot a multidisciplinary character, three research departments joined forces. Additionally, actors active in the area were asked to take place in the steering committee. From the start a special relationship existed with the IWB as the most critical actor. IWB was landowner, fulfilled a vital function and owned much knowledge of the area and drinking water production. The IWB cooperated in the pilot by making a pilot site available and by contributing to the knowledge development, but also set requirements on quality control. Their influence on the design of the pilot was therefore large. The financer of the project also put its requirements on the pilot in the sense that society should benefit directly. Accordingly, opening up the area for the public became part of the project, even though the IWB only moderately supported this. These initial discussions were not taken into account in the planning and so delayed the pilot. The real testing period therefore had to be shortened, which in a later phase reduced the trust in the reliability of the results.

Despite the moderate scepticism of IWB due to the expected risks, they decided to participate because they were curious too and there was a long-standing policy pressure to rehabilitate the area. What convinced the IWB was the pilot status of the project and the consequent expectations put on the project. Expectations were that the project was used for scientific knowledge development, would have a small impact and had a temporary character. For the IWB, the participation in the pilot was considered a gesture towards science. Due to the framing as a research pilot they did not expect the pilot to serve other goals. In contrast, for the university research is a starting point for societal change. Consequently, interests in research were shared, but the reasons to participate and future interests differed. These were not explicated.

In conclusion in the pilot initiation and design stages:

- The presentation of the idea in a pilot in combination with long-standing external pressure enabled the initiation of a pilot project
- The interactions taking place in this stages largely influenced the design. Compromises made reduced the innovativeness of the pilot (cf. Sendzimir *et al.* 2008).
- The seeds for later conflicts were seeded in this stage by raising different expectations and choosing position towards the pilot.

Pilot implementation and monitoring and analysis stages
During the implementation and monitoring and analysis stages the intensity of the pilot and of the cooperation was highest. Initial results seemed promising, based on which it was decided to expand the pilot site. Near the end of the pilot when more results became available tensions started to increase. The university took the step to propose further diffusion. Reasons for advocacy included the recognition of benefits for multiple interests, supported by positive results from the pilot, and the dependency on resources of other actors to continue research and expand the concept. Moreover, the university realized that environmental interests were not represented in the debate. None of the involved organisations considered it as her task to safeguard ecological quality. The IWB disagreed upon the interpretation of the results and the usability thereof for diffusion. In their eyes critical issues were not addressed (how to omit different types of risks) and added value was lacking for them. However, it was particularly the governance style exercised by the university and the presentation of the plans as given that was disapproved by the IWB. It did not fit their expectations of the pilot and their view on the tasks of a university. In their eyes the university took the seat of an environmentalist (cf. Turnhout *et al.* 2008). This situation escalated when the university publicly blamed the IWB for being conservative and politics got involved. In hindsight both blamed that 'the other' had used the pilot as a political game by not showing intentions for diffusion or to meet societal pressure and create favourable conditions for negative diffusion. The bad relationships caused the pilot not to have any follow up in the Lange Erlen. Due to the negative atmosphere and the lack of importance given to restoration, other government agencies that were moderately positive withdrew.

In conclusion, in the implementation and monitoring and analysis stages:
- Knowledge and experience in floodplain revitalisation practice and participative processes was developed
- Follow up for the pilot is prepared, because of the belief in the concept and out of self-interest. However, the perceived interference of the university at the core of the production process, and so in the domain of the IWB while excluding her, caused an explosion of relationships
- Differences in perceptions on 'evidence' and the importance of issues became apparent and could not be bridged due to a reinforced belief in initial expectations (role of the pilot in a research-niche versus pilot as a starting point) and limited openness of perseverant leaders to learning (see also Knall 2006)

Pilot diffusion stage
In the diffusion phase the pilot site was expanded, a new pilot was initiated in the Birs River, contacts were deliberately broken and a very small political step has been taken. Politicians requested to take an initiative for opening the discussion with the German counterparts about the wastewater treatment plants. It should be noted that the different stages did not run in sequence. The expansion for instance starts soon after the initiation of the monitoring phase and stops simultaneously with the implementation and monitoring phase, whereas the new pilot was started up after the Stellimatten pilot.

In conclusion, in the diffusion stage:

- All diffusion patterns have their start in earlier phases of the pilot (expansion was during implementation, breaking contact follows the developments by the end of the analysis phase, and the Birs project was initiated because other diffusion strategies failed).
- Except for the political response, all diffusion patterns are internally driven
- Currently, the only option to re-initiate the concept would be to omit all risks, but it can be doubted if this is possible. Social risks (littering, plants) might be negotiable, but other risks deriving from the natural system such as the variable discharges and the vulnerability to storms cannot be removed.
- In the future when emotions have cooled down and different people are employed, new cooperation could be initiated, although it should be in a more inclusive and incremental way.
- Conditional for diffusion to occur is not only the development of good results that is approved by the critical actor(s), but also the quality of the process. This can influence the interpretation. Therefore it is important to recognize dependencies and critical roles.

6.6.2 Factors of influence

In this last section factors that have influenced the pilot project are discussed. In Table 6.4 an overview of the three main categories of factors is given. The section finishes with a short discussion on possible management actions to influence the pilot and dilemmas an initiator might face.

Table 6.5: Overview of influential factors

Factors enabling the pilot project	- Favorable biophysical conditions - Long standing societal pressure - Pilot project status - Risk control
Factors steering the pilot project	- Inclusion of actor interests - Resource dependency - Monitoring results

Factors influencing diffusion of the pilot project	- Ambiguity of evidence
	    - Externalities
	    - Limited representativeness
	    - Short monitoring duration
	- Poor diffusion strategy
	    - Differences in expectations
	    - Inappropriate perceived governance style
	- Limited willingness
	    - Lack of sense of urgency
	    - Personal characteristics and attitudes

<u>Factors enabling the pilot project</u>

The initiation of the pilot project was inspired by previous research in the area and the insights that the quality of the Wiese water had improved. The pilot could be initiated because of the pilot status and associated expectations on its use for research and reversibility, the risk control and the long standing societal pressure.

<u>Factors steering the pilot project</u>
The pilot was planned for three years. However, not all actors' concerns were included in the design. Necessary adjustments delayed the process in such a fashion that eventually only one year of monitoring could take place. Nevertheless, based on initial results the pilot was expanded.

<u>Factors influencing the diffusion of the pilot project</u>
The pilot 'evidence' was not as straightforward as the pilot initiator thought. The combination of difference in perceptions on externalities (e.g. littering), uncertainty in results due to short monitoring period and limited representativeness of the pilot location for other areas because issues were not covered, caused the actors to perceive evidence differently. Next, diffusion management was poor. Expectations on the function of the pilot were different and already settled in an early stage. Exercising diffusion strategy that does not fit with the expectation caused opposition. The dependency for resources on the critical actor was not well included in the strategy. The governance style was very negatively perceived, which increased scepticism. Defending different stakes, the initiator opened the possibility to be blamed for being not mandated. Additionally, she was considered to interfere in core tasks of the critical actor. On the other hand, the limited willingness of the critical actor to diffuse further increased tensions. For the critical actor, a sense of urgency was lacking. The innovation was not considered to have added value. Moreover, it would increase risks. The limited willingness was further fostered by non-matching personal characteristics and attitudes. Some people were not prepared to listen and learn, they were convinced of their own right and power games were played. The different expectations, interpretations, interests and interpersonal relationships caused the process to escalate into a blaming and naming game, and leading the actors to each go their own way.

The high tension in the pilot project also caused that the issue came on the political agenda, which might in the long term be beneficial for floodplain restoration (Weaver *et al.,* 2008, Knall 2006). This could be considered a benefit of the science-policy interface, just like the initiation of the pilot in the first place and the development of knowledge.

Some recommendations and dilemmas for pilot project initiators
The Stellimatten pilot project provides useful lessons for pilot project initiators. These include that all relevant critical stakes need to be included from the start. This reduces the chance for the need of large adaptations in the pilot and consequent delays, increases the chance of constructive social learning, and takes away the need to take another actor's seat. However, as this case showed, cooperation is no guarantee for constructive social learning.

Next, expectation management is of importance even though this poses a dilemma on the initiator. Presenting the pilot as a research pilot clearly helped in this case to get the project started. The same presentation contributed to the development of expectations that there would not be any follow-up. Consequently, commitment for diffusion was low. Change in opinion or intention from the part of the initiator might be interpreted as being unreliable when the critical actor does not change accordingly. This is the *research pilot paradox.*

Following, contemporary policy-making asks for open governance styles. This implies not only exercising these styles, but particularly the perception thereon needs to be positive. The perception could be fed by slowing down the process, jointly developing evidence and addressing critical aspects for critical actors. Issues with representativeness and ambiguity of evidence are then addressed as well. Note that in case a critical actor deliberatively wants to hamper the process from the start and yet seemingly wants to show he is cooperative, this actor can do this by reducing representativeness. Unfavourable conditions are created (e.g. choosing a non-representative site, shortening testing period) and the validity of evidence for other time and space dimensions can be easily disputed.

Taking the external route (e.g. mobilising politics) is very risky, particularly if the actor you depend on is well performing and is of vital importance. Even if successful, it might further put the relationships under pressure. A last strategy is, if chemistry between individuals is really lacking, a last option is to wait a few years until the main individuals have left and to start with a new team.

7

Comparing the three case studies

In the previous three chapters I analyzed and discussed the individual pilot projects. In this chapter I compare and contrast the three pilot projects in order to find regularities and differences in the nature and functioning of pilot projects. The framework developed in chapter 3 is used as a basis for the comparison. The chapter consists of three parts. First, the nature (i.e. characters and uses) of the pilot projects is discussed, leading to the identification of design dimensions. Second, the effects, effectiveness and the influence of the context are discussed. Third, I discuss the framework, its value and the possibilities for expansion. The results supply input to the reflection on pilot projects in the last two chapters of this thesis.

7.1 The nature of pilot projects

By the nature of a pilot project I mean its use and character. In this section, I first discuss the differences and similarities in the use over time of the three pilot projects. Next, I focus on the differences and similarities in the designs of the three pilot projects. By pilot design I mean that part of the pilot character that is actively influenced by the initiator and other participants. This analysis provides insight in the design choices and the influences of the multi-actor setting on the design. Lastly, I discuss the component of the character that is contextually determined.

7.1.1 Differences and similarities in the use over time of the three pilot projects

As discussed in chapter 2, pilot projects can be used for at least nine purposes. These have been clustered in the use categories 'Research', 'Managerial', and 'Political-entrepreneurial'. With the help of the Nonagon, the uses of the pilot projects have been analyzed. The three case studies confirmed the expectation that within one pilot many uses are present, but that some uses are more dominant than others. Due to the similar method of analysis the uses of the pilot projects and the developments therein can be compared.

I classified Beuningen as a 'managerial, political-entrepreneurial pilot project' type. Over time, the managerial aspect became even more dominant. The pilot combined the opportunity to implement CFR with resolving a local nature-safety dilemma. As time progressed the motivation for the pilot, which was resolving the problem, became more apparent. Advocacy for CFR diminished slightly when some of the project goals, such as implementation of the pilot, were achieved and the attention of the initiator shifted to new projects. I classified Altenheim as a 'research-managerial pilot project'. Over time the political-entrepreneurial function became more dominant in combination with the managerial use. The research use diminished because research was considered to be completed. The pilot project was strongly used for advocating the implementation of the IRP. I classified Basel as a 'research-managerial pilot'. Scientific research provided the motivation for initiation, but the pilot was designed for risk reduction. The pilot project functioned as insurance against influencing a larger area and so for protecting the core of the drinking water production system. Over time, the pilot was transformed into a political-entrepreneurial pilot in which the different actors attempted to prove they were right. A summary of the pilot project uses and their developments is provided in Table 7.1.

Table 7.1: Dominant pilot uses of the three case studies at t=o (start) and t=1 (end)

Dominant pilot use	**T=0**	**T=1**
Beuningen	Managerial/ Political-Entrepreneurial	Managerial
Altenheim	Research/ Managerial	Political-Entrepreneurial/ Managerial
Basel	Research/ Managerial	Political-Entrepreneurial

A first observation that can be made is that all three pilot projects show dynamics in their use over time, with Beuningen showing the least change. The political-entrepreneurial use in this pilot diminished and so the managerial function became dominant alone. A second observation is that Altenheim and Basel move towards political-entrepreneurial use, which can be explained by the idea that as the pilot projects near the end stage at t=1, the initiators attempt to diffuse the results. Moreover, diffusion does not go as well as anticipated by the initiators and so there is a need from their point of view to reinforce the political-entrepreneurial use of the pilot project. At t=1, the Beuningen case has not yet provided 'field evidence', problem ownership for diffusion is lacking (nobody feels responsible for ensuring CFR implementation), and the initiators gradually withdraw as ambassadors. They need to move on to new projects and are not interested in securing their interests through advocacy activities or political games. Another reason for a lack of interest is that the pilot had a strong pragmatic driver. Once the local problem had been resolved, interest shifted away.

In conclusion, the initial use of the pilot projects was highly influenced by the goals of the initiator and honed by the interests of other participating actors. The development of the use was dependent on the change in goals of the initiator, the resource availability and the relation with future users. In other words, the development of the use depended on the willingness to devote resources to diffusion (e.g. lack of interest to advocate diffusion in Beuningen, or, full conviction and research interest in Basel) and the availability of capacity (e.g. in Altenheim specific government agencies are tasked with the diffusion). Lastly, it should be noted that actors can associate different meanings to a use. For example, 'advocacy' can be exercised to either promote or prevent diffusion.

7.1.2 The characters of the three pilot projects: the designs

The characters of the three pilot projects have been described on the basis of the six characteristics identified in chapter 2 (i.e. scale, innovation, knowledge orientation, relation to policy and management, status and actor-network). It appeared that the characters are partially designed and partially determined by the context. In this section the designed components of the character are discussed and compared. In the following section, the contextually determined parts of the character are discussed.

The design of a pilot has a broader meaning than only the design of the intervention, such as the shape and location of secondary channels or the frequency of inundation. Rather, 'design' indicates how the substantive and process elements of the pilot are shaped. 'Design' implies the active influence of the initiator in interaction with other actors involved in the project team. Table 7.2 provides a summary of the designs of the three pilot projects discussed in chapters 4-6, according to the characteristics identified as actively influenceable. I will call these the *design dimensions*. Note that design dimensions are not necessarily fixed. Some initiators will have more influence on the design than others, depending on their skills, the marketing of the pilot, and the policy importance given to the pilot. However, this issue is not discussed in detail in this thesis.

Table 7.2: Designs of the three different pilot projects

Characteristic	**Design Dimension**	**Beuningen**	**Altenheim**	**Basel**
Scale	*Scale limitation*	Confined in space time and problem scope	Confined in space, time and problem scope	Confined in space, time and problem scope
	Reversible	No	Yes	Yes
Innovation	*Level*	Moderate	Moderate	Radical
	Type	Conceptual	Conceptual	Conceptual
Knowledge Orientation	*Knowledge design*	Monitoring absent; Research in related issues is included (biophysical, institutional, social)	4-year monitoring and analysis program; Biophysical knowledge	1 year monitoring and analysis; Biophysical and Social knowledge
	Learning design	Formalisation of conceptual and process knowledge; Conditions for social learning/ soft knowledge building	Formalisation of evidence; Conditions for interdisciplinary learning	Formalisation of evidence; Conditions for interdisciplinary learning Joint analysis
Status	*Flexibility*	Moderate: hard, but relatively wide, boundaries for trial and error	Moderate: hard, but relatively wide, boundaries for trial and error	Limited: tight boundaries for trial and error
	Resource allocation	Site, participation, knowledge support	Site, technology, political commitment, Overarching knowledge team	Site, Participation in steering committee, Laboratory support
Actor-Network	*Initiator*	Researchers and initial user (NGO)	User (Government)	Researchers
	Involved actors	Project team: Future users, Landowners, Quality controller	Professional interdisciplinary team; Users	Landowner and intended future user; Quality controllers in steering committee
	Governance style	Facilitative-Consultative	Cooperative	Consultative - Informative

Based on Table 7.2 the following observations on the design of pilot projects across the case studies can be made:

- All three pilot projects were *confined in all dimensions of scale*. However, the extent to which they are confined is variable (e.g. from ½ hectare to full floodplain) and is relative to the concept that is being tested. For one concept the meaning of 'full scale' is different from that of another (e.g. floodplain in Basel, river stretch in Beuningen and river section in Altenheim).

- *Reversibility is not an inherent characteristic* of pilot projects. Even if pilot projects are reversible, this only applies to the biophysical situation (i.e. return to the biophysical reference situation in a short period without additional interventions) and not to the actor-network system. Changed relations cannot be undone. This observation conquers with expectations of interviewees. In the Basel case, the expectation of reversibility was the convincing argument for participation of some of the actors.
- *The meaning of knowledge development programs is diverse*. All pilot project initiators claimed to initiate the pilot for knowledge development. The extent, manner and moment of inclusion of knowledge development activities in the pilots varied, however. Basel had a clear, though only 1-year long, monitoring program from the start. Altenheim only initiated monitoring after initial physical work had been put in place, and this lasted 4 years. In Beuningen, monitoring was not part of the initial pilot and was only included at a later stage. In contrast, research activities going beyond 'intervention-monitoring-analysis' approach were present. The pilot projects shared the application of diverse learning strategies, including formalization of knowledge and creating conditions for interactions. The interaction conditions varied between inviting quality controllers and setting up joint designs.
- *Flexibility was restricted, but not eliminated, in all cases*. Fixed sites were allocated to the pilot project where local problems had to be resolved. Project team members, legislation and external agreements (e.g. hydropower agreements) provided further boundaries. Within these boundaries there was space for trial and error and tailor-made solutions.
- The *relation between the special status and resource allocation* in pilot projects is confirmed across all cases. Sites were specifically made available, new resources were developed (e.g. interdisciplinary team) and cooperation that under routine circumstances would be unlikely took place.
- *Pilot project initiators* can be internal to the problem or policy (users, landowners), external (researchers) or mixed. Initiators for Beuningen were mixed, for Altenheim internal and for Base external.
- *Actor involvement is a process of internalization and externalization.* Shifting the boundaries occurs in a formal way (e.g. inclusion of future users and quality controllers) and in a more subtle way in the game of giving and taking room for interaction and negotiation. Internalizing relevant actors is justified by the complexity of the issue and increases the representativeness of the pilot, but might hinder speed and direction as intended by the initiators. The internalization-externalization processes led to the active involvement of diverse actors in Beuningen and to a relatively traditional role pattern in Basel with researchers and a controlling team. In Altenheim, the developers were both future users and quality controllers. Due to the disciplinary focus, involvement of local actors was of little importance.

7.1.3 The characters of the three pilot projects: the context

In addition to the design by pilot initiators and other involved actors the context also influences the pilot's character. The *contextual dimensions* that are relatively independent from the initiator or that specifically address the relation of the pilot to the context derive from the characteristics 'relation to policy and local context', 'innovation', 'special status', and 'actor network'. Table 7.3 provides a summary of these contextually determined aspects of the character. The table describes the situation at the initiation of the pilot. Due to external developments, such as changing values on governance or ecology the positioning of the pilot in its context changes, but this is not discussed in this section.

Table 7.3: The position of the three case studies in their context at t=0

Characteristic	Context dimension	Beuningen	Altenheim	Basel
Relation to policy and local context	*Relation to policy and management*	In policy periphery, but fit with IWM paradigm Regional focus	Part of national policy program (IRP) and fit with IWM paradigm National focus	In periphery: in line with national policy but not with owner Local Focus
	Local contextual dependency	Reflection of local actors in design criteria; location specific design	Using biophysical conditions; Responding to externalities	Influence local actors in safety norms
	Incidence of occurrence	Single	Single	Single
Innovation	*Driver*	Demand-driven	Demand-driven	Supply-driven
Special Status	*Attitudes towards pilot*	Pragmatism, idealism and slight scepticism ('gardening') Sense of urgency	Initial scepticism amongst engineers Sense of urgency	Idealism (benefits) and scepticism (risk)
Actor Network	*External actors*	Different administrative layers Citizens	Utility company Citizens Politicians Farmers	Citizens Regional (=international) politics and industry
	External governance style	Consultative	Authoritative Informative	Authoritative Informative

The overview in Table 7.3 shows that the three pilots are positioned differently in their contexts. New insights that can be derived from the table regarding the relation between a pilot character and its context include:

- The *relation between 'relation to policy and management' and 'the level of innovation' is blurred*. The assumption that freedom exists for more radical innovation in the policy periphery, while in the policy core innovation is capped, is not that clear cut. The Basel pilot, which has the most distance from the main policy stream, can indeed be considered the most radical. However, Altenheim is not necessarily less radical than Beuningen, as could have been expected based on the position in their contexts. Indeed, correcting mechanisms deriving from the local contextual dependency start to work. For instance, regulations and the search for consensus with other stakeholders can also limit the innovativeness.

- The *'driver of innovation' influences actor attitudes and adoption*. Demand-driven innovations (Altenheim, Beuningen) address issues for which users need solutions. Users are directly interested and willing to invest in the pilot project. This does not mean that supply-driven innovations are not perceived as improvements, but users need more time to become convinced. Note that supply-driven innovations can be transformed into a demand-driven innovation for the purpose of the pilot. The pilot project then meets policy demands better and fits with existing institutions. This is the case for Beuningen: CFR itself is supply-driven, but in the pilot a local issue is addressed for which CFR is used as a basis.
- The *special status of the pilot was confirmed* in all cases. Despite some skepticism and the distance from their core activities, actors did participate. All invited actors participated. Participation was fostered by a sense of urgency, curiosity and social commitment (e.g. contributing to science). There is thus an interesting mix between skepticism and belief in a pilot project.
- *Identification of external actors is essential*, particularly when the desire for diffusion of the pilot exists. External actors have limited direct influence on the pilot, but can have large indirect influence. Additionally, when conditions change their influence might change and they may hold the key to some solutions (e.g. reduction of pollution in the Basel pilot).
- Within one project, *different governance styles have been exercised*. The project leader exercises an internal style within the project team. The initiator or the project team as a whole exercises an external style to external actors. External styles are less intensive and less focused on interaction. The adoption of the style can be explained by the fact that external actors are incoherent, numerous, potentially threatening or considered non-critical for the direct development of the pilot project.

7.1.4 Concluding remarks on the character of a pilot project

Two main conclusions on the character of the pilot can be made in this section. First, all pilot projects have a unique character that can be described by six characteristics. Despite the differences between the cases, the three pilot projects all showed a focus on innovation and diffusion, confined scales, claims about knowledge and learning, and spatial and temporal contextual dependency. They all benefitted from, or even were enabled by, the special pilot project status. Second, the pilot character is partly designed and partly contextually determined. I distinguished between the *design dimensions* and *contextual dimensions*. The latter cannot be influenced by the initiator or only in a limited fashion. Table 7.4 provides an overview of the design- and context dimensions. It should be noted that whether a characteristic is contextually determined or is designed, may differ across pilot projects. In some projects there is more space to design than in others, and some initiators take more initiative in designing than others.

Table 7.4: Design dimensions and contextual dimensions of a pilot project

Characteristic	**Design Dimension**	**Context Dimension**
Relation to Policy and Local Context	Incidence of occurrence	Position towards policies and management Local contextual dependence
Scale	Scale limitations Reversibility	-
Innovation	Level of innovation Type of innovation	Type of driver of innovation
Knowledge Orientation	Knowledge creation design Learning design	-
Special Status	Flexibility Resource availability	Attitude towards pilot
Actor-Network	Initiator Involved actors Governance/ management style	External actors External governance style

The three case studies demonstrated that initiators exert a large influence on the design of a pilot project. However, their dependency on other actors in the pilot project also made that the pilot project was highly influenced by them. Particularly the actor's power positions, deriving from both formal and informal aspects such as reputation or anticipated political support, and their interest in the pilot project was important in the extent to which each actor put their stamp on the design. The pilot projects were used for different purposes at the same time. Typical pilot characters, related to exclusive uses (see Chapter 2, Table 2.4) could therefore not be recognized. Rather, the pilot project character reflects the relative influence of the different actors in relation to the biophysical, social and institutional context.

7.2 Effects of pilot projects

7.2.1 Overview of the effects of the studied pilot projects

Pilot projects can generate effects in the biophysical- and actor network system's response, knowledge creation and learning, and diffusion. In an individual pilot project the nature and the extent to which effects are generated differs. Table 7.5 summarizes the effects established in the three case studies. In the remainder of this section I discuss observations of each of the types of effects and discuss the effectiveness of the studied pilot projects.

Table 7.5: Effects of the three case studies summarized

		Beuningen	Altenheim	Basel
System's Responses	*Biophysical*	Vegetation rejuvenation; Increased in discharge capacity	Semi-natural wetland conditions; Changed presence of species; Favourable conditions for retention	Semi-natural wetland conditions; Undisturbed drinking water production during pilot
	Actor-Network	Temporary collaborative structure of previously opposing actors; Explication of roles	Interdisciplinary team established	Temporary cooperative structure; Increased distance between actors
Knowledge development	*Knowledge creation*	Handbook for CFR designing	Flooding schemes; Ecological responses	Ecological responses; Methodology; New research; questions
	Learning	Design experience; Concept refined; Constructive social learning	Concept-context interactions (e.g. externalities) ; Constructive social learning	Destructive social learning
Diffusion		Remaining cooperation; Second pilot project; Included in proposed policy program Use in education program	Extension in time and problem scope; Inclusion in policy program; 2 Sites implemented; Formalisation of governance structures	Temporary spatial expansion; Partial dissemination to new pilot; Breaking up contacts

7.2.2 On systems' responses

The first effects of a pilot project are the responses of the biophysical- and actor-network system. This aspect is generally not mentioned in literature on the instrument pilot project. A reason could be that it is just assumed and 'forgotten' when authors jump to the learning and diffusion, which has their interest in system innovation studies (e.g. Van den Bosch *et al.* 2008, Van Mierlo 2002). However, this aspect is not only an effect in itself but also contributes to the other effects: it co-determines the nature of the knowledge developed and thus the knowledge potentially diffused. In contrast, in literature where the impact of a pilot project is assessed, the biophysical systems' response is usually dominant (e.g. Wüthrich *et al.* 2001, GwD SO/HR 2000).

In the three case studies, biophysical responses related to the establishment of native species following on the restoration of natural dynamics and natural habitats. Actor-network responses included the activation of actors within a network (e.g. water producers were previously not involved in floodplain restoration) and the development of relationships between actors. Previously non-existent cooperative structures were developed. Remarkable in the Basel case was the growing distance between the actors involved in the pilot project. In Beuningen, previously opposing actors defended each other within their own organisation. The project manager of Beuningen named both this merging of actors and their learning on river dynamics as the largest benefits of the pilot. In his view these effects could not have taken place outside a pilot setting: theory and practice were inherently intertwined.

7.2.3 On knowledge development

The second type of effect is knowledge development. Despite the importance given to this in advance and the expectations that pilot projects can develop knowledge (e.g. Raven 2008, Hoogma *et al.* 2002, Pahl-Wostl 2006), this is rarely used as an individual measure of pilot effectiveness. Instead, pilots are generally evaluated on the lack or extent of diffusion (e.g. De Groen 2004, Sanderson 2002, Greenberg and Shröder 2004). This implies that knowledge development sec as a benefit of pilot projects is not acknowledged or is taken for granted. In this view, knowledge becomes valuable if it can be used as 'hard' evidence to convince opponents and placate participants and proponents. In my view, knowledge development is both a contribution of a pilot project and provides the basis for diffusion. Pilot projects in particular enable the process of ascribing meaning to information through experience, context, interpretation and reflection and thus knowledge development (Bhatt 2000, Davenport *et al.* 1998).

The importance given to knowledge creation in the case studies was reflected in the pilot project designs, and in the reports and (scientific) articles produced (e.g. GwD SO/HR 1999, Wüthrich *et al.* 2001, Peters *et al.* 2006). Traditionally, and this is demonstrated by the Altenheim and Basel case, knowledge creation focuses on the functioning of the innovation in a practical setting. Before-after approaches are used in evaluation and monitoring plays a large role. As such, knowledge is developed on the innovation and the river system and can be used for further diffusion of the innovation. In contrast to the other two cases, the Beuningen case shows that the focus of knowledge creation is not necessarily on the functioning of the innovation in practice, but can also lie on conceptual knowledge, on designing and on institutional conditions to enable the concept. Accordingly, the nature and depth of the created knowledge are variable across pilot projects. Moreover, knowledge is intentionally and unintentionally developed both during monitoring and analysis, and during designing activities.

In all three case studies learning was first, and most explicitly, fostered by the spread of knowledge through grey literature. However, one can speculate, assuming that reports are usually only read by a small, directly involved group (i.e. team members, to a lesser extent a steering committee), that learning through interaction is a more powerful means to deepen learning. Particularly soft knowledge can be spread more easily this way. However, this does not mean that reports do not have a function: knowledge and evidence is more easily accepted if it is formalized and it can reach a broader group over a longer period of time. Scientific literature was mentioned as a means to create trust in the knowledge, because it provides a certain level of quality control. Grey literature and practical articles are connected to the daily practice of the (aimed) users. Rule-based and interactive learning are thus complementary modes of learning.

A second means to enhance learning is through encouraging social learning mechanisms by installing interdisciplinary teams or pilot project teams with actors with different interests. These settings also contribute to the creation of specific knowledge that cannot be created through formal studies alone. In Beuningen and Altenheim these social learning processes can be considered constructive, because actors grew towards each other in their way of thinking. For example, engineers in Altenheim first delayed the monitoring but later considered EF as a technically relatively easy option. In Beuningen, previously opposing actors learnt to appreciate each other's ways of thinking. Moreover, the created trust in each other and the concept meant that 'evidence' was not conditional for diffusion. In Basel in contrast, the social learning was of a destructive nature. Destructive social learning means that despite the interactions and learning from each other, no joint problems and strategies could be defined. More strongly, the process caused actors to drift apart in their perceptions. They became increasingly convinced of their own problem perception and that the others could hinder their interest rather than contribute. This means that instead of joint problem approaches, individual interests were placed above shared interests.

In addition to being a product of a pilot project, knowledge development itself functions as a means to allow for 'failure' in the pilot. Due to the presence of a knowledge development function, biophysical effects that would be considered as failure under routine conditions are now named as 'being of interest for learning purposes'. When the pilot is used for advocacy reasons this claim loses meaning. If the innovation is to be diffused, counter evidence that the innovation does not work under the given circumstances is not beneficial to its diffusion. However, diffusing the knowledge that something does not work under certain conditions is also a valid result of a pilot project.

7.2.4 On diffusion

The third type of effect is the diffusion of the pilot. Even though knowledge development is usually mentioned as a reason for initiation, diffusion is often considered the 'higher' goal (Van Mierlo 2002, van Sandinck and Weterings 2008). In this line of thinking pilot projects in the public domain are explicitly linked to innovation trajectories and governance change. Common evaluation criteria for pilot projects are the diffusion of 'evidence' into policy or decision-making (Pawson and Tilley 1997, Sanderson 2002) or the duplication of the innovation (Van Mierlo 2002, Rogers 1995). In contrast to this thought, I demonstrated that pilots are not necessarily nor uniquely used for diffusion. For instance, when resolving a problem or when playing political games (e.g. a pilot for the sake of placating criticism that an issue is not addressed) the pilot itself is an end goal. Even when diffusion is attempted, this is often exercised as a separate action. This is most clear in the Beuningen case, where in the project description a pilot was indicated as a deliverable. Alike, in the Basel case the pilot was a means for knowledge development more than part of an explicit innovation trajectory from the start. Nevertheless, in both cases diffusion efforts were picked up during the piloting period. Diffusion was thus an important aspect of all pilots studied in this research. One could claim that even if pilot projects are not conducted within a formal innovation trajectory, they can become part of a, probably less clearly indicated, innovation process. The related pilot dynamics are discussed in more detail in chapter 8. Here, observations in achieved diffusion are further discussed.

The diffusion that took place in the three case studies includes: dissemination into new pilots (Basel, Beuningen) and projects (Altenheim), expansion in space (Basel), time and problem scope (Altenheim), and institutionalization (Altenheim, Beuningen). Apart from the diffusion of the concept itself in different gradients (high in Altenheim, low in Basel), knowledge and institutions are also clearly diffused. For example, tasks were transferred (Beuningen), temporary project structures are formalized (Altenheim) and future cooperation is excluded as an option (Basel). A concept that is relatively flexible enables tailor-made diffusion. A risk of 'light' diffusion of IWM concepts is that the barriers to IWM are ignored instead of being dealt with and so the benefits to IWM can be disputed. When relating diffusion to the level of innovation, it appears that the more radical supply-driven innovations (Basel) have more difficulties in diffusing than less radical innovations.

Diffusion is highly influenced by the scale and contextual embedding of the pilot. For example, diffusion of the Basel pilot moves from ½ hectare to ½ hectare, while diffusion of the Altenheim and Beuningen pilot goes from floodplain to floodplain. Altenheim was embedded in a strategic policy context and the diffusion remained at the strategic policy level (the IRP). Basel and Beuningen, in contrast, were initiated at the operational level. Here, the diffusion takes place primarily along the operational lines and has more difficulty in moving to the strategic level. A reason diffusion remains at the same level is that learning takes place primarily within the project team. The project team connects more strongly to either the strategic or operational level. A strong operational-strategic interaction is lacking. Therefore, diffusion to the other level is more difficult and requires the inclusion of actors and actions at multiple levels. This *interconnectedness* was best exercised in Beuningen which is reflected in the patterns of diffusion that show, in addition to dissemination at the operational level, some form of institutionalization, even if it is weak. The communication products are another indicator for the extent of interconnectedness. In Basel these remain at the scientific level, management documents are limited, and strategic policy documents are lacking.

7.2.5 Limited diffusion effectiveness of pilot projects

Effectiveness is the extent to which the desired or intended results have been produced (Oxford Compact Dictionary of Current English, 2005). For pilot projects, effectiveness is often defined as the extent to which *narrow diffusion* has been achieved. This means whether the innovation as a whole has been diffused into new projects or policies. In this section I illustrate that for the three case studies the diffusion effectiveness was limited. To do so, I compare and contrast the goals of the pilot projects with their diffusion results (Table 7.6). Since goals changed during the pilot process, I distinguish between initial goals (as described in the project descriptions) and later goals (i.e. developed during the course of the pilot and expressed by respondents). It should be noted that effectiveness could also be assessed along different dimensions (e.g. broad diffusion), but that I here specifically choose to follow the initiators in indicating that the effectiveness was limited from their viewpoint.

Table 7.6: Diffusion effectiveness of the three case studies

	Initial Diffusion Goals	Later Diffusion Goals	Achieved Narrow Diffusion	Diffusion Effectiveness
Beuningen	Absent	Expansion in place and time to river section (approx. 40 km) and long-term cycles	2 sites implemented Inclusion in policy proposal No expansion in time	Effective from initial goals, Limited effectiveness from later goals
Altenheim	Institutionalization in IRP and dissemination to 13 areas	Institutionalization in IRP and dissemination to 13 areas	Included in IRP 2 Sites implemented	Highly effective for institutionalization, limited for dissemination
Basel	Absent	Dissemination to all recharge areas in the Lange Erlen (13)	No diffusion in Lange Erlen One new, simplified, pilot	Effective from initial goals; Ineffective from later goals

The initial goals as depicted in Table 7.6 have been derived from early pilot project plans (e.g. Oberrheinagentur 1996, Wüthrich *et al.* 1999, Radboud University 2005). The later diffusion goals were derived from interviews with project leaders. The difference from the initial goals showed that in Beuningen and Basel the initiators progressively developed or expressed higher expectations of the pilot. Initial goals were the implementation of a pilot and the performance of a study. Reasons not to include diffusion in the pilot project goals were a short-term focus on implementation and a view that diffusion is a separate activity (see also chapter 8). As a consequence, diffusion strategies were not included in the formal project description and no money was allocated. Lastly, diffusion goals can be kept modest for strategic reasons. Not naming specific diffusion targets provides protection. Initiators can save face and prevent financial or other consequences if things do not go as planned. It also provides space to change their judgment about the innovation, and it prevents initial opponents feeling trapped and deciding not to participate. Starting with relatively low ambitions can help to convince sceptics to participate in the pilot project. Pressure for diffusion can gradually be increased, although this has the risk, as happened in Basel, that the initiators are accused of setting false expectations.

The diffusion effectiveness based on the initial goals is positive in both Beuningen and Basel, but when taking the adjusted goals into account a different picture emerges. The Basel case was far from effective because there was only diffusion in a simplified form. Beuningen did show a larger extent of diffusion, but also here the ideal of cohesive, long-term, iterative and large-scale management instead of performing scattered single projects is still far away. In the Altenheim case, in contrast, it has been clear from the start that institutionalization and dissemination into 13 areas were the goals. Determining the effectiveness is therefore more straightforward. Effectiveness can be evaluated as high for institutionalization, but the limited for dissemination. After 15 years only two out of thirteen projects have been implemented.

The limited effectiveness of pilot projects in achieving narrow diffusion explains the disappointment in pilot projects as policy instruments (e.g. Sanderson 2002). This study contributes to analysing the effectiveness of diffusion in a broader way. By studying pilot project dynamics in-depth, strategies to increase effectiveness can be developed. Chapter 9 addresses this issue extensively.

7.3 Reflecting on the framework: new insights on pilot projects

The comparison of the three case studies provides insights in the nature and functioning of pilot projects in IWM beyond individual projects. Additionally, insights were elicited on the possibilities and limitations in designing a pilot. In this section I provide an overview of the insights and highlight how the framework of analysis that I developed for pilot projects and applied in this study can be expanded.

7.3.1 The ambiguous and dynamic nature of pilot projects

The cross-comparison has confirmed the expectation that pilot projects are being used for diverse and multiple purposes at the same time (research, managerial and political-entrepreneurial). The use, and particularly the dominant use, may shift over time. Two different patterns in the development in the nature of a pilot project have been identified in the case studies:

- The focus of a pilot project is often first on the collection of ‘evidence’, after which valorization of the pilot project is attempted by anchoring the pilot in society and policy. Diffusion is not always an explicit major goal from the start, but becomes gradually more important with ‘evidence’ being used to support beliefs and expectations.

- The pilot is first designed to implement the innovation in practice. As time progresses and deadlines need to be met, the design focus narrows down to the implementation of the pilot to resolve the pressing problem

The use influenced the character of the pilot through the identified design dimensions. The design therefore reflects the relative influence of the initiator and other participating actors and can take multiple forms. Initiators attempt to design the pilot to meet their interests. The extent to which an actor can influenced the design depended on their role and resource availability. The context also placed its mark on the character through the context dimensions. These included for instance the relation to policies, but also the influence of non-participating actors. The framework of analysis was refined to include governance style. Initiators exercised a governance style towards pilot participants and, possibly as the project team, they exercised a governance style towards external actors. The latter style was more closed. Strictly speaking it is more correct to speak of a management style when the initiators are not governmental bodies.

7.3.2 Political behaviour

The case studies provided the indication that pilot projects could be used for political behaviour in three ways:

1. Participation in the pilot
2. Design of the pilot
3. Presentation of the results

Actors can decide to participate, not because they are interested in the innovation per se, but rather with the intention of influencing the design of the pilot, keeping an eye on what is going on in the floodplain or mitigating the social or political pressure to change practices. In the design of a pilot, actors can evince political behaviour by deliberately making the pilot less representative of possible follow-up projects. The results of the pilot can then more easily be set aside with the actor claiming that the pilot project results provide no indication that the innovation will work in another area as well. In the presentation of results, actors can highlight favourable results and leave out or minimize the attention paid to other types of results.

7.3.3 Effects of pilot projects

The pilot projects showed all of the identified types of effects. Furthermore, the embedded relation of system's response, knowledge development and diffusion was confirmed. The focus in establishing effects was on hard aspects in all cases, including establishing interventions, developing knowledge on the water system and diffusion of the innovation itself. The achieved diffusion, however, was broader in the sense that soft and partial aspects also diffused. I describe specific insights per effect type below.

Systems' response

Pilot projects dealing with conceptual innovations for the water system establish a system's response when the intervention is implemented. Actor responses always take place. However, the forms and intensities of the responses can differ. The responses seen were of two types: converging and diverging, whereby in a converging actor-network the pathway to future cooperation was paved, while in a diverging actor-network future cooperation was made difficult. Not all pilot projects establish a biophysical response. For instance, some pilot projects focus on process aspects (e.g. developing a participatory approach) or on technologies that do not affect the local biophysical system (e.g. placing a small wave rotor in the estuary). The examples in the three in-depth case studies did show a biophysical response.

The assumed reversibility of pilot projects, which was a pre-condition for some actors to initiate a pilot, applies only to the biophysical system. Biophysical changes are reversible in most cases. However, sometimes it can take years or even decades to return to the reference situation and additional interventions may need to be taken. Obviously, when there has not been any impact on the biophysical system, reversibility is not an issue. Changes in the actor-network are, in contrast, only reversible in the sense that hard organisational structures can be made undone after the piloting period. Soft aspects, such as developed relationships, cannot. This is something to be aware of when starting a pilot: in all projects opinions are formed about the partners, both positive and negative, and these can determine future cooperation.

Knowledge development

The case studies confirmed the initial finding that knowledge development is used as the justification for initiating a pilot project (see chapter 2). All initiators claimed to initiate the pilot for this reason. However, the meaning and importance given to knowledge creation and learning is diverse (e.g. who should learn what, how to monitor, actor interaction and the formalization in grey and scientific literature). The importance given to knowledge development is not surprising. First, pilot projects do offer more opportunities for knowledge creation and learning than routine projects. Reasons for this are the experimental attitude, leading to the installation of monitoring and analysis programs and greater openness to learning. Actors also cooperate in unusual coalitions. The merging of their existing knowledge leads to new insights. Using the knowledge claim helps initiators to meet the expectations of other actors and so to persuade them to support the initiation of the pilot project. The knowledge claim also provides the initiator with protection against what would otherwise be considered 'failure'.

Pilot projects appeared to enable the development of a complex constellation of knowledge. The knowledge can be on diverse aspects including concept-context interactions, designing, actor values and assumptions about the concept. In general, pilot projects are particularly strong in developing contextual knowledge grounded in practice and in the enabling actors to gain experience. Due to these specific possibilities for knowledge creation and learning, pilot projects hold a unique position in policy- and innovation processes.

Despite the possibilities for unique and thorough knowledge development, the case studies also give reason to think that the potential for knowledge creation and learning across a broad range of actors has not been fully exploited. Possible reasons for this are the inherent biases and frames guiding the research (Bergman and Coxon 2005), lack of interest, the soft nature of knowledge making it difficult to recognize, and the absence or inadequacy of activities. For example, not all pilot projects have extensive monitoring activities nor a balanced communication strategy to facilitate interactions between stakeholders.

A major reason to initiate pilot projects is to develop evidence to enable informed decision-making. However, the case studies demonstrated that knowledge can be interpreted differently. 'Evidence' can be disputed and is of an ambiguous nature. For example, in Basel according to one actor the pilot is beneficial for multiple goals, according to the other actor risks are too large (Wüthrich and Geisbühler 2002). Comparably, in Altenheim according to one actor the pilot showed the benefits for ecology and the concept should be applied in all areas, whereas according to another actor the results within the pilot are questionable and would be disastrous for other areas where other conditions apply (GwD SO/HR 2000, Bürgerinitiative Breisach). The interpretation of knowledge to be acceptable as evidence depends on beliefs and assumptions of actors, their research tradition and position in the process (Bergman and Coxon 2005). Furthermore, 'evidence', or rather the interpretation of knowledge, appeared to contribute to diffusion, but is not a necessary pre-condition. Anticipated evidence may suffice to create trust in each other and the innovation to enable diffusion, as was demonstrated in the Beuningen case. Non-shared perceptions on evidence, however, and particularly the consequent actions taken, do hinder diffusion.

Lastly, in addition to the findings enabled by the framework, its refinement would further facilitate future research. For example, the knowledge dimension 'generic-contextual' could be refined. I observed that knowledge is neither contextual nor generic, but that the knowledge is contextually dependent. For example, some permits are specific to a municipality, while others apply to the national context. Next, learning is a multi-dimensional concept that cannot be described appropriately in terms of exclusive learning types (e.g. either rule-based or learning through experience). Instead, the learning types partially overlap and complement each other. More specifically, social learning could be refined. In scientific literature, social learning is assumed to bring actors together. This study showed that despite social learning attempts (i.e. social learning as a means) the distance between actors can also increase. I therefore introduced the terms *constructive social learning* and *destructive social learning* to indicate the two types of social learning products. Usually, the intention of social learning is to establish constructive social learning, which is thus the type meant in literature when discussing social learning (e.g. Muro and Jeffrey 2008, Mostert *et al.* 2007). Destructive social learning is a negative outcome. However, destructive social learning might also be intentionally strived after to deliberatively prevent diffusion of the innovation. Lastly, the aspect of anticipated evidence or 'when do actors have sufficient trust in the innovation and each other?' could be a valuable addition to the framework.

Diffusion

Through diffusion a pilot project, or aspects thereof, becomes part of a larger policy- or innovation process. Diffusion can occur both explicitly and implicitly. Actors are not always aware of the knowledge they have and apply to new situations. All studied pilot projects had some diffusion aspirations, which were adjusted over time. However, the effectiveness was limited. Diffusion appeared to be directly related to the capacity of actors and their willingness to devote resources to diffusion.

In the remainder of this section I discuss new insights on diffusion while following the structure of the framework.

Patterns of Diffusion

I conceptualized the patterns of diffusion as *dissemination* to other pilot projects and management projects, *scaling up*, which in its turn includes *expansion in space, time and problem scope,* and *institutionalization*. On the basis of this conceptualization the following observations can be made:

- Within the identified patterns, more complex patterns could be discerned by distinguishing between first and second order diffusion. For example, through initial institutionalization, second order diffusion in the form of dissemination took place. Theoretically, multiple order diffusion could take place over time. However, the context increasingly plays a role by providing new inputs and so after some point it is questionable whether the observed pattern is really diffusion of the pilot or the result of a more general development.
- Dominant diffusion patterns are related to the design of the pilot. The spatial scales remained comparable, and the policy embedding remains the same. The pilot project primarily moves within a policy layer (e.g. from local to local or from regional to regional).
- Dissemination patterns are weaker than scaling-up patterns in achieving independency of the initiator. Institutionalization in particular ensures a longer lifetime of the concept and persistence in implementation than other forms of diffusion. Reasons are that resources are made available to implement the concept and to continue knowledge development. The innovation becomes part of a relatively stable system (cf. Zonneveld 1991). The continued diffusion of disseminated pilots is more uncertain because the diffusion is dependent on individuals taking up the challenge and is more prone to being reduced in ambition level. On the other hand, the concept benefits from more freedom and the flexibility for tailor-made solutions.

- Despite the importance of institutionalization for diffusion across bureaucracies, the Altenheim case shows that institutionalization is no guarantee for (easy) implementation. Here, the often mentioned gap between policy and practice is confirmed.
- Diffusion, and particularly scaling up, is about shifting boundaries by including additional actors and resources. Accordingly, the complexity of the policy or management project increases, or rather, is more acknowledged than in the pilot project.

<u>The Nature of What is Diffused</u>

The most straightforward idea on the nature of diffusion is that the innovation tested in the pilot is reproduced (e.g. Van Mierlo 2002, Rogers 1995). Indeed, interviewees indicated that they evaluate a pilot according to whether the innovation becomes a (formally) approved alternative to existing practices and particularly by whether the innovation is used again. Replication is particularly applicable to pilot projects dealing with artefacts. For pilot projects dealing with concepts, pure replication is unlikely owing to the need to adapt to local circumstances every time. Nevertheless, diffusion of a conceptual innovation is possible, is often core to the attempts of developers and is recognized by others as diffusion. In addition to this *narrow diffusion*, less tangible and therefore less obvious forms of diffusion occur. This includes the diffusion of knowledge, both hard and soft. All options together can be conceptualized as *broad diffusion*. Examples of diffused hard knowledge in the case studies include knowledge on floodplain revitalisation and methods in Basel and knowledge on fluvial landscape patterns in Beuningen. Diffusion of soft knowledge is in its turn less easily identifiable than diffusion of hard knowledge. Examples of diffused soft knowledge from the case studies include the desire for continuation of interdisciplinary work in Altenheim, design skills and an established understanding of each other's way of working in Beuningen and breaking contacts in Basel. Diffusion can also be *negative*, such as deliberately not continuing cooperation or deciding not to use the innovation.

In the following list I give an overview of elements that I elicited from this research as being diffused. In brackets I include the patterns of diffusion that match with the form of diffusion:

- The innovation (both artefact and concept)
    - Application of the innovation in other spaces or times *(dissemination, expansion)*
    - Inclusion or deliberate exclusion of the innovation as a policy alternative *(institutionalization)*
- Hard Knowledge
    - Adaptation of ongoing policies based on 'evidence' or on conceptual assumptions *(institutionalization)*

  - Use of hard knowledge (on the biophysical system, designs, boundary conditions, externalities, technology, methods) in new projects or adaptation of innovation *(dissemination, expansion)*
  - Formalizing cooperation structures or institutional arrangements (*institutionalization)*
  - Development research questions or awareness of knowledge gaps *(dissemination, expansion, institutionalization)*
- Soft Knowledge
  - Use of experience and skills in diverse forms (e.g. in designing, in process management, working methods) *(dissemination, expansion)*
  - Renewed or cancelled cooperation *(dissemination, expansion, institutionalization)*

<u>Channels of Diffusion</u>
The last aspect necessary to describe diffusion is the channel through which the diffusion takes place. The channels of diffusion are conceptualised as *internal, external* or *mixed*, with internal referring to pilot participants and external to non-actively involved actors. The important role of the initiators in diffusion in all cases indicates that the channels of diffusion are predominantly internal, particularly during or directly after the pilot. In Beuningen, the withdrawal of the initiator -for diverse reasons- reduced the desire to continue with the pilot and the innovation.

The importance of internal actors for diffusion implies that internalizing actors facilitates diffusion. Actors can then learn and become a conduit for knowledge (Argote and Ingram 2000). Additionally, through their internalization their resources, including decisional power, become available. For example, in Altenheim, where the pilot expanded into an open-ended project, the actor with the decisional power to stop or continue was the initiator. However, internalisation goes beyond formal inclusion in participation processes: actors need to feel committed or at least not threatened. For example, in Basel the actor with decisional power was not fully internalized in the pilot and decided not to continue.

Diffusion through internal actors explains why diffusion primarily moves along comparable policy levels (see patterns of diffusion). Actors bring the knowledge to their own context. Consequently, institutionalization is most likely when the initiators derive from the strategic policy level such as in Altenheim, and least likely when they are policy outsiders, such as in Basel. Diffusion across policy levels occurs when the interconnectedness between strategic and operational levels across organisations and policy levels is well established.

External channels of diffusion were limited and occurred only at later stages, if present. An example was the interstate knowledge exchange (LAWA) in the Altenheim case, whereby the nature of diffusion is in the form of a source of inspiration. The influence of the pilot becomes less directly recognizable.

7.3.4 Conclusion

The initial framework provided a structured way to describe pilot project uses, characteristics and effects in terms of systems' responses, knowledge development and diffusion. Insights on the ambiguous and dynamic nature of pilot projects, the design of pilot projects, the irreversibility of actor relations, the claimed importance of knowledge development in pilot projects, and the limited exploitation of the knowledge potential were generated. The development of soft knowledge in particular is often under-appreciated. Other new insights lay in the refinement of social learning effects to include destructive and constructive social learning, and the broadening of the understanding of pilot project diffusion. Diffusion relates to the innovation, as well as hard and soft knowledge to different places in policy and management circles through internal and external channels. Diffusion is unlikely without an active role of the initiator and is largely determined by their position in the network.

Overall, the framework of analysis offers a structured approach for pilot project evaluation. It enables the elicitation of factors that contribute to diffusion and diffusion dynamics. The results from this chapter indicate that pilot projects can be designed to some extent and that relations exist between the pilot character and its effects. Consequently, conditions can be created to strengthen the effects of pilot projects. In the following chapter I will discuss pilot dynamics further and develop strategies to increase the diffusion effectiveness.

PART III: Reflection

8.

Pilot project dynamics: enhancing diffusion

8.1 Introduction

In chapter 7, I explained that initiators usually focus on diffusion and that the diffusion effectiveness of the case studies was limited. Additionally, I indicated in diverse places in this thesis that pilot projects are dynamic. Goals and designs change over time. In this chapter I elaborate on pilot dynamics by discussing pilot evolution (section 8.2) and factors of influence (section 8.3). Subsequently, I formulate strategies that can be used to enhance the diffusion effectiveness (section 8.4). As such, this chapter elaborates on the framework developed and applied in this thesis to systematically analyse pilot projects. The empirical basis for this chapter derives from both the case studies and the WINN projects of the primary analysis.

8.2 Pilot project evolution

The case studies demonstrate that in pilot projects different activities are undertaken. In combination with the contextual interaction this leads to a specific dynamic process for an individual pilot project. In this section, I discuss and conceptualize pilot project evolution. Evolution refers to the dynamic process the pilot experiences as a result of the activities.

A pilot project includes, following its initiation, five different activities. With initiation I mean the transformation of an idea into a formal pilot project to which resources are dedicated. The five activities include:

i. *Process design*: setting up actor participation and the planning of other activities to be undertaken
ii. *Design of the intervention*: shape, duration, scale of the intervention
iii. *Implementation* of the intervention in the field
iv. *Monitoring and analysis* and

v. *Diffusion*: feedback and spread of knowledge from the pilot into practice and policy-making

In Figure 8.1 the activities are depicted. Although the activities are depicted as a sequential process, practice can deviate from this. Activities that are depicted later can be initiated earlier or in parallel. For instance, monitoring can start before implementation to gain insight in the reference situation, or a design can be re-addressed during monitoring. Additionally, in a pilot not all activities have to be undertaken. Usually, the activity 'implementation of an intervention in the field' is considered the core of a pilot. When actors use the term 'pilot project' they usually refer to this narrow meaning of pilot projects.

A basic assumption of the pilot process as depicted in Figure 8.1 is that pilot projects converge and adjust societal innovation processes. Diverse limiting factors (indicated with the diamonds in Figure 8.1) cause ideas not to persist or at least not in the intended way. They are adjusted or refined before the process can continue. Most ideas do not even make it to the initiation of a pilot project. Even when a pilot project is started, the innovativeness of the ideas has usually been reduced in the search for consensus and a match with policies and institutions (cf. Sendzimir *et al.* 2009). Biophysical and particularly societal constraints become evident during the design process and the implementation. Some pilot projects will run into such big hurdles that they are stopped. Next, monitoring and analysis activities can also run into hurdles. Despite the seemingly rational nature of the activity, it is subject to interpretation. Particularly in Basel, and also in Altenheim the subjective nature of monitoring and analysis was revealed. The quality and representativeness of the pilot projects were questioned. Lastly, even if all previous activities have been undertaken, diffusion can be very limited. Reasons include disappointing results, bad relationships, shifts in policy attention and limited marketing. Additionally, diffusion is not of interest in pilot projects that are used as an end (e.g. to resolve a local issue). Accordingly, the pilot process works as a filter for broader societal innovation processes.

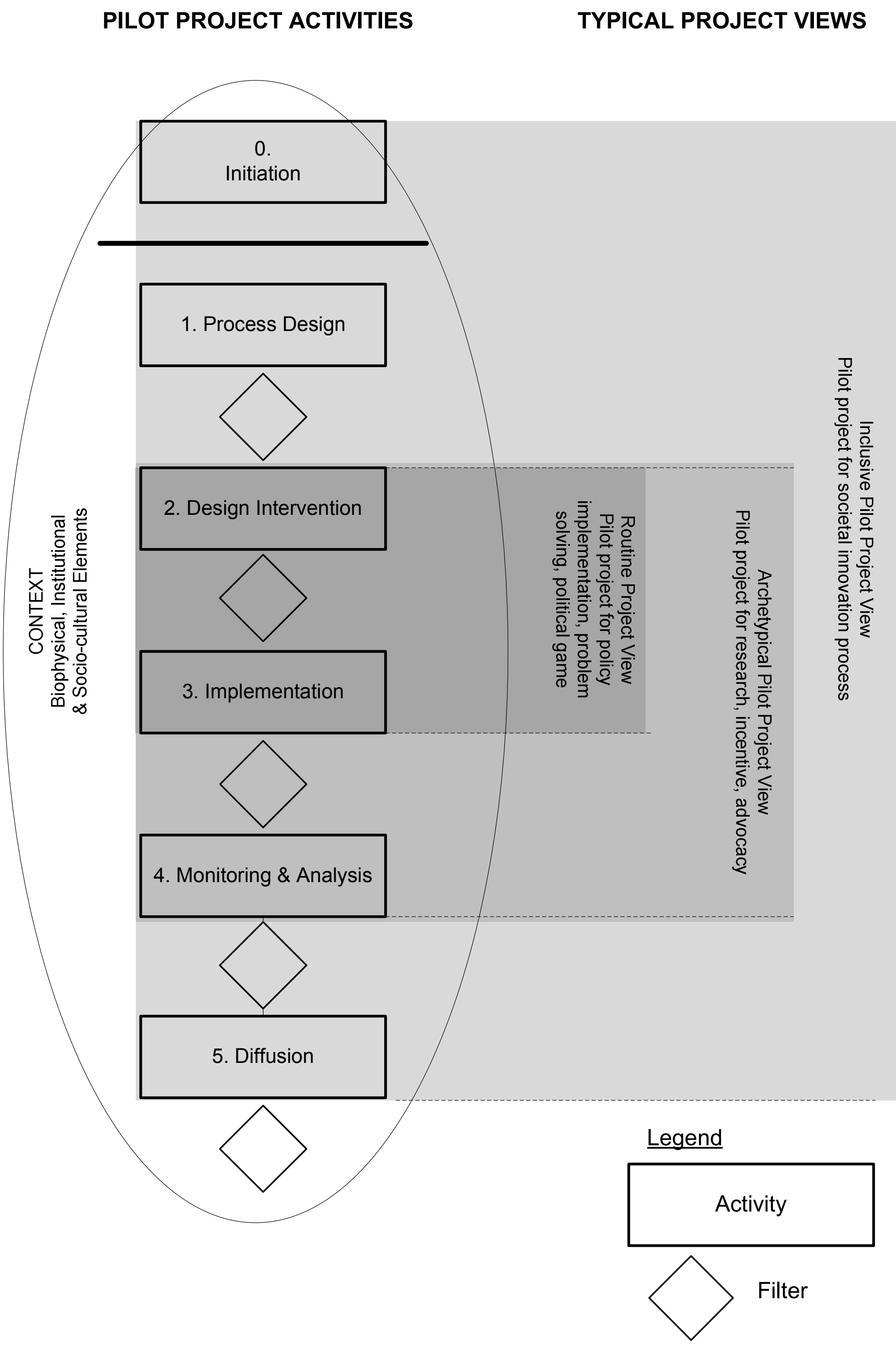


Figure 8.1: Pilot project activities and accompanying pilot project views

On the right hand side of Figure 8.1 typical project views and accompanying pilot project uses have been depicted. Narrow *routine project views* focus on design and implementation activities. This works well when the project is a means to achieve policy implementation or as a political game to divert attention. In *archetypical pilot project views* the view is expanded to include monitoring and analysis. In reality this activity is often the first to be reduced when time or finances are tight. Pilot project uses that fit in this view include research pilots, but also incentives for innovation and advocacy pilots. I choose to exercise an *inclusive pilot project view* so as to include societal innovation. This means that diffusion becomes explicitly part of the pilot project and related activities can be included in the initial project plan. Only in this way can the connection to broader societal innovation processes be established. However, if the purpose is explicitly *not* to do this, a more narrow view suffices. The inclusive view does not mean that undertaking all activities is necessary for diffusion. For instance, the Beuningen pilot showed diffusion into management, despite its lack of implementation and monitoring. The initiation, process- and intervention design provided sufficient incentives to initiate diffusion. Moreover, diffusion has been of a diverse nature (e.g. the innovation, associated knowledge and cooperation).

Diffusion activities were in most instances initiated late in the pilot process. Some preparation for diffusion was present, but a sharp focus on diffusion (e.g. who learns what, adjustment of strategies, connection to critical actors) in the pilot projects was often lacking. For example, policy-makers that are important for policy embedding were only invited during the presentation of the pilot results, or an inventory of potential future application areas and anticipated issues was lacking. Even when diffusion was seemingly well prepared, such as in Altenheim where the pilot was strongly connected to policy-makers, the activities fell short in adjusting to contextual dynamics and so failed to establish implementation of the concept in multiple areas. The need for diffusion management immediately provides a dilemma for initiators. The intervention, monitoring and analysis need thorough attention to develop a 'working' innovation and useful and hard knowledge. Meanwhile the quality of knowledge and the trust therein also depends on soft process aspects, including values, perceptions and relationships. Additionally, the main diffusion strategy is to encourage learning with future users who are not necessarily interested in, or of interest to, the pilot project. It is, however, a pitfall to focus solely on the hard aspects of knowledge development. This increases the chance of excluding the questions of future users or controlling authorities. Preparation for diffusion is therefore a mixed process of collecting and learning both hard and soft knowledge. Moreover, preparation for diffusion runs throughout the pilot process and interweaves with other activities. In the following section I provide a structured discussion of factors influencing pilot dynamics.

8.3 Factors influencing pilot dynamics

The factors that influence the pilot derive from the context and the design choices. The context at the point of pilot initiation and the project plan provide the pre-conditions of the pilot project. These influence the initial pilot dynamics. Through their interaction and autonomous contextual developments, the context and the design choices change over time. In this section I discuss both internal (design) factors and external (contextual) factors that appeared in the studied pilot projects to influence the pilot project.

In the pilot design and management the following factors appeared to be of importance for the pilot and its diffusion:

- **Actor Network structures:** The actor-network structure determines how actors are positioned in the pilot project and policy domain and therefore which resources are available, which stakes are safeguarded, and who can learn through experience and interaction. The following factors were found to be of specific importance:
  - *The position of critical actors:* Critical actors are those actors without whom the pilot cannot take place or continue (Baakman 1990, Enserink 1993). They hold for example critical resources (e.g. land), are responsible, act as quality controllers (e.g. the water authority), or are future users. Inclusion of critical actors in the pilot enables the initiation of the pilot. Additionally, their questions and concerns can be included and their learning fostered. On the other hand, they also influence the design of the pilot project with their concerns and requests.
  - *Representation of stakes*. Not all stakes are necessarily represented in the pilot project by their 'natural' stakeholder. Risks thereof are that this interest is not safeguarded and that existing knowledge on this issue is not used. Additionally, when another actor takes up the task instead, their integrity and legitimacy can be questioned, particularly when they are assumed to be 'neutral'. Questions arise as to whether they have a hidden agenda or use public research money to advocate certain policies. Consequently, their position becomes vulnerable and the process gets jeopardized.
  - *Landownership:* Landownership is of large importance in IWM therefore mentioned here separately. When being the landowner, the initiator can, within the boundaries of regulation, initiate a pilot project. When landownership is more scattered, the landowners need to be convinced to participate. Convincing arguments can be that they are interested in the innovation, that they serve society, societal pressure or compensation. The chance increases that the preparation time for the pilot increases and that designs need to be adjusted to convince the landowner.
  - *Interconnectedness*. 'Interconnectedness' refers to the extent that vital connections between operational and strategic levels are established. A high level of interconnectedness encourages simultaneous learning at all levels. Consequently, favourable conditions such as freedom from

rules, trust and a feeling of importance can be created (cf. Nilsson 2005).

- *Interface between science and policy.* Pilot projects are a forum for creating dialogue and cooperation between science and policy. All interviewed participants recognized the added value thereof (c.f. Freiberger 2007, Wüthrich and Geissbühler 2002). Pilots enable the bridging of gaps between policy-makers and scientists. Common gaps are timely delivery versus research rigour and policy relevance versus long-term understanding (cf. Turnhout *et al.* 2009, Cabinet Office 2003, CIS 2003).

- **Site and scale choices:** The pilot site and the scale influence which issues are addressed in the pilot project. For example, with the choice for a site, large risks can be omitted (e.g. far away from critical infrastructure), specific relations addressed (e.g. where nature conservation and flood defence meet), or maximum benefits developed (e.g. where are the conditions right for this innovation). With the scale choice the level of complexity addressed can be influenced. By limiting spatial scales, actors can be excluded (e.g. landowners, regional governments) or less river processes studied. By limiting temporal scales, only short term impacts can be studied and interventions isolated from long-term strategies. These design choices have large influence on the representativeness of the pilot for new projects and thus for the diffusion (cf. Hommels *et al.* 2007, Hoogma *et al.* 2002).

- **Governance styles:** The governance style determines the space that is provided to actors to actively participate and so influences who learns what through interaction. Depending on the openness of the governance style, decisions are taken with a more or less explicit influence of diverse stakeholders (Pretty 1994). Open governance styles equip initiators better in anticipating or evening out hurdles in the pilot projects. The complexity of the 'real-world' (i.e. under non-pilot conditions) can be represented better and actors can be prepared for diffusion by setting up constructive social learning processes. Closed styles, in contrast, enable initiators to focus on specific issues, not to compromise on the innovativeness of the pilot and not to be delayed by broad discussions and learning processes.

- **The quality and intensity of knowledge program designs** determines which questions are addressed, which knowledge sources are used and which learning modes are facilitated. As such, the design influences which knowledge is developed and how 'evidence' is accepted (see perceptions of evidence). The quality and intensity of the knowledge program can be highly diverse across different pilot projects. Initiators can design the knowledge program alone or in cooperation with the project team. The knowledge design is influenced by the importance given to learning, the skills of individuals and the frames actors hold. Frames guide which questions are asked, which methods are used for monitoring and analysis, which knowledge is recognized and how results are interpreted (Bergman and Coxon 2006, Schön and Rein 1994). That ideas about learning have changed was demonstrated by the extent to which public participation is facilitated. In the more recent pilot projects, public participation is a common aspect, but in the older pilot projects this was not the case.

- **Initiators as ambassadors or entrepreneurs.** Diffusion largely depends on the extent to which initiators act as ambassadors of the innovation or as (policy) entrepreneurs (Huitema and Meijerink 2009). Lack of interest from initiators to facilitates or encourages diffusion hampers diffusion. Ambassadors consider the innovation as their 'baby' and are convinced of the added value. Entrepreneurs consider the pilot as an investment for future benefit. For commercial actors this means making money out of the innovation. Researchers, NGOs and civil servants attempt to gain benefits through renewed work and research opportunities, status, and effective use of public money. To be effective ambassadors or entrepreneurs, initiators need to have good substantive and communicative skills. Both communicative skills within the project team and with external actors such as citizens are of high importance. Many actors were convinced to participate because of the enthusiasm of the initiator. People that have these skills were often praised. In contrast, those that lack these skills were considered as primary sources of tensions. The departure of these individuals can, however, open up the process again.

- **The innovativeness of the pilot project** influences the extent to which the pilot project is recognized by actors as useful and how the innovation fits in existing institutions. Highly innovative pilot projects addressing future challenges or radical changes in existing practices could be considered interesting. At the same time they are often considered not feasible or at least complicated to implement. Pilot projects with low innovativeness usually address operational barriers and methods to increase effectiveness and efficiency. They fit within existing institutional arrangements and ways of thinking. Lowering innovativeness therefore increases the fit with institutions and think-frames, but may reduce chances for change and the extent to which IWM barriers are identified or addressed.

- **Flexibility of the innovation:** Flexibility refers to the freedom of interpretation and use of the innovation for a specific situation. This particularly applies to conceptual innovations. Flexibility of an innovation enables diffusion through tailor-made solutions to fit with local preferences (cf. Quist 2007). A risk of too little flexibility is that 'solutions' are implemented that do not fit the problem. A risk of too much flexibility is that in the search for consensus the ambition level of the innovation is reduced. Consequently, the integrity of the diffusion can be disputed and those attached to the innovation may lose commitment (Sendzimir *et al.* 2009). A risk of too little flexibility is that the innovation is simply transplanted and conflicts with local conditions and interests.

- **The special status of the pilot:** In pilot projects special conditions apply (cf. Raven 2006, Hoogma *et. al.* 2002). Examples include the availability of extra resources (e.g. a site, laboratories, experts), media attention and a relative freedom from policy (e.g. no policy goals have to be achieved). Participants indicated that they experienced positive energy from participating in a pilot project. They were very clear that it was the pilot setting that enabled the initiation of the pilot project in its current form. Due to the pilot status, some actors participated who would not have done so under routine circumstances. The special status, however, also brings its own hurdles for diffusion to non-pilot situations (cf. Hommels *et al.* 2007). The special status limits the representativeness of the pilot, because conditions and attitudes change in new situations. The usability of the developed knowledge for the new situation can then be questioned and the threshold for actors to participate becomes higher. In the pilot, professional risks are low due to the tolerance of failure, actors have more freedom for creativity and they can work on public relations. Once the pilot and thus the special status disappear, actors no longer enjoy the freedom of the pilot. They need to return to 'everyday work'.

- **The timing of diffusion strategies:** Diffusion is fostered by learning of both hard and soft knowledge. Much of it needs time to be learned. Institutions are particularly slow learners (Zonneveld 1991, Argyris and Schön 1996, North 1990). Therefore, for diffusion to take place, a certain 'preparation time' should be taken into account. Sudden changes can cause opposition. Additionally, the policy agenda may have shifted, making results irrelevant (see also autonomous contextual dynamics).

In the context the following factors appeared to be of importance for the pilot project and its diffusion:

- **Perceptions of evidence** of users and other critical actors influence whether they support or hinder the diffusion of the pilot. This aspect determines whether they think the innovation is of added value. With monitoring and analysis, evidence is developed during the pilot. However, evidence appeared to be ambiguous. It is subject to interpretation and can be highly diverse within a pilot. The perception on the evidence provides the basis for decision-making. Shared evidence facilitates diffusion, but differences in perceptions of evidence can be a source of conflict. Note that evidence does not necessarily derive from monitoring and analysis. Other information sources (e.g. science, related pilot projects) in combination with expectations of the pilot can cause actors to *anticipate evidence*, and guide their decision-making.

- **Perceptions of governance styles** influence actor relations and cooperation. With their perception on the governance style, participants develop an opinion of the skills, reliability, integrity and knowledge of the initiator. When the styles are perceived as inappropriate, tensions may arise. Participants can feel threatened or insulted by the governance style and cancel renewed cooperation. Note that the way initiators intended the style does not always agree with how participants perceive the style. Initiators can have mixed feelings about which style to use, but participants clearly prefer open styles. Muro and Jeffrey (2008) and Nilsson (2005) also indicated that open styles increase mutual understanding and trust in each other and in the 'evidence' of the pilot.

- **The relation to policies and the institutional fit** influence the freedom to innovate, the pilot acceptance and the likelihood of adoption by policy-makers. Pilot projects in the policy core may benefit from resources policy actors often possess. Policy actors have larger influence on these pilot projects to make them fit with institutions and policy goals. This reduces the innovativeness, but increase chance of adoption because they fit with the demands of policy-makers. In this line, pilot projects that are developed by the user are easier adopted because the innovation can be matched with the user's demands. Pilot projects that are less dependent on policy actors can be more innovative, because initiators can stay closer to the original pilot ideas. However, pilot projects that do not fit with institutions are likely to strand in a debate about who is responsible and should take the lead and finance the tasks. Even when this is solved, large-scale diffusion is unlikely because institutions would have to change. Rather, the innovation is dropped or made fit with the institutions, because individual managers are not willing or able to change institutions. Institutions are stable entities (North 1990). Additionally, when institutional drivers for change are lacking adoption of the innovation is unlikely. For example, when an actor acts as required (or even better) there is no need to change practice.

- **Fit with values and Zeitgeist.** The values that actors exercise influence what is observed and considered important in the pilot. These can be values on the content and on the process. For example, pilot projects that enable to combine both flood defence and ecology fit with current values and are more likely to be adopted than pilot projects that do serve one of these goals, but harm the other. At the meta-level, dominant values are reflected in the Zeitgeist. The Zeitgeist refers to the spirit or mood of a particular period of history (Compact Oxford Dictionary 2005). The Zeitgeist can enable the initiation and institutionalization of a pilot. For example, in a 'green movement', meaning that environment is an important issue in politics, media and amongst individuals, nature development is supported. However, a Zeitgeist contradicting the pilot project can also hinder its initiation or diffusion. The pilot is then 'ahead of its time'.

- **Autonomous contextual dynamics:** 'The context' is a broad notion in which the pilot is just one of the many factors of influence. Therefore it is not unlikely that the impact of a pilot is small (cf. Weiss 1980). Moreover, the context has its own dynamics over time (e.g. new policies, new Zeitgeist). By not recognizing and adapting to this, the content of the pilot will no longer fit the policy agenda or values. Additionally, process values, such as the meaning of democracy and a move towards individualism, can also change. Actors require more transparent, accountable and participative governance (GWP 2000, UNESCO 2006, EC 2000, Vreugdenhil and Ker Rault 2009). Not meeting the changed democratic values in combination with increasing engagement of actors, may cause opposition. However, recognizing contextual dynamics is not always easy because of the gradual nature of some changes and the internal focus of pilot initiators.

- **Institutionalization:** Institutionalization is a form of diffusion, but also encourages broad application in the long term. When institutionalized, application of the concept is enabled or even required (cf. Quist 2007). Institutionalization fosters further diffusion. Institutionalization brings the innovation to the attention of authorities and agencies, decouples the innovation from the initiator and ensures the allocation of resources. Accordingly, a longer-term stability is ensured (Zonneveld 1991). In some instances, institutionalization is even conditional for further diffusion. For example, a dike technology needs to be approved by a special board before operational managers are allowed to choose it. A risk of institutionalization is 'over-institutionalization' whereby rigidness of standardisation wins over flexibility (Frantzeskaki *et al.* 2010).

In summary, a large number of factors from the pilot design and its context influence the pilot dynamics. Perceptions actors have of each other and of the evidence appear to be a leading factor therein. Perceptions derive from disciplinary and cultural backgrounds, roles and interest in the process and personal values. Perceptions are relatively stable, but not unchangeable. Governance styles, knowledge development and actor-network settings can influence the perceptions. The perceptions are therefore the product of pre-conditions, contextual developments and design choices and adjustments therein. The latter two provide openings for strategies, the first two are external. Section 8.4 further discusses possible strategies for enhancing diffusion.

8.4 Encouraging diffusion

In the previous sections I have demonstrated how pilot dynamics and diffusion are intertwined. The configuration of factors influencing the pilot can facilitate or hinder diffusion. The reason I zoom in on diffusion is twofold. First, diffusion is inherently part of pilot projects and is fed throughout the pilot by systems' responses and knowledge development. Second, diffusion effectiveness is often considered as moderate to low (see also section 7.5). To explore the reasons for this and the possibilities to improve diffusion effectiveness, I focus in this section on hampering factors and accompanying strategies to foster diffusion. The hampering factors are derived from the case studies and could be confirmed by or complemented with insights from the WINN projects and from literature.

8.4.1 Factors hampering diffusion

The factors that hamper diffusion are related to how initiators design and manage the pilot, how critical actors perceive the pilot and whether they are interested in, or willing and able to adopt the knowledge. At a generic level the factors hampering diffusion can be clustered into:

1) **Absence of diffusion management**
2) **Inadequate diffusion management**
3) **Lack of support or opposition from critical actors**

<u>Absence of diffusion management</u>

Diffusion does not occur autonomously, or only in a limited fashion. Lack of active influence of the initiators as ambassador or entrepreneur highly reduces the chance of large-scale diffusion. Reasons initiators do not actively promote diffusion, are:

- They are *not interested.* They may have conducted the pilot for other reasons, may prefer to do initiation tasks, have other obligations or may even leave the initiating organisation

- They are unaware of the need for diffusion management and their role therein. Consequently, they exercise a *Wait-and-See Attitude.*

- They exercise a narrow view on pilot projects, meaning that they consider the pilot process as a sequential process where diffusion takes place after the pilot. Consequently, initiators *lack responsibility* for diffusion activities. More specifically:
    - There is a *lack of incentive*: Tasks have been fulfilled once the pilot has been implemented and they return to 'business as usual'.
    - There is a *lack of capacity:* Resources have not been reserved for diffusion activities from the start

<u>Inadequate diffusion management</u>

Key to diffusion is the creation of knowledge and the learning thereof by critical actors. Inadequate knowledge management hampers diffusion. The following factors cause inadequate diffusion management:

- *Knowledge program is absent or is of low intensity*. Monitoring and analysis are lacking, knowledge is not formalised nor spread through a variety of means such as reports, scientific literature, meetings, media, and workshops.

- *Poor quality of knowledge program*:
    - The *focus is single-sided on hard and substantive knowledge*, while soft and process knowledge are at least as important for knowledge development. This is often underappreciated or the importance only recognized at a late stage. As a consequence, the learning can become of a destructive nature. Actors take distance from each other and cancel future cooperation. Note that such a development would be positive for those who attempt to remove an issue from the agenda.
    - *The contextual dependency of the knowledge has not been explicated*. The wider applicability of the developed knowledge is not understood nor communicated. This may lead to useless or even damaging knowledge in new situations (cf. Flyvbjerg 2006).
    - *Translation of the knowledge into rigid guidelines*. In the guidelines, the flexibility of the pilot project gets lost. Consequently, knowledge cannot be adjusted to make a tailor-made application to the new situation.

- *Poor actor management*.
    - *Ignorance of current and future critical actors* such as users or responsible authorities. Not identifying these actors implies that they cannot be invited to the pilot as participant or observant. The consequences thereof are that a) not all existing knowledge is used for the pilot, b) other actors take the seat of missing actors, which might again lead to reduction of trust, and c) the actors do not learn through experience and do not build relationships
    - *Lack of skills.* Necessary skills for diffusion are communication, understanding of the issue, endurance, enthusiasm and the management of expectations. Setting false expectations can cause disappointment or even opposition and without the enthusiasm of an initiator, others won't follow. However, the combination of these skills within one person is rare, while it is often expected. Particularly the combination of initiator and endurance is rare. Using different people, however, might harm continuity and the developed trust. Trust namely not only builds between organisations but also between individuals.

- *Poor timing of diffusion management*. Diffusion management is initiated only after the pilot, instead of considered an inherent part of the pilot. Learning, however, usually requires time and takes place throughout the pilot. Additionally, pilot projects that have been initiated for specific policy issues can, by having to wait too long for the results, only provide knowledge that is no longer relevant because the policy agenda has shifted (Liebowitz and Margolis 1995, Cabinet Office 2003).

This refers to a known dilemma between science and policy that science wants to do thorough research, whereas policy needs quick results.

- *Complexity of the process:* Inherent to complex problems is that a single actor cannot have an overview of all knowledge. Change cannot be attributed to specific factors and unforeseen effects occur (Martin and Sanderson 1999, Functowitz and Ravetz 1993, Mittleton-Kelly 2003). Since the system is poorly understood, initiators cannot know what the 'right' knowledge is for the 'right' actor, if they have the knowledge at all, and how this will further affect diffusion. Note that the complexity can also work in the advantage of diffusion because of unforeseen developments. For example, new solutions may emerge to resolve crucial barriers.

<u>Lack of support or opposition from critical actors</u>

When critical actors do not support or even oppose diffusion of the pilot, diffusion does not take place or at least not to the intended extent. Particularly when initiators are policy outsiders and the pilot takes place in the policy periphery, the dependency on these critical actors is large. I highlight four factors that can cause critical actors to not support diffusion or that can even create opposition:

- *Lack of institutionalization.* If the innovation is not institutionalized, meaning that the innovation is not an option in the standard practice or protocol of actors, they cannot choose for the innovation. Particularly governmental bodies can be restricted to choose from an approved list of options. Radical, supply-driven innovations that lack this connection to institutions are therefore unlikely to be diffused in policy contexts.

- *Misfit of innovation with existing institutions*. Even if formal institutionalization is not necessary, actors can still be constrained by existing institutions. For example, when there is a misfit in scales between the innovation and existing institutions, it is more likely that the concept is adjusted or not further diffused than that the institution or existing practices are adjusted (Young 2002, Vreugdenhil *et al.* 2010b). Pilots undertaken in the policy periphery are more likely to show misfits with institutions than those undertaken at the policy core.

- *Lack of interest*. Actors do not recognize the outcomes as positive, or at least not for their situation. The innovation has no added value for them. More negatively, when they expect externalities and conflicts with their goals they might actively oppose diffusion.

- *Inadequate perceived governance styles.* Inadequate perceived governance styles are, in the case of conceptual innovation in complex problems, usually the closed styles. Closed styles with autocratic decisions and limited legitimacy collide with contemporary democratic values and lead to non-shared knowledge programs. Not all questions that critical actors consider relevant are asked and disagreement arises on methods considered appropriate. Consequently, evidence is disagreed upon and relationships are put under pressure. The relationships are even further stressed when the personalities of the different team leaders do not match. Note that the perceived style and the intended style are not necessarily the same.

- *Non-representativeness of the pilot* for new situations. Design choices, including small scales, exclusion of actors, non-critical sites, not addressing relevant knowledge questions, and the special status make that the usefulness of the pilot for new situations can be subject to doubt. Conditions change when the pilot project is diffused (cf. Hommels *et al.* 2007, Hoogma *et al.* 2002). Opponents can use the argument of limited representativeness to strengthen their case against diffusion of the innovation. Moreover, they can attempt to deliberately reduce representativeness further if they are not interested in diffusion from the start. For example they can support a pilot project site in which core risks are not challenged.

Table 8.1 provides an overview of the factors hampering diffusion. In an individual project a mixture of these hampering factors is present.

Table 8.1: Overview of factors hampering diffusion

Category	**Hampering factor**

1. Absence of diffusion management	• Lack of interest of initiator
	• Wait-and-See attitude
	• Lack of responsibility
	  - Lack of incentive
	  - Lack of capacity

2. Inadequate knowledge and learning management	• Absence of knowledge program
	• Poor quality knowledge program
	  - Focus on hard and substantive knowledge
	  - Lack of explication of contextual dependency of knowledge
	  - Loss of flexibility
	• Poor actor management
	  - Ignorance of current and future critical actors
	  - Lack of adequate skills
	• Poor timing
	• Complexity of the process

3. Lack of support from critical actors and opposition	• Lack of institutionalization • Misfit with institutions • Lack of interest of intended user • Inappropriate perceived governance style • Non-representativeness (perceived or steered)

8.4.2 Strategies to encourage diffusion

To encourage diffusion, the hampering factors need to be addressed. Hurdles need to be evened out and contributing conditions strengthened. In this section, I suggest strategies that can be undertaken to enhance the diffusion of pilot projects in water management. The strategies relate to the design dimensions: resource allocation, knowledge creation, scale choice, level of innovation, actor network management and governance styles. Design dimensions provide the buttons to influence the pilot design and therefore possibly the pilot dynamics. Additionally, I highlight the role of the initiators because participants clearly emphasized the importance of this. Note that design dimensions are not universally applicable: some initiators have access to more dimensions than others.

For an individual pilot project a mixture of strategies can be selected to set up adequate pilot project management. Actor- and problem analysis before the pilot and regular monitoring of perceptions during the pilot contribute to making decisions on strategies. Most important for enhancing diffusion is the understanding that it is a common pitfall to focus on the intervention and the development of hard knowledge alone and not to actively include diffusion activities. Instead, one should **exercise an 'inclusive pilot project view'** (see section 8.2). Such a view enables the inclusion of diffusion activities in the pilot project plan, undertaking diffusion activities throughout the pilot, and developing a thorough knowledge creation and learning program. The different knowledge dimensions need to be in balance. All knowledge dimensions of substantive, process, hard and soft need to be addressed, as well as the contextual dependency of the knowledge.

In Table 8.2, I provide an overview of possible strategies and how these relate to the design dimensions and hampering factors. The table shows that one strategy sometimes utilizes multiple design dimensions and that changing an individual dimension can contribute to multiple strategies.

Table 8.2: Relations between strategies, design dimensions and hampering factors

Strategy	**Design dimensions**	**Hampering factor**
1. Include diffusion activities in research plan	Resource allocation	1
2. Include a balanced and agreed upon knowledge program	Knowledge program design Actor-network management Scale choices	2,3
3. Enhance knowledge spread and validation	Knowledge program design Incidence of occurrence	2
4. Explicate contextual dependency and representativeness	Knowledge program design Scale choices	2
5. Identify and connect to current and future application areas, institutions and users	Level of Innovation Actor-network management Resource allocation	2,3
6. Exercise open governance styles	Governance styles	3
7. Monitor regularly the desired governance styles and expectations	Governance styles	3
8. Continue to act as ambassador or entrepreneur	Skills	1,2,3
9. Facilitate gradual transfer of ownership	Skills	3

In more detail, the following strategies contribute to enhancing diffusion:

1. **Include diffusion activities in the project plan** so that resources are reserved and the activities are planned from an early stage on. The importance of starting diffusion activities early so that they have time to become effective is not always understood. Even if planned, they are easily sacrificed. Formal inclusion helps to safeguard diffusion activities and to raise awareness of their importance.

2. **Exercise a balanced and supported knowledge program**. This means that all types of knowledge should receive attention (substantive, process, hard and soft). Designing the program in cooperation with participants and future users increases the chance of approval of outcomes. It is less likely that different interpretations of 'evidence' are made, knowledge gaps can be identified better and the critical questions of the different actors can be included. This makes the outcomes more relevant to them. The outlines for the knowledge program should be included in the project proposal to safeguard its execution, while it should stay flexible enough to adjust to ongoing insights.

3. **Enhance knowledge spread and validation**. Knowledge spread and validation can occur simultaneously by writing scientific and professional publications and by **conducting multiple pilots.** Knowledge spread takes place primarily through participants and can be fostered through written and oral material and field excursions whereby the pilot functions as an example (cf. Flyvbjerg 2001). Scientific anchoring implies further specification and contributes to the status of the innovation. Conducting multiple pilots contributes to familiarity with the innovation across a broad range of actors and contributes to establishing common practice. Moreover, results are less dependent on one example. Multiple evidences can be collected and contextual dependency decreases. These actions might increase the willingness to adopt the innovation (see also Raven 2007, Pawson and Tilley 1997).

4. **Explicate the contextual dependency or the representativeness** of the developed knowledge. When striving for diffusion, compare the new and old contexts to identify which knowledge still applies and if values have changed. **Monitoring contextual dynamics** facilitates adjusting the innovation to new contexts. Scale choices, knowledge programs and location choices all influence the representativeness. Expanding scales in time, space and problem scope increases the representativeness of the biophysical and actor complexity for policies. However, increasing representativeness might reduce the implementation speed of the pilot project and reduces the ability to isolate specific research aspects.

5. **Identify and connect to current and future application areas, institutions, users** and other critical stakeholders. Stakeholders representing economic, social and environmental issues should all be included (cf. Quist and Vergragt 2006). Start early explorations of interest and connect the pilot to the goals of critical actors so that there will be added value for them or at least no externalities. By internalizing these actors in the pilot they can indicate their requirements for diffusion and commence learning. I demonstrated that diffusion mainly occurs through internal channels, because intensive learning modes are available to these actors and they assign more importance to the pilot than when they do not participate. Also important is establishing cooperation across strategic and operational levels to foster diffusion at both levels. Commitment can be increased through co-financing arrangements. Identify the requirements for institutionalization and the need for adjustment of the innovation in case it conflicts with existing institutions. A risk of such a 'light' version is that the pace of change for IWM decreases as well as the commitment of the developers (Sendzimir *et al.* 2009). If one does not want to reduce the level of innovativeness one should be prepared to foster learning over a longer period with the risk of being lost in a big 'pool of projects and processes'. Identifying and highlighting the available policy space might help actors to understand their options.

6. **Exercise open governance styles** that favour constructive social learning processes. Perceptions on the pilot and its evidence can diverge (Muro and Jeffrey 2008). On the one hand, exercising open styles makes more knowledge available, questions and methodologies can be agreed upon and other actors' viewpoints and different interests can be taken into account (cf. Leeuwis 2000). On the other hand, open styles allow actors to acquire experience, which in its turn fosters diffusion. Actors learn to understand the pilot project, and each other at a professional and personal level, develop enthusiasm or aversion for the innovation, and gain experience in designing and implementation as well as their mutual interdependencies. Providing information alone has little impact on decision-making (Weiss 1980).

7. **Regularly monitor the desired governance style and expectations** of pilot participants and future stakeholders. Changes in democratic values can then be incorporated. Additionally, monitor whether the intended and perceived governance styles still match. For sensitive pilots, a relatively neutral steering committee could safeguard the quality of the process.

8. Initiators should **continue to act as ambassadors or entrepreneurs** to drive diffusion because diffusion is inextricably associated with them. Preferably the same individuals as those initiating the pilot should facilitate the longer term diffusion process. Particularly the continued enthusiasm and rust built through communication and commitment are important. Since diffusion requires different skills, different individuals may have to contribute. If so, continuity needs to be guarded by creating overlap of involvement and

initial individuals need to remain committed albeit less prominently. An exception is that if personalities clash, one could retire from the process and so opening it again.

9. **Facilitate gradual transfer of 'ownership'** to the users so that dependency on initiators gradually reduces and that long-term diffusion through external channels can be ensured. Ownership implies that users consider the innovation as their own, recognize their 'stamp' on the innovation, and have access to it when they want (cf. Nilsson 2005). A mixture of formal and informal institutionalization can create ownership. The transfer process should go gradually, whereby initiators must be prepared to not claim ownership or emphasize their own role. Sudden withdrawal should be prevented.

Applying these strategies can foster diffusion, but there is no guarantee of effective diffusion. Contextual elements that cannot be influenced also play a role in diffusion and provide windows and barriers to diffusion. The good news is that contextual developments can offer new windows to stagnant processes, for example, when new people are put in charge.

8.5 Concluding remarks: Strategic behaviors and design dilemmas

From the preceding discussion on strategies to enhance diffusion and the understanding of pilot processes it appears clear that pilot projects cannot be steered. They can be facilitated, but the outcomes remain uncertain. Moreover, initiators have to deal with paradoxes and associated dilemmas inherent to pilot projects. Some of these dilemmas are fed by strategic behavior of both initiators and participants.

An example of strategic behaviour is when participants purposely limit the representativeness of a pilot project. They use their resources and power to influence the pilot design in such a way that knowledge not relevant for diffusion is developed. This happens when actors participate so as to close off long-existing societal pressure for action. They participate for the show. From the start, the intention of these actors is to withdraw when the official pilot time is over. Even if they do not have access to the design, they can always use the representativeness argument as an exit-option. To enforce their arguments they can conduct a shadow analysis of the pilot project. Note that a shadow analysis can also be done for the opposite reason: the 'official' pilot analysis develops a negative advice regarding the innovation, but the actor collects evidence to show that it does work. A second example is when actors start with a high bid. Starting negotiations at a more realistic level would cause them not to achieve intended goals. They anticipate that they will have to search for consensus during which goals will be lowered. Risks are that other actors consider the gap between communicated risks too wide to negotiate.

Lastly, paradoxes related to the diffusion of pilot projects, include:

The pilot paradox: The special pilot conditions allow a project to be initiated. Indeed, risks are confined and actors are triggered to be at the forefront and to participate. However, the same special conditions hinder diffusion of pilot projects, because representativeness of the pilot is low (cf. Hommels *et al.* 2007). Scales and attitudes change and protection diminishes.

The *research pilot paradox*: Pilot projects framed as research pilots specifically, benefit thereof for their initiation because they are considered as non-threatening for existing policies. However, presenting a pilot as such feeds the expectation that diffusion into new projects and policies is not strived after. Advocating diffusion is then considered an unexpected and inappropriate change, which increases the resistance against it.

The institutionalization paradox: Institutionalization ensures that the innovation is considered as a policy-option and ensures expansion and dissemination over longer periods of time (Zonneveld, 1991). Resources are reserved to ensure this. For the innovation to be institutionalized, existing institutions need to be changed. However, now that the innovation has become common property, it becomes a barrier to new innovations. Additionally, knowledge becomes standardized and the flexibility that ensured tailor-made applications and provided one of the success factors for the pilot gets lost. Lack of tailor-made applications hinders further diffusion and particularly dissemination.

Initiator's paradox: For effective diffusion an initiator needs to actively promulgate diffusion of the pilot project. Yet, to ensure long-term continuation, the knowledge should become independent of the initiator. Ownership should be transferred to potential users and other actors in the field. Consequently, the initiator is both necessary for diffusion and hinders diffusion. He needs to drive diffusion and take distance at the same time.

The policy innovation paradox: A pilot that is close to existing policies and institutions is more easily recognized and experiences fewer barriers to inclusion in policy than a pilot conducted in the policy periphery. However, it is in the policy periphery that there is space for the development and testing of more radical innovations. A pilot at the core thus loses innovativeness.

9.

Conclusions, Contributions and a Research Agenda

In the introduction to this research I highlighted the popularity of inducing pilot projects in water management, as well as the expectations of pilot projects for societal change. At the same time, pilot project participants and evaluators are often disappointed in the outcomes. With this thesis, I aimed to deepen the understanding of pilot projects in water management and to develop strategies to facilitate the diffusion of the pilot projects into policy and practice. Due to the existing research gaps on pilot projects in IWM, the instrument itself had first to be understood. To achieve this, I first elicited reasons for initiating or participating in a pilot project. Second, I conceptualized the characteristics describing an individual pilot project and distinguished pilot projects from laboratory experiments and routine water management projects. I categorized the characteristics into design dimensions and contextual dimensions on which initiators have little influence. Third, I determined the effects of a pilot project in the water management domain. These three building blocks provided the fundament to study how pilot projects influence the water management domain and which factors hamper the diffusion of the pilot projects into policy and management. I further suggest strategies to address hampering factors. Overall, the research contributes to debates on policy development and innovation processes in the public sphere, and particularly to the role of pilot projects in Integrated Water Management practice. The overarching question addressed was:

How do pilot projects in Integrated Water Management contribute to policy and practice and how can their contribution be strengthened?

The following more specific research questions were addressed:

1. What is the nature of pilot projects in Integrated Water Management?
    a. For which purposes are pilot projects used?
    b. How can pilot projects in Integrated Water Management be characterized?

2. How do pilot projects contribute to policy and practice in Integrated Water Management?
    a. What effects do pilot projects have on water management practice and policy?
    b. What are the mechanisms through which effects on water management practice and policy occur?
    c. Which factors inhibit the influence of a pilot project on water management practice and policy?
3. How can the contribution of pilot projects to policy and practice be strengthened?

In answering the research questions, I used a mixture of theoretical and empirical material to develop and test a framework of analysis for pilot projects. The empirical data derived from (i) sixteen WINN pilot projects, of which four were studied in more detail (WINN is the water innovation platform of the Dutch Ministry of Transport, Public Works and Water Management), (ii) interviews with past and present national and international water managers and scientists, and (iii) three in-depth case studies on floodplain rehabilitation in the Rhine Basin in Switzerland, Germany and The Netherlands. Data for the case studies derived from interviews, project participation and documentation review. The framework enabled the analysis of pilot projects, a comparison across the case studies and the elicitation of insights on pilot project dynamics.

In this final chapter I provide answers to the research questions (section 1). Next, I discuss the contribution of this thesis to the scientific debate (section 2). Lastly, I discuss limitations and propose a research agenda for pilot projects (section 3).

9.1 Answering the research questions

9.1.1 Research Question 1. What is the nature of pilot projects in Integrated Water Management?

The first and highly determining choice I made for this research was to exercise a broad perspective on pilot projects to enable the inclusion of a full range of pilot projects. I defined pilot projects initially as '*projects in which innovative approaches or technologies are applied at a small-scale field setting in order to gain broad insight in the functioning of the innovation in praxis. Knowledge is possibly diffused into policy-making and management'*. The selection of a broad range of pilot projects has led to the identification of nine different ways to use a pilot project (chapter 2). Additionally, I identified six characteristics to describe an individual pilot. Essentially, this choice allowed me to recognize the ambiguous nature of pilot projects (see chapter 7), and generate the following insights:

1. The concept 'pilot project' is subject to interpretation (multi-interpretability)
2. Single pilot projects can be used for many reasons (multi-purpose) (*see RQ1a)*

3. Every pilot project has its unique character (multi-faceted) *(see RQ 1b)*

The *multi-interpretability* of the concept ‘pilot project’ appears from the lack of shared meaning given to pilot projects. The boundaries of the concept pilot project are set by the (claimed) spirit of experimentation, the application in a field setting and the presence of scale limitations in at least one dimension. However, within these boundaries room for interpretation exists in how intensive the knowledge focus should be, how innovative the tested concept should be, what the meaning of ‘small-scale’ is, and how much impact a pilot project should have on societal processes. A distinction between pilot project as an end and pilot projects as a means can also be made. As an end, the pilot is expected ‘to work’ and ‘solve a problem’, while as a means more uncertainty is allowed because ‘the pilot should have the freedom to fail, because only then can we learn’. As a means, the pilot is a step towards broader change.

The multi-interpretability of the concept may imply that within a single pilot project the participants give different meaning to the ‘correctness’ of the design and goal of the pilot project. The different interpretations of a pilot project can also lead to different expectations, which can be the reason for disappointments later in the process.

Research Question 1.a. For which purposes are pilot projects used?
Pilot projects were found to be initiated for three main purposes:

- Research
- Managerial
- Political-Entrepreneurial

More specifically, nine different uses have been identified. They can be initiated for the *early evaluation* of policies and the *exploration* of research questions (Research), as *insurance* against large-scale policy failure, to *implement policy*, for *problem mitigation*, and to *initiate communication* (Managerial), and as a *political game* (e.g. removing an issue from the agenda), to *advocate* specific solutions, and as an *incentive* for innovation (Political-Entrepreneurial).

An individual pilot project in IWM is seldom used for a single purpose. All actors have their own reason to initiate or participate in a pilot. For the developers, a major reason to initiate a pilot project, next to their own learning, is to foster learning by the unaware or sceptical user. One respondent formulated clearly that ‘if the user would have been convinced of the innovation, they would immediately have bought 100 pieces’. For the developer, the pilot is therefore a means to improve the innovation based on grounded knowledge. User demands can be met, an issue can be placed on the policy agenda and actors can be convinced to create the necessary support and collect resources. The developers can also profile themselves as being at the forefront and having relevant experience. For the user and other actors critical to the implementation of the innovation, the pilot is a way to see if the innovation brings added value without large financial, political, or professional risks. There is a mixture of enthusiasm and scepticism in pilot projects. Through participation actors can also influence the design and so mitigate externalities. Critical actors, such as landowners or authorities, can also participate to mitigate societal pressure that demands them to change their practices. Note that an actor can be developer and user at the same time. The purposes of pilot projects can also be hidden. For example, an actor can pretend to participate in the pilot to support the innovation but in reality aim to get an issue off the agenda. Consequently, a pilot is a *multi-purpose* instrument, whereby the uses can change over time. Most often the emphasis in the early stages lies with research and shifts over time to more advocative uses.

I have in this thesis developed the Pilot Nonagon as a tool to assess the use of a pilot in a structured way and to track shifts in uses over time. In the Pilot Nonagon, the perspective of an individual actor or of an analyst can be mapped. The Nonagon enables a comparison of the perspectives of different actors within one pilot, the development thereof and the comparison of uses between pilot projects.

The multiplicity of uses provides an explanation of why pilot projects often do not meet the expectations of actors. For example, some actors expect a pilot to inform policy making, but initiators might be more interested in resolving a local issue and do not actively inform policy makers. This can be disappointing to the other actors.

Research Question 1.b. How can pilot projects in Integrated Water Management be characterized?

Pilot projects can be distinguished from laboratory experiments and routine projects in IWM. Pilot projects are distinct from laboratory experiments in that pilot projects are undertaken in the outside world and explicitly focus on the interaction between the innovation and its context. In laboratory experiments, the context is completely controlled and experiments can be repeated. Pilot projects are unique. Lastly, laboratory experiments are usually undertaken at a smaller scale and with a smaller number of actors (usually experts only) than pilot projects. In contrast to routine water management projects, in which standard and accepted techniques are used, in pilot projects innovative approaches or technologies are used. Learning is attempted, or at least claimed. Additionally, pilot projects do not necessarily need to meet existing policy targets as is required of routine water projects. A refined definition of pilot projects is that ‘pilot projects are projects undertaken in the spirit of experimentation in a field setting with an –at least claimed- focus on innovation and knowledge development, often at a small scale’.

An individual IWM pilot project can be described on the basis of six characteristics. Each of these characteristics can have diverse values (chapter 2). The unique mixture of characteristics determines the multi-faceted character of the pilot.

The characteristics and their range of values relate to:

- *Scale:* Pilot project scales are confined, in at least one of the dimensions time, space and problem scope. The extent a pilot is confined on each of the dimensions ranges from absent to high.
- *Innovation:* The level of innovation ranges from high to low in contrast to existing practices and policy. Innovations can be supply-driven, where the developer offers an innovation to a user, or demand-driven, where a user requests an innovation to increase effectiveness or efficiency of existing practices.
- *Knowledge Orientation:* The intensity of the knowledge orientation can vary between low and high. The knowledge focus ranges from expert-oriented to communication-oriented, in which a broad range of societal actors is involved. Learning includes rule-based learning through monitoring and analysis, or social learning through interactions.
- *Relation to Policy and Local Context:* Pilots can be undertaken at the policy core or in the periphery. Pilots in the policy core address policy issues that are high on the agenda. In the policy periphery, there is more room for trial and error, but a lower sense of urgency for policy makers to invest in the pilot and learn from it. Pilot sites can be chosen to include or exclude certain issues.
- *Actor Network:* The actor involvement in IWM pilots varies but can include researchers, governmental bodies and societal actors such as companies, NGOs or citizens. Roles include users, developers and quality controllers. The initiator exercises a governance style that refers to how the initiator involves other actors and thus to the extent actors have influence on the pilot (Pretty 1994). The governance style can range from open facilitative to closed informative (Ker Rault 2008).
- *Special Status of the pilot project:* A pilot receives additional resources and enhanced participation owing to its special status and associated attitudes. The extent to which the special status influences the participation and resource availability can range from low to high.

To finalize, Table 9.1 provides an overview of the set of typical characteristics of the three different pilot types discussed under research question 1a. Note that political-entrepreneurial behaviour can be identified in three aspects of the pilot: in the decision to participate, in its design and in the presentation of results (see chapter 7.3).

Table 9.1: Typical characteristics of research, managerial and political-entrepreneurial pilot projects

	Research	**Managerial**	**Political-Entrepreneurial**
Scale	Confined	Full or confined	Full or Confined
Innovation	High Supply-driven	Moderate Demand-driven	Low or High Supply-driven
Knowledge Orientation	High Monitoring and Analysis	Low Social learning	Moderate Monitoring and Analysis, Social Learning
Relation to policy and local context	In the periphery	At the core	At core or Periphery
Actor network	Initiative from research institute Closed	Developers are users Focus on implementers and external actors	Focus on users
Special status	Moderate	Moderate Fixed site	High Deliberate site choice

9.1.2 Research Question 2. How do pilot projects contribute to policy and practice in Integrated Water Management?

I have answered this question in two ways. First, I identified the types of effects that pilot projects can establish and thus the contributions they make to policy and management (question 2a). Second, I discussed pilot project dynamics. I conceptualized pilot project evolution and elicited factors influencing the dynamics. This provided insight in the mechanisms through which pilot projects contribute to policy and practice (question 2b). Subsequently, insights in the pilot dynamics provide the basis for understanding factors limiting diffusion (question 2c).

Research Question 2.a. What effects do pilot projects have on water management practice and policy?

The effects of pilot projects are manifested as:

1. *Systems' Responses* or more specifically Biophysical responses and Actor-Network responses
2. *Knowledge Development* or more specifically Knowledge Creation and Learning
3. *Diffusion of the knowledge or the innovation.* Diffusion can be described in terms of patterns, nature and channels

The effects are embedded, meaning that the systems' response is a direct effect of the pilot and knowledge development is a reaction to this effect. Together, these provide the basis for diffusion.

Systems' Response

The biophysical response represents the biophysical changes deriving from the intervention and the reaction of the biophysical system to this. The actor-network responses involve the establishment of relations and cooperation between actors who did not cooperate previously. Additionally, actor-network responses are changes in the actor-network structure in reaction to the pilot project, including the convergence or divergence of actors.

Knowledge Development

In the studied pilot projects, knowledge was developed on the interaction of the innovation with its context through monitoring, on issues related to the pilot project but not directly measurable (e.g. extent of fit with institutions), and on designing. Knowledge created about, and during, the pilot project can be described in terms of three axes with dimensions labelled as *substantive versus process*, *generic versus contextual* and *hard versus soft*. Substantive knowledge relates to the technology or system. Process knowledge relates to the pilot development, actor interactions and process conditions such as insights in the necessary permits. Generic knowledge is transferable to other areas and times, while contextual knowledge is limited to a particular setting. Hard knowledge refers to knowledge that can relatively easily be written down. It is of a quantitative nature or tangibly qualitative nature such as actor maps. Soft knowledge refers to knowledge that is embedded in individuals such as experience and skills, or exists between actors such as shared values or relationships. A selection of the different types of knowledge developed in the three case studies is depicted in Table 9.2. I found that in most pilot projects the initial focus is on substantive, generic and hard knowledge, but actors acknowledge in retrospect the development of process- and soft knowledge. Recognizing this, interviewees admitted that the pilot could have been designed more effectively to actively develop these types of knowledge.

Table 9.2: Examples of knowledge developed in the case studies

		Process	Substantive
Context-dependent	*Hard*	- Actor roles and interests - Permitting process - Compensation schemes - Landownership	- Ecological impacts of intervention - Supporting technologies - Flooding schemes
	Soft	- Attitudes towards pilot - Interdisciplinary and – organisational relationships - Motivations for design choices (scale, location) of participants	- Experience in designing
'Generic' (to regional floodplain management)	*Hard*	- Actor-network of floodplain management - Separate institutionalization of nature and hindering IWM - Strategies to cope with externalities	- Water quality of the river - Floodplain revitalisation mechanisms - Monitoring practices - Conceptual guidelines
	Soft	- Relation participation and acceptance/support - Attitudes towards floodplain revitalisation	- Experience with concept and accompanying technologies

Learning refers to the extent to which the knowledge has been adopted by an actor. I assumed that learning in pilot projects can take place through rule-based learning, experience and interaction (Dreyfus and Dreyfus 1986). All three types of learning were confirmed in this study. The three types of learning are thereby complementary rather than exclusive. The explicit focus for encouraging learning in the studied pilot projects was mostly through the formalization and spread of hard, substantive knowledge across a relatively large group of people via documents and presentations in workshops. The pilot functioned as a tangible example (cf. Flyvbjerg 2006). For a smaller group that actively participated in the pilot project, learning was encouraged, both intentionally and unintentionally, through building experience in designing and setting up processes. Interactions between actors led to an exchange of knowledge (cf. Wenger 1998, Salomon and Perkins 1998). This more intense learning is directly related to the extent of participation in the pilot. Participation is therefore the most powerful means of learning. The extent, to which actors learn, depends not only on participation but also on factors such as existing beliefs, interests and individual openness to learning (Brown *et al.* 2003).

Given the types of problems addressed in pilot projects and the created conditions, I confirmed the assumption of Pahl-Wostl (2006) that pilot projects are favourable platforms for social learning. However, rather than assuming that social learning by definition brings actors closer together and is therefore the answer to dealing with complex problems, I found that social learning can be both of a constructive and destructive nature. *Constructive social learning* does adhere to mainstream social learning in which actors grow towards each other (e.g. Pahl-Wostl 2006, Mostert *et al.* 2007). However, *destructive social learning* refers to actors taking distance from each other as a result of negative interaction. This can result in actors no longer cooperating with each other. Whether this is considered as a positive or negative pilot outcome depends on the goals of the actors within the pilot project.

Diffusion

Diffusion in this thesis refers to the extent to which the created knowledge has been re-applied in new situations, institutions, or even to refine the original pilot. The knowledge can be formalized in project plans, policies and organisational structures, but it can also find its way into working methods and habits. Diffusion is the product of learning, but goes one step further in the sense that it transforms knowledge back into action. Learning applies to individual actors. Learning is thus the driver for change, but is not a guarantee (Grin and van de Graaf 1996). In describing diffusion, I go beyond the replication of artefacts, which is common for product innovation (e.g. Rogers 1995). Instead, I propose, in line with Hoogma *et al.* (2002), a more complex conceptualization of diffusion of pilot projects in IWM. I describe diffusion in terms of patterns of diffusion, the nature of what is diffused and channels of diffusion.

Patterns of diffusion include 'Dissemination' and 'Scaling Up'. Dissemination includes the initiation of new pilot projects, management projects at comparable scale, or the adjustment of the initial pilot, all based on knowledge developed in the pilot. In the scaling up pattern, the scale is increased and thus the nature of the problem changes. Scaling up includes 'expansion' and 'institutionalization'. Expansion is the (temporary) enlargement of the pilot project or the initiation of full-scale management projects. Institutionalization implies the inclusion of the pilot in institutions, for instance in a policy or in the formalisation of a cooperation structure. Diffusion patterns were found to relate primarily to the pilot design. The pilots moved from local to local, from regional to regional or from national to national levels. Additionally, diffusion can have multiple iteration rounds and show different time patterns. In some pilots diffusion takes place during the pilot project on the basis of anticipated evidence, in others it takes years before the pilot project is embraced and accepted by the intended actors.

The *nature of what is diffused* can be narrow or broad. 'Narrow diffusion' refers to the duplication or transfer of the innovation. 'Broad diffusion' includes all types of diffusion: positive or negative, explicit or tacit. Overall, I found the following aspects subject to diffusion (the related diffusion patterns are in italics):

- The innovation (both artefact and concept)
    - Application of the innovation in other spaces or times *(dissemination, expansion)*
    - Inclusion or deliberate exclusion of innovation as a policy alternative *(institutionalization)*
- Hard Knowledge

    - Adaptation of ongoing policies based on 'evidence' or on conceptual assumptions *(institutionalization)*
    - Use of hard knowledge (on the biophysical system, designs, boundary conditions, externalities, technology, methods) in new projects, education or adaptation of innovation *(dissemination, expansion)*
    - Formalizing cooperation structures (*institutionalization)*
    - Development of research questions or awareness of knowledge gaps *(dissemination, expansion, institutionalization)*
- Soft Knowledge
    - Use of experience and skills in diverse forms (e.g. in designing, in process management, working methods) *(dissemination, expansion)*
    - Renewed or cancelled cooperation *(dissemination, expansion, institutionalization)*

The *channels of diffusion* can be internal, external or mixed. 'Internal' refers to pilot participants and 'external' to non-participants. In practice most diffusion takes place through internal or mixed channels. This is easily understood when realizing that pilot projects are powerful forms for learning and in particular for learning of participants. Interactions between participants or between participants and their organisations foster diffusion of knowledge. Participants are the largest conduits for knowledge (Argote and Ingram 2000). They take the knowledge and spread it further. This understanding of the importance of internal channels for diffusion emphasizes the role of initiators as ambassadors or entrepreneurs. Autonomous diffusion rarely occurs.

Research Question 2.b. What are the mechanisms through which effects on water management practice and policy occur?

The initial framework that I developed for this research (chapter 3) appeared to be useful for analysing pilot projects at a fundamental level. Based on the developed insights I could take the analysis one step further by recognizing and recording pilot project dynamics. To understand pilot project dynamics better, I developed a model of pilot evolution and elicited factors influencing the dynamics (chapter 8).

<u>Pilot project evolution</u>

I recognized five different activities in the studied pilot projects: *1) Process design, 2) Intervention Design, 3) Implementation of the Intervention, 4) Monitoring and Analysis* and *5) Diffusion.* Despite the seemingly logical order, activities can take place in different orders or in parallel, or not at all. For example, monitoring can be minimized once it appears that resources have run out. The activities that are included depend on the views actors have of pilot projects. The views are the result of the meaning given to pilot projects and actors' interests.

I conceptualized three different types of views on pilot projects to indicate which views initiators and participants may exercise and which consequences this may have for design and expectations. In a *Routine project view* a focus exists on the 'intervention design' and 'implementation' of the intervention (activity 2 and 3). The pilot project is an end for policy implementation and problem mitigation. In an *Archetypical pilot project view* the focus is expanded to include 'monitoring and analysis' (activity 4), even though this activity is often the first to be sacrificed when time or finances are limited. The focus of knowledge development in this view is on hard knowledge and the potential for soft knowledge development is not fully utilized. As suggested by the name, this type of view is most commonly exercised. In both views, diffusion is separated from the pilot and is only considered to occur after the pilot in an autonomous fashion. In the *Inclusive view,* in contrast*,* all activities are undertaken. In this view, pilot project dynamics are recognized and diffusion is considered an inherent part of a pilot. Diffusion is actively facilitated. Therefore, one should exercise this view when interested in the diffusion of a pilot project.

Factors of Influence

I also elicited diverse factors that influence the pilot dynamics (chapters 7 and 8). These factors derive both from the pilot and from the context. The factors from within the pilot are the *design dimensions.* These are the pilot characteristics that can be designed by the initiator. Examples are the scale size and governance style. The *contextual dimensions* of the pilot provide the pre-conditions. However, neither the context nor the design are static. The pilot is undertaken in a field where many other policy processes, management actions, studies and innovations take place. These external processes, in combination with internal processes that influence the pilot or its biophysical or institutional or socio-economic context, foster new pilot dynamics.

Factors in the pilot design and management and in the context that were found to influence the pilot dynamics include:

In the pilot design and management:

- *Which actors are involved* influences which knowledge and resources are available, which stakes are safeguarded, and who can learn through experience and interaction.
- *Scale and site choices*: Scale choices and the choice for pilot sites allow for isolating specific issues and can reduce complexity and risks. However, they can also limit representativeness for diffusion
- *The governance style* determines the space that is provided to actors to actively participate and so influences who learns what through interaction.
- *The quality and intensity of the knowledge program design* influences how much and which knowledge is developed.
- *The interest of initiators in diffusion* influences to what extent the initiator facilitates or encourages diffusion.
- *The innovativeness* of a pilot project influences the extent to which the pilot project is recognized by actors as useful and how the innovation fits in existing institutions.

- *Flexibility* allows for adjusting the innovation in the pilot or in its wider application to the local biophysical conditions and actors' interests.
- *The special status* of the pilot project enables the initiation of a pilot project, but also provides barriers for diffusion owing to reduced representativeness
- *The timing of diffusion strategies* influences perceptions and the relevance of results

In the context:

- *The perceptions of evidence* of users and other critical actors influence whether they support or hinder the diffusion of the pilot. Shared evidence facilitates diffusion.
- *The perception governance styles* influences the relation between actors and therefore whether renewed cooperation is favoured or not.
- *The relation of the pilot project to policies and the institutional fit* influences the relative freedom a pilot has to be innovative and the likelihood of adoption by policy-makers.
- *The extent of fit with values and the Zeitgeist* that actors exercise influence what is observed and considered important in the pilot. The 'Zeitgeist' can enable or hinder the initiation of certain pilots.
- *Autonomous contextual dynamics* can cause the pilot to no longer fit the policy agenda or values.
- *Institutionalization* encourages broad application in the long term. When institutionalized, application of the concept is enabled or even required.

Research Question 2c. Which factors inhibit the influence of a pilot project on water management practice and policy?

In most pilot projects studied, the initiator was interested in diffusion. However, when the primary benefit was in the implementation of the pilot, diffusion was of less importance to the initiator. For other participants diffusion was slightly less important, particularly when direct benefits were lacking. Whether they supported diffusion or not, or even took any initiative, was therefore variable. For some participants it could even be of interest to diffuse a negative message and so help to exclude certain policy options. Reasons are that the innovation in its current form would harm their interests, and that relationships have worsened so much that new cooperation is no longer an option. Despite the importance placed on diffusion, I demonstrate in line with studies from Sanderson (2002), Cabinet Officie (2003) and De Groen *et al.* (2004) that diffusion effectiveness is not obvious. It should also be mentioned, however, that all interviewees of the three case studies indicated that despite disappointments regarding narrow diffusion, the pilot was valuable. Valuable elements were the generation of new data and the defence of each other to non-participants.

As argued under research question 2.a, diffusion depends on the quality and extent of learning of critical actors. Critical actors are those actors whose support is conditional for diffusion of the pilot, because they own necessary resources such as land, have legal responsibilities and accompanying legal instruments, or are the future users of the innovation. Note that an actor can be critical for more than one reason, and can even be developer and user at the same time. The factors that hamper diffusion are related to how initiators design and manage the pilot and so attempt to influence perceptions, and how critical actors perceive the pilot and are interested in, or willing and able to adopt the knowledge. At a generic level the hampering factors for diffusion can be classified as:

1) **Absence of diffusion management**
2) **Inadequate diffusion management**
3) **Lack of support or opposition from critical actors**

More specific factors hampering diffusion have been summarized below. In an individual pilot project, a selection of these factors is present.

<u>Absence of diffusion management</u>
A first reason for the absence of diffusion management is simply that initiators are *not interested* in diffusion. They had other intentions with the pilot, prefer to do other type of activities or have other obligations.

Where initiators are interested in diffusion, the biggest pitfall in diffusion management is that a narrow project view is exercised (see question 2b). As a result of this view:

- Initiators exercise a *wait-and-see attitude.* Diffusion is assumed to occur autonomously.
- An *incentive is lacking.* Initiators achieved their target (i.e. implementation of a pilot) and diffusion falls outside their responsibility. Moreover, the pilot addresses an issue that no actor is or feels responsible for. It falls between two policy domains (e.g. is it neither safety nor nature).
- *Capacity is lacking* because resources have not been reserved to undertake diffusion.

<u>Inadequate diffusion management</u>
In addition to the absence of diffusion management, its quality can be inadequate. Since the creation of knowledge and the learning by critical actors are key to diffusion, inadequate diffusion management refers to inadequate knowledge management. More specifically:

- The pilot *lacks a knowledge program*. Monitoring and analysis, formalisation of results, and sharing activities are absent.
- The *knowledge program is of poor quality*. This means that the focus is single-sided on hard and substantive knowledge and that the contextual dependency of the knowledge has not been made explicit. Consequently, the knowledge might be translated in presumably universal rules that become rigid guidelines for diffusion (Frantzeskaki *et al.* 2010).

- *Actor management is of poor quality.* Current or future critical actors have not been identified or have been ignored. Consequently, not all available knowledge is used for the pilot and actors do not learn through experience or feel ignored. Due to a lack of skills of the initiator (e.g. inappropriate communication, limited understanding of the issue, absence of enthusiasm and endurance, setting false expectations) actor relations are put under pressure.
- *The timing of diffusion management is poor.* Diffusion management is initiated after the pilot, instead of as an inherent part of the pilot. Actor learning was therefore limited or the policy agenda has shifted (Liebowitz and Margolis 1995, Cabinet Office 2003).

Lack of support or opposition from critical actors

When critical actors do not support or even oppose diffusion, diffusion does not take place or at least not to the desired extent. Five factors that can cause critical actors not to support diffusion or even to oppose diffusion include:

- *Lack of institutionalization.* Some actors are restricted to choosing from formally approved options. Innovations that have not (yet) been approved cannot be used further.
- *Misfit of innovation with existing institutions*. When there is an institutional misfit (e.g. due to scale choices), the innovation is easily dismissed or conformed to the existing institutions (Vreugdenhil *et al*. 2010b).
- *Lack of interest*. Actors do not recognize the innovation to have added value for them. When they expect conflicts with their goals they may even actively oppose diffusion.
- *Governance styles perceived as inadequate.* Closed governance styles are often considered inadequate in IWM. They collide with contemporary democratic values and lead to non-shared knowledge programs. Evidence is disagreed upon and relationships are placed under pressure.
- *Non-representativeness of the pilot* for new situations. Actors are not convinced by the pilot for the new situation. Opponents can use the argument of limited representativeness to strengthen their case or even attempt to deliberately further reduce representativeness.

9.1.3 Research Question 3. How can the contribution of pilot projects to policy and practice be strengthened?

Despite the presence of a variety of factors hampering diffusion of a pilot, initiators are not entirely powerless in fostering diffusion. The main strategy for encouraging diffusion is to explicitly **include diffusion activities throughout the pilot and to adopt a balanced focus on the development of all dimensions of knowledge**: substantive, process, hard and soft, together with explicating the contextual dependency. For every pilot project a tailor-made package of strategies can be developed. Essentially, a pilot project should inhibit aspects of all three types of pilot projects to foster diffusion: The explicit focus on knowledge from the research pilot project, the focus on communication and building shared experience from the managerial pilot and the initiator as ambassador who remains open to learning from the political-entrepreneurial pilot. More specifically, the following strategies can be applied (for more detail see chapter 8.4.2):

1. **Include diffusion activities in the project plan** so that resources are reserved for this and the activities are planned from an early stage.

2. **Build an agreed upon knowledge program**. The design of the knowledge program should occur in cooperation with participants and future users to increase the chances of acceptance of the outcomes. Knowledge gaps can be identified better and critical questions of the different actors can be included.

3. **Enhance knowledge spread and validation**. Validation of findings through scientific and professional publications and by **conducting multiple pilots** contributes to the status of the innovation, the familiarity across multiple actors, and reduces the contextual dependency (cf. Raven 2007, Pawson and Tilley 1997). Use different sources, both formal and informal. They are complementary rather than exclusive. Moreover, the initiation of new pilot projects can be needed to build new shared experience that could not be transferred from the pilot because new actors are involved.

4. **Explicate the contextual dependency** of the developed knowledge and preserve the flexibility. When striving for diffusion, compare the new and old contexts to identify which knowledge still applies, which aspects have changed and how the innovation can be adjusted to the new situation.

5. **Identify future application areas and future critical stakeholders at an early stage.** Start early explorations of interest. By giving critical stakeholders, such as future users, a role in the pilot project they can indicate their requirements for diffusion and start learning across all organisational levels (see also strategy 2). Commitment can be increased through co-financing arrangements, but also societal pressure that has built up over the years can be used to convince actors to participate.

6. **Exercise open governance styles** that favour constructive social learning processes. Shared perceptions on the pilot and its evidence can be developed (Muro and Jeffrey 2008). Actors will better understand the pilot and their dependencies upon other actors.

7. **Regularly monitor the desired governance style and expectations** of pilot participants and future stakeholders and users. Changes in democratic values can then be incorporated to prevent the development of negative feelings. Additionally, monitor the match between the intended and perceived governance styles.

8. Initiators should **act as ambassadors or entrepreneurs** to drive diffusion. Diffusion is inextricably associated with initiators. Preferably, there should be continuity in the individuals facilitating the entire pilot including the long-term diffusion process. If not, continuity in the process needs to be guarded by creating overlap in the involvement. Prominent individuals need to remain committed.

9. **Facilitate transfer of 'ownership'** to the users so that dependency on the initiators gradually reduces. This ensures continuation and diffusion on the long term. A mixture of formal and informal institutionalization can be used. Initiators must be prepared to not claim ownership or emphasize their own role.

Despite the possibility to exercise strategies to enhance diffusion, the complexity of IWM and the autonomous contextual dynamics make the exact meaning (e.g. what is 'early') and the effectiveness of the strategies unpredictable. Some hurdles cannot be removed. They are externally determined and cannot be influenced by the initiators. Moreover, it is unlikely that a single pilot will change an entire policy domain. Most pilots will have their greatest impact on their direct context. Expectations should be adjusted accordingly. Exceptional pilot projects, like exceptional research that is socially attractive, may, however, have the expected impacts. Inherent to the diffusion of pilot projects is that, specifically at the operational level, the actor context changes. The shared experience developed in the pilot project is unlikely to be transferred. Instead, new joint (pilot) projects should be initiated to build new shared experience.

The uncertainty in effectiveness of the strategies is further exacerbated by 'hidden' or 'strategic' behaviour (cf. De Bruijn and Ten Heuvelhof 2008). Examples are when actors attempt to limit the representativeness of the pilot, use the argument of limited representativeness as an exit-option to withdraw once the pilot is over since their participation was only to meet societal pressure, or when actors have their own shadow research program in the pilot. Some dilemmas in strategies that initiators face include:

- Do we strive after institutionalization, and if so, how?
- When and how do we reduce our own role?
- How do we balance between representativeness and favourable conditions for initiation? And: How do we communicate about our own intentions?
- Do we choose for incremental innovation and conform to policy- or user demands or do we stay close to our ideals?

The dilemmas can be explained as follows:
The *institutionalization paradox* implies that institutionalization is very important, if not conditional, for the innovation to be adopted by policy-makers. Support is ensured for a long period of time. However, due to institutionalization the innovation

might lose the flexibility it enjoyed in the pilot for tailor-made applications. Moreover, once institutionalized, it might become a hurdle itself for new innovations. The *initiator's paradox* implies that for effective diffusion an initiator needs to actively promulgate diffusion of the pilot project. Yet, ownership should be transferred to potential users and other actors in the field to ensure long-term continuation. Consequently, the initiator needs to both drive diffusion and take distance. The *pilot paradox* implies that favorable conditions enable the initiation of a pilot, but these same conditions hinder diffusion (cf. Hommels *et al.* 2007). For example, confining scales reduces risks and so helps to convince actors to participate, but at the same time it reduces representativeness of the pilot for diffusion. Presenting the pilot for research purposes may convince actors to participate, but when changing the pilot goals they may feel cheated. *The policy paradox* implies that a pilot project that is close to existing policies and institutions is more easily recognized and experiences fewer barriers to inclusion in policy than a pilot conducted in the policy periphery. However, it is in the policy periphery that there is space for a pilot that addresses more radical innovation.

9.2 Reflections on contributions of this thesis to practice and science

The research conducted in this thesis contributes to water- and innovation management and to policy development literature in several ways. The starting point for this research was that the incidence of pilot projects as a policy-, management- and research instrument is growing. They are used to increase the quality of policy making by providing evidence of a policy and are expected to contribute to societal change, and to deal with IWM characteristics such as uncertainty, dynamics and different interests (Van Mierlo 2002, Huitema *et al.* 2009, Collins *et al.* 2007, Mitchell 2005, Walters 1997, Termeer and Meijerink 2008). Nevertheless, evaluators of pilot projects are often disappointed in the extent to which the innovation has been replicated and policies have been adapted (Sanderson 2002, Martin and Sanderson 2001, Cabinet Office 2003, De Groen *et al.* 2004). Additionally, diverse authors (e.g. Greenberg and Shroder 2004, Huitema *et al.* 2009) acknowledge that very little is known about pilot projects as an instrument in IWM.

The contributions of this thesis lie in the increased understanding of pilot projects, the developed support for pilot evaluators and initiators to analyse pilot projects in a structured way, and the formulation of strategies to influence pilot projects. Insights were developed in i) the instrument itself: its ambiguity and added value, ii) the contributions of pilot projects to policy and management and iii) pilot dynamics: pilot evolution and factors of influence. I elaborate on these insights below.

The value of the research should, like pilot projects, be considered as part of a process of systematic production of examples and insights, based upon which the body of knowledge on pilot projects can be increased (Flyvbjerg 2006). Additionally, in line with the research philosophy (see 1.6) the context plays a large role in the value of the results that are not universally true. The context also causes that changes cannot always be attributed to specific factors (Martin and Sanderson 1999, Sabatier 1988) and that pilot projects can also only to a limited extent be actively designed. This implies that recommendations made in this thesis for designing a pilot project to achieve certain goals are not necessarily effective and should be seen as guidelines for facilitating a pilot project, rather than as strict rules. Moreover, they should be tailor-made to the specific pilot project one is working on.

9.2.1 Pilot projects as an instrument for policy, management and research

<u>Expanding policy development models with the ambiguity of pilot projects</u>
In the different policy development models that I used as a basis for this research (the Analytical, Political and Holistic models), different views exist on pilot projects. However, none of the theories holds an inclusive view on the meaning of pilot projects. The models with an analytical or political view on policy-making emphasize either research or political-entrepreneurial uses of pilot projects (cf Bovens *et al.* 2001, Teisman 1995, Miser and Quade 1985) (see chapter 2). Holistic policy theories such as Adaptive Management and Transition Management have a broader view of pilot projects (Lee 1999, Hoogma *et al.* 2002, Huitema *et al.* 2009). They explicitly assign a role to pilot projects in the policy process and address both the research and management uses.

With this study, I expand the understanding on pilot projects in all the theories by highlighting the ambiguity of pilot projects. The ambiguity of pilot projects can be recognized in the multiple purposes for which they are used, the multi-facetted character and the different ways to interpret pilot projects (see RQ 1). More specifically, I expanded the model of Huitema *et al.* (2009) who made a distinction between research and managerial pilots, by refining each of these categories of specific uses, and I add the political-entrepreneurial category. This category is generally not included in the holistic models or the analytical models. Additionally, the multifaceted character and the design dimensions that I identified have not been discussed in theory before.

<u>Positioning pilot projects as an instrument: their added value</u>
I could, in line with the work of Lee (1999) who compared pilot projects with laboratory experiments, distinguish pilot projects from other water management instruments and highlight their added value. Initially, I distinguished pilot projects from laboratory experiments and routine projects in IWM (chapter 3, RQ 1b). To highlight their added value in (scientific) research in addition to their value to IWM practice, I also compare and contrast them here with case study research in IWM. Case study research is also in IWM a popular, but contested, research method (e.g. Eisenhardt 1989, Flyvbjerg 2006, Yin 1993, Dul and Hak 2008). In Table 9.3 I provide a comparison between the four instruments.

When comparing the different instruments to a fleet, laboratory experiments compare to submarines, pilot projects to sailing boats, case study research to rafts and routine water management projects to ferries. In laboratory experiments conditions are completely under the control of the initiator and the target is clear. Much knowledge can be developed about the innovation that is of technological nature (Lee 1999). In case study research, the researcher is an observant and cannot intervene: he needs to follow the waves. Valuable knowledge on understanding projects can be developed. This is particularly interesting for IWM, because projects are abundant in IWM. As a research instrument, pilot projects lie in between laboratory experiments and case studies. Initiators can design some aspects, but other aspects are context dependent, like a sailor who can haul the sails but still depends on the wind. Additionally, in most boats the sailor cannot work alone. He needs a team. All of the team members gain experience during the voyage about sailing, external conditions such as waves and streams, and about teamwork. Objects of study in pilot projects can be both concepts and artefacts. Routine projects as ferries, lastly, use well-established and standardized approaches and technologies, can deal with most circumstances, can plan when to arrive where and can do that multiple times.

Table 9.3: Comparing and contrasting laboratory experiments, pilot projects and case study research

	Laboratory experiment in IWM ' submarine'	**Pilot Project in IWM 'sailing boat'**	**Case Study Research for IWM 'raft'**	**Routine IWM project 'ferry'**
Design Influence	Complete control content and context	Semi-controlled content Given context	Absent	Standardized content Given context
Content	Innovative artefact	Innovative artefact or approach in field situation	Diverse projects	Proven approach
Potential for Knowledge development	High: on the innovation	High: on innovation-context interaction	High: on dynamics in single settings	Absent
Flexibility of content	Low	High	Absent	Low
Role main actor	Developer/ Initiator	Developer/ Initiator	Observant	Implementer
Actor participation and learning reach	Developer	(Temporary) new cooperation of diverse actors	Observant	Implementer or fixed actor coalition

A 'pilot project-open governance style' model

The interaction between practicing with change and the change of practices is demonstrated in this thesis by the interaction of open governance styles and the diffusion of pilot knowledge. Exercising open governance styles enables the inclusion of stakeholders and their knowledge in a project and so better develop IWM practice that includes a wide range of economic, environmental and social dimensions. Additionally, open governance styles are increasingly asked for in contemporary democratic societies. However, policy-makers are not always experienced in exercising open governance styles or may be hesitant for unforeseen effects. In a pilot project, policy-makers can practice with such a change. Moreover, major hurdles for initiating open governance styles can be overcome, because power structures are not fundamentally challenged in a pilot project setting. Instead, the pilot project provides a space for experimenting and learning, while risks and negative consequences have been limited (Lee 1999, Hoogma *et al.* 2002). In other words, a pilot project enables policy-makers to practice with more open governance styles and gain experience in participation and cooperation. At the same time, this practicing with open governance styles contributes to the diffusion of the pilot. In open styles participants are more actively involved and often the number of participants is also higher. Therefore, more actors learn more intensively through interacting and experiencing. The actors can then develop new or broader, and possibly shared, problem perceptions, perceptions of each other and of the evidence (e.g. Brown *et al.* 2003, Argyris and Schön 1996). This new situation contributes to diffusion in diverse ways. First, I demonstrated in this thesis, in line with Argote and Ingram (2000), that internal actors are the main channels of diffusion. Internalizing actors through open governance styles increases the number of channels for diffusion and thus increases the chance for diffusion. Additionally, by broadening problem perspectives, actors can better recognize benefits of the innovation and create negotiation space (Leeuwis 2000, De Bruijn and Ten Heuvelhof 2008). Consequently, the support for the pilot increases and possible barriers for diffusion can be omitted. In contrast, pilot projects with closed governance styles are more vulnerable to negative actor relations and limited recognition of the benefits of the innovation.

9.2.2 Contributions of pilot projects to policy and management

In chapters 2 and 3, I provided a structure of three different types of –embedded- effects of pilot projects on policy and management: systems' response, knowledge development and diffusion. Since different types of effects of the pilot projects can now be recognized, pilot evaluators can make more comprehensive evaluations of pilot projects and balanced statements about their results.

The framework enriched existing literature in which learning, patterns and channels of diffusion were recognized, but systems' responses and specifications of knowledge creation were not, or at least not systematically (e.g. van Mierlo 2002, Douthwaite *et al.* 2003, Rogers 1995, Quist 2007, van den Bosch and Rotmans 2008, Van Sandinck and Weterings 2008). The response of the biophysical system is characteristic for IWM, where pilots are implemented in river basins. The actor-network response is typical for complex problems. The dimensions I identified for knowledge creation were known in literature (e.g. Dosi 1988, Bhatt 2000, Nonaka and Takeuchi 1995), but the combination of hard-soft, contextual-generic and process-substantive for the evaluation of pilot projects was not. Insights from this study are the initial focus in pilot projects on hard, generic and substantive knowledge and later acknowledgement of other types of knowledge, particularly when problems in actor relations arise (see RQ2a). More generally, I found that the potential for knowledge development was not always fully exploited, that the contextual dependency of knowledge appeared to be a relative notion and that the learning taking place in a pilot is not a single mode of learning. Instead, learning took place through a mixture of interactions, experience and rule-based learning. I refined social learning theory by finding positive and negative developments in terms of relationships as a result of the social interactions. Lastly, I refined the diffusion concept by distinguishing between narrow and broad diffusion and positive and negative diffusion.

9.2.3 Pilot project dynamics and pilot project management

Further contributions of this thesis are the increased insight in pilot dynamics and the possibilities for pilot project management. First, by eliciting different views on the evolution of pilot projects I could help to explain how classical pilot project management often leads to disappointments. Next, I identified diverse internal and external factors that influence a pilot process. I elaborated on authors such as Hommels *et al.* (2007), Douthwaite *et al.* (2002), Bijker (2006) and Hoogma *et al.* (2002) who argued that the special conditions hamper a pilot's diffusion. I refined the conditions by the elicitation of the temporary commitment of actors, the limited representativeness of the pilot, and disagreement about evidence, and developed the pilot paradox. These findings demonstrate that the power of pilots is particularly in the initiation of processes. Additionally, I elaborated on Zonneveld's (1991) and Quist's (2007) insights on the role of institutions in change, by formulating the dilemma of institutionalization initiators face. Institutions provide stability and so contribute to diffusion, but they can also hinder diffusion due to the loss of flexibility. Furthermore, insights on the importance of experience-based and interactive learning for diffusion were confirmed by literature (e.g. Callon 1986, Nilsson 2005, Lee 1999, Mostert *et al.* 2007).

Based on the identification of design dimensions and the insights in pilot dynamics, developed insights, I could develop strategies to facilitate diffusion. From this inventory, initiators can select and build their tailor-made strategy. I argued that at the heart of pilot dynamics are the perceptions of critical actors of each other and of the evidence. I proposed strategies that are known in literature (e.g. participative governance, Pretty 1994), but specified these for the pilot project situation. Key to diffusion is the accommodation of the learning of critical actors throughout the pilot. Examples of proposed more specific strategies are the early identification of future users and areas, balancing the knowledge program and the reservation of resources for diffusion. I agree with Callon *et al*. (1986) that differences in perceptions are inherently part of governance of complex systems and that learning cannot take it away, but I also showed that bridges can be build, mutual understanding created and perceptions adjusted for the specific issue you are working on in the pilot. Additionally, in elaborated on negotiation theory. Leeuwis (2000, p.9) argued that in water resources management actors are not willing to take serious part in communication platforms because the resource is too scarce. I agree that conflicts may arise, but I also demonstrated that constructive social learning is necessary to for finding the win-win in complex settings and avoid conflict. Lastly, I elaborated on actor-network management (e.g. De Bruijn and Ten Heuvelhof 2008) by relating strategic behaviour to pilot project design and management, such as participation as a cover up or the choice of the pilot site (see RQ3).

9.2.4 Broader applicability of results

The empirical basis of this thesis lies in Integrated Water Management and more specifically in floodplain management in the Rhine Basin. One could discuss to what extent the results are limited to this research domain, or are also applicable outside river management, outside the Rhine Basin and outside IWM. Many aspects of the pilot dynamics were recognized in different policy development theories and studies. The use of insights developed in this thesis for pilot projects on regulation of the build environment illustrates the wider applicability of the research in practice (Van der Heijden and Vreugdenhil 2009).

Conditions that characterize the studied material include a dynamic multi-actor setting, the situation of the pilot in the public space, the interaction of the societal and biophysical system, the focus on conceptual innovation, and the relatively unique character of the pilot that requires before-after analysis. When transferring results, these types of characteristics should be taken into account. It is probable that the broader applicability of the insights from this thesis decreases when moving away from water management, when moving from north-west Europe to elsewhere, or, when moving from conceptual innovation in public management to commercial innovation in the consumer market. The extent to which results apply to these broader application areas is an issue for future research (see 9.3).

9.3 Beyond this study: a research agenda

Using a mixture of theory and empirical material, I have developed a descriptive framework to characterize and evaluate pilot projects. I made a characterization of pilot projects in water management, identified different ways pilot projects are used, conceptualized the pilot process and the diffusion process by which pilot projects influence policy and management, elicited factors that influence the pilot dynamics, and suggested strategies to facilitate pilot project diffusion. However, many questions regarding the nature and dynamics of pilot projects still remain unanswered and new questions have emerged from this research. Consequently, I propose a research agenda for pilot projects (see Table 9.4).

The first issue on the agenda relates to the applicability of the findings of this study. The work of Van der Heijden and Vreugdenhil (2009) (see 9.2.4) suggest already a wider applicability. The nature of pilot projects, their role in policy-making, and tensions between policy continuity and innovation are not limited to water management. Testing and evaluating the conceptual framework in other fields of natural resource management, such as forestry or marine- and coastal management, and beyond, could yield valuable insights in the wider applicability of results.

Second, research choices and biases have directed this research. Therefore, new views on the material could be developed, different methods applied and different emphases placed. For example, the framework for pilot projects developed in this thesis is the first of its kind. However, it is not the only conceivable framework. Therefore, new studies on pilot projects should remain open to the possibility of conceptualizing pilot projects differently and so deriving different insights on pilot projects. Next, design dimensions have been identified in this research and some of their influences on the pilot projects have been studied. However, some relations have not been studied, or only to a limited extent. An example thereof is the relation between expectations and pilot project dynamics. Expectations were recognized to be of importance in process development and satisfaction, but in-depth study of expectations were lacking. Possibly, expectations should be more modest because actors are caught in a 'pro-innovation bias' (Rogers 1995). Lastly, insight in other relations would benefit from applying different methods. In this thesis, case study research with interviews was dominant. This contributed to recognizing contextual dependency, including actor's emotions that are expressed to the researcher in reaction to open questions. Different types of methods provide different insights. For example, statistical analysis would contribute to finding regularities in diffusion patterns or in relations between characters and diffusion.

Third, in this thesis I focus on pilot projects that have already been implemented or are near implementation. However, many pilot project ideas do not reach the initiation stage, nor do they achieve implementation. Pilot sites or partners cannot be found. I have studied pilot project use and underlying motivations for initiation. I did not study when and how it was decided to not choose for a pilot, but to take a different action or do nothing at all. Some reasons could be a lack of belief in the innovation, perception of the pilot as an obstacle to achieving other goals, the risk that the pilot is not taken seriously because it has no consequences for individuals, its use as a diversionary tactic, the risk of disputed evidence, or that the pilot is expected not to provide useful information. Similarly, there has been little attention for the factor time. Including time more specifically would allow analysis of the development in intensity and patterns of diffusion over time and the role of contextual developments therein. Overall, future research on the dynamics of pilot projects from conception to 'termination' could make pilot mechanisms more insightful.

Fourth, in this research, the commercial aspects of pilot projects in water management received little attention. From the WINN projects it appeared that in technology-oriented pilot projects there is a large role for commercial partners. Private companies develop new technologies that public bodies decide to buy and apply in a pilot project. This aspect was not studied throughout the research and it is not known how this aspect influences the pilot dynamics. Relevant research questions are how and why commercial actors initiate a pilot project, how the interaction with public organisations takes place and how technological innovations diffuse.

Table 9.4: Future Research Agenda

Research topic	Research Question (examples)
Applicability of the findings on pilot projects to natural resource management in general	- Is the suggested conceptual framework (characteristics, uses, and effects) together with the findings on pilot project dynamics applicable in natural resource management fields other than water and beyond?
Empirical testing of the validity and completeness of the findings	- Which patterns in the relations between pilot designs and effects can be found? - What role do expectations play in pilot projects? - How can the nature of pilot projects be conceptualized differently?
Pilot project dynamics further in-depth	- How are ideas selected to be implemented as pilot projects? - What are the underlying mechanisms determining the evolution of a pilot project from the initial idea to its termination? - How do diffusion processes develop over time and what influences this?
Commercial and technological pilot projects	- For which purposes do commercial actors initiate a pilot project? - How do pilot projects with technological innovations evolve and why (which factors are of influence)? - How do interactions between public and private actors influence the nature and functioning of pilot projects in the water domain?

To finalize, this thesis demonstrated that pilot projects clearly have their own position in IWM policy and research. Pilot projects have two main benefits. First, pilot projects enable (temporal) cooperation between actors in unconventional coalitions. Under routine conditions this cooperation could not be established because risks are too large, domains have been separated and a 'spirit of experimentation' is lacking. In pilot projects the risks are controlled, and more creativity and tolerance is exercised. Additionally, pilot projects may address cross-discipline, cross-sectoral and cross-scale issues. Science-policy interfaces can be relatively easily created. Consequently, pilot projects bring actors together who usually do not work together and they can build shared experience.

The second main benefit is that in pilot projects context-dependent knowledge on relatively well-defined IWM questions can be developed. The reasons thereof are the application in the field and the enhanced or new actor interactions. Both laboratory experiments that lack contextual dependency, and case study research, in which the researcher can only observe, fall short in achieving this. Through the pilot, the innovation can be translated into practice and find its way into policy. At the same time, expectations should remain realistic that most pilot projects have their main impact on their direct environment and are just one of the many processes in IWM. Achieving large-scale change through a pilot project alone is an exception rather than a rule. The majority of pilot projects will contribute to the accumulation of knowledge and setting a direction.

Overall, pilot projects can thus initiate new processes or give a push to stagnant policy or innovation processes. The pilot setting enables actors to practice with change. Subsequently, established practices could possibly be changed.

References

Adams, S., and Kriesi, H. (2007). The Network Approach. Theories of the policy process, 2nd ed. In: P.A. Sabatier (ed). University of California, Davis, Westview Press.

Amoros, C., Rostan J.-C., Pautou, G., Bravard, J.P., (1987). The reversible process concept applied to the environmental management of large river systems. *Environmental Management* 11(5): 607-617.

Argote, L. and Ingram, P. (2000). Knowledge Transfer: A Basis for Competitive Advantage in Firms. *Organizational Behavior and Human Decision Processes* 82(1): 150-169.

Argyris, C., and Schön, D., (1996). Organizational Learning II: Theory, Method and Practice. USA, Addison-Wesley Publishing.

Armbruster, J., Muley-Fritze, A., Pfarr, U., Rhodius, R., Siepmann-Schinker, D., Sittler, B. et al. (2006). FOWARA: Forestede Water Retention Areas. Guideline for decision makers, forest managers and land owners. Bühl, Germany.

Baakman, N.A.A. (1990) Kritiek van het openbaar bestuur. Amsterdam (in Dutch)

Baptist, M.J., Penning, W.E., Duel, H., Smits, A.J.M., Geerling G.W., Van der Lee G.E.M., Van Alphen J.S.L., (2004). Assessment of the effects of cyclic floodplain rejuvenation on flood levels and biodiversity along the Rhine River. *River Research and Application* 20(3): 285 - 297.

Bennett, C.J. and Howlett M. (1992). The lesson of learning: Reconciling theories of policy learning and policy change. *Policy sciences* 25(275-294.).

Bergman, M. and Coxon, A. (2005). The quality in qualitative research. *Forum Qualitative Social Research* 6(2): article 34.

Bhatt, G. (2000). Organizing Knowledge in the Knowledge Development Cycle. *Journal of Knowledge Management* 4(1).

Blaikie, N. (2007). Approaches to Social Enquiry: Advancing Knowledge. Polity Press, Cambridge.

Bijker, W.E. (2006). The Vulnerability of Technological Culture. In: H. Nowotny (ed) Cultures of Technology and the Quest for Innovation. New York, Berghahn Books: 52-69."

Birckmayer, J.D. and Weiss, C.H. (2000). Theory-based evaluation in practice: what do we learn? *Evaluation Review* 24(4): 407-431.

Biswas, A. (2004). Integrated Water Resources Management: A Reassessment. *Water International* 29(2): 248-256.

Bosch, T. (2002) Om de macht over water. De nationale waterstaatsdienst tussen staat en samenleving 1798-1849. Europesche Bibliotheek, Zaltbommel (in Dutch)

Bovens, M., 't. Hart, P., van Twist, M., Rosenthal, U., (2001). Openbaar Bestuur: Beleid, Organisatie en Politiek Alphen aan den Rijn, Kluwer Publishers. (in Dutch)

Braun, V. and Clarke, V. (2005). Using Thematic Analysis in Psychology. *Qualitative research in psychology* 3: 77-101.

Brown, H.S., Vergragt, P., Green, K, Berchicicci, L. (2003). Learning for sustainability transition through bounded social-technical experiments in personal mobility. *Technology Analysis and Strategic Management* 15: 291-315.

Buijse, A.D., Coops,H., Staras, M., Jans, L.H., van Geest, G.J., Grifts, R.E., Ibelings, B.W., Oosterberg, W., Roozen, F.C.J.M. (2002). Restoration strategies for river floodplains along large lowland rivers in Europe. *Freshwater Biology* 47: 889-907.

Burgerinitiative Breisach. Burgerinitiative für eine verträgliche Retention Breisach/ Burkheim e.V. http://www.buergerinitiative-breisach-burkheim.de

Cabinet Office (2003). Trying It Out, The Role of 'Pilots' in Policy-Making: Report of a Review of Government Pilots. R. Jowell (ed). London, City University.

Callon, M. (1986). The sociologiy of an actor-network: the case of the electric vehicle. In: Callon, M., Law, H., Rip, A.(eds). Mapping the dynamics of science and Technology. Sociology of Science in the Real World. Houndmills: Macmillan: 19-34.

Campbell, D.T. (1967). Administrative experimentation, insitutional records, and nonreactive measures. In: J.C. Stanley (ed): Compensatory education: A national debate. Chigago, Rand McNally.
Campbell, D.T. (1975). Reforms as Experiments. Handbook of Evaluation Research. In: M. Struening and E.L. Guttentag (eds). Beverly Hills, Sage Publications.
Campbell, D.T. and Russo, M. (1999). Social Experimentation. Sage: Thousand Oaks, CA. 405pp.
Canton Basel-City (1999). Landschaftspark Wiese. Landschaftsplan Basel, Riehen, Weil am Rhein (in German)
Carlsson, L., and Berkes, F., (2005). Co-management: concepts and methodological implications. *Journal of Environmental Management* 75: 65-76.
Carpenter, S., Walker B., Anderies J.M., Abel N., (2001). From Metaphor to Measurement: Resilience of What to What. *Ecosystems* 4: 765-781.
Carter, J. and Howe, J. (2006). Stakeholder participation and the water framework directive: The case of the Ribble Pilot. *Local Environment* 11(2): pages 217 - 231.
Charmaz, K. (2006). Constructing Grounded theory- A practical guide through qualitative analysis. Sage Publications London.
CIS (2003). Common Implementation Strategy for the WFD (2000/60/EC), Carrying forward the Common Implementation Strategy for the Water Framework Directive -Progress and Work Programme for 2003 and 2004.
Collins, K., Ison R., (2006). Dare we jump off Arnstein's ladder? Social learning as a new policy paradigm. Proceedings PATH Conf 4-7 June 2006 http://oro.open.ac.uk/8589/01/Path_paper_Collins_Ison.pdf, Edinburgh.
Collins , K., Blackmore, C., Morris, D., and Watson, D., (2007). A systematic approach to managing multiple perspectives and stakeholding in water catchments: Some findings from three UK study areas. *Environmental Science Policy*, 10, p. 564-574.
Compact Oxford English Dictionary. (2008) 3rd revised edition. Oxford University Press, Oxford, UK.
Convention on Biological Diversity (1993). Convention on biological diversity. Concluded at Rio de Janeiro on 5 June 1992.
Corbin, J. and Strauss, A.L. (1998). Basics of qualitative research: Techniques and procedures for developing grounded theory. Thousand Oaks, California, Sage Publishers.
Cosgrove, W. and Rijsberman. R. (2000) World Water Vision: Making Water Everybody's Business. World Water Council and Earthscan Publications, London, UK.

Davenport, T., De Long, D., Beers, M. (1998). Successful Knowledge Management Projects. *Sloan Management Review* Winter.
De Bruijn, H., and Ten Heuvelhof, E., (2008). Management in Networks: On multi-actor decision-making. London and New York, Routledge.
De Bruin, D., Hamhuis, D.,van Nieuwenhuijze, L., Overmars, W., Sijmons, D., Vera, F.(1987). Ooivaar. De toekomst van het rivierengebied. Arnhem, Stichting Geldersche Milieufederatie. (in Dutch)
De Groen, J., Potze, A., de Jonge, B., Rutjens, J. (2004). Innovatie van de overheid: Een Buitenkans. Positionering van de afdeling Strategie en Innovatie. Den Haag, NSOB. (in Dutch)
De Groot, M. and De Groot, W.T. (2009). "Room for river" measures and public visions in the Netherlands: A survey on river perceptions among riverside residents. *Water Resources Research* 45 W07403 doi:10.1029/2008WR007339.
Dehnhardt, A. and Petschow U. (2008). Governance in River Basins - Introduction and Overview. Sustainability in River Basins. A Question of Governance. e. Dehnhardt A.; Petschow U. Munich, Oekom-Verlag.
De Jonge, J., Van der Windt, N. (2007). Doorbraken in het Rivierengebied - De levensloop van transformerende concepten en hun netwerken in het centrale rivierengebied 1970-2005. Wageningen, Alterra: 60. (in Dutch)
Denzin, N.K., and Lincoln, Y.S. (eds) (2005). Handbook of qualitative research. Sage, Thousand Oaks.
Dietz, T., Ostrom E., Stern P.C. (2003). The struggle to govern the commons. *Science* 302(5652): 1907-1912.

Dosi (1988). Technical Change and Economic Theory, Burns and Oates.
Douthwaite, T., Kuby, T., Van de Fliert, E., Schulz, S. (2003). Impact pathway evaluation: an approach for achieving and attributing impact in complex systems. *Agricultural Systems* 78: 243-265.
Dreyfus, H., and Dreyfus, S., (1986). Mind over Machine: the Power of Human Intuition and Expertise in the Era of the Computer. New York, Free Press.
Dryzek, J. (2005). Deliberative democracy in divided societies: alternatives to agonism and analgesia. *Political Theory* 33(2): 218-242.
Duel, H., Baptist, M. J., Penning, W.E., (2001). Cyclic Floodplain Rejuvenation: A New Strategy Based on Floodplain Measures for Both Flood Risk Management and Enhancement of the Biodiversity of the River Rhine. NCR publication 14-2001. Delft.
Dul, J. and Hak T. (2008). Case study methodology in business research. Oxford, UK, Elsevier Ltd.

EC – European Committee (2000). Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy, council of the European community; Official Journal L 327, 22/12/2000 P. 0001 – 0073.
EC - European Committee (2002). Directorate-General for Environment. Implementation of Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources. Synthesis from year 2000 member States reports Report COM 407.
EC- European Committee (2007). Commission Staff Working Document, Communication from the Commission to the European Parliament and the Council. 'Towards Sustainable Water Management in the European Union' First stage in the implementation of the Water Framework Directive 2000/60/EC. SEC (2007) 363, COM (2007) 128 final.
Eisenhardt, K.M. (1989). Building theories from case study research. Academy of Management Review, 14: 532-550.
Enserink B. (1993). Influencing Military Technological Innovation, Eburon: Delft.

Fischer, F. (1995). Evaluating Public Policy. Chicago: Nelson-Hall Publishers.
Flyvbjerg, B. (2001). Making Social Science Matter: Why social inquiry fails and how it can succeed again. Cambridge, Cambridge University Press.
Flyvbjerg, B. (2006). Five misunderstandings about case study research. *Qualitative Inquiry* 12(2): 219-245.
Forget, G. and J. Lebel (2001). An ecosystem approach to human health. *International Journal of Occupational and Environmental Health* 7(2).
Frantzeskaki, N., Slinger J,H., Vreugdenhil, H.S.I., Van Daalen, E. (2010). Social-Ecological Systems Governance: From Paradigm to Management Approach. *Nature and Culture* 5(1): 84-98.
Freiberger, H. (2007). Environmental relevance of projects in the South of Upper and High Rhine (Northern Switzerland, Southwestern Germany): The problem of scientific input to practical work" Mitteilungen der Naturforschenden Gesellschaften beider Basel. *Mitt. Naturforsch. Ges. Beider Basel* 10: 39-56.
Freude am Fluss (2007). Freude am Fluss. An innovative approach to river management. Drukkerij Libertas, Beuningen.
Funtowicz, S. and Ravetz JR (1993). Science for the post-normal age. *Futures* 25: 739-755.

Geels F., and Raven R., (2006). Non-linearity and Expectations in Niche-Development Trajectories: Ups and Downs in Dutch Biogas Development (1973-200*). Technology Analysis and Strategic Management* 18(3/4): 375-392.
Geerling, G.W., Ragas A.M.J., Leuven R.S.E.W., Van den Berg. J.H,. Breedveld. M, Liefhebber. D., Smits. A.J.M. (2006). Succession and Rejuvenation in floodplains along the river Allier (France). *Hydrobiologica* 565: 71-86.
Geldof, G. (2005). Interactive Implementation. 10th International Conference on Urban Drainage, Copenhagen/Denmark, 21-26 August 2005.

Giddens, A. (1984). The Constitution of Society – Outline of the Theory of Structuration. University of California Press."

Glaser, B.G. and Strauss, A.L. (1968). The Discovery of Grounded Theory. New York, Aldine.

Greenberg, D., Linksz, D. and Mandell, M. (2003). Social Experimentation and Public Policy-Making. The Urban Institute Press, Washington.

Greenberg, D. and Shröder M. (2004). The digest of social experiments. Washington DC, Urban Institute Press.

Grin, J., and Van de Graaf, H. (1996). Technology assessment as learning. *Science, Technology and Human Values* 20(1): 72-99.

Gunderson, L., Holling, C.S., Light, S.S. (1995). Barriers and bridges to the renewal of ecosystems and institutions. New York, Columbia University Press.

Gunderson, L. (1999). Resilience, Flexibility and Adaptive Management -- Antidotes for Spurious Certitude? *Conservation Ecology* 3(1): 7.

GwD SO/HR (Gewässerdirektion Südlicher Oberrhein/ Hochrhein) (1997). The Integrated Rhine Programm - Flood control and restoration of former flood plains on the Upper Rhine. G. Klaiber, Pharr, U., Kuhn, S. Lahr (D), State of Baden-Wuerttemberg (Germany).

GwD SO/HR (Gewässerdirektion Südlicher Oberrhein/ Hochrhein) (1999). Auswirkungen der ökologischen Flutungen der Polder Altenheim. Ergebnisse des Untersuchungsprogramms 1993-1996. Materialen zum Integrierten Rheinprogramm. Band 9. J. Vieser, Staeber, Kuhn, Ministerium für Umwelt und Verkehr. Lahr. (in German)

GwD SO/HR (Gewässerdirektion Südlicher Oberrhein/ Hochrhein) (2000) Gesamtkonzept ökologische Flutungen im Integrierten Rheinprogram. Materialen zum Integrierten Rheinprogramm Band 11. U. Pfarr (ed). Temporäre Arbeitsgruppe 'ökologische Flutungen'. Lahr, Baden-Württemberg. (in German)

GwD SO/HR (Gewässerdirektion Südlicher Oberrhein/ Hochrhein) (2001). Integriertes Rheinprogramm. Fragen und Antworten. Lahr, Baden-Württemberg, Germany. (in German)

GWP – Global Water Partnership Technical Advisory Committee (2000). Integrated Water Resources Management. Background paper no. 4 Stockholm, Sweden.

GWP - Global Water Partnership Technical Advisory Committee (2004). Integrated Water Resources Management and water efficiency plans by 2005- why, what and How? Stockholm, Sweden

Havinga, H. and Smits, A.J.M. (2000). River Management along the Rhine: a retrospective view. in: Smits, A., Nienhuis, P., Leuven, R. (eds.) New approaches to river management.

Healey, P. (2006). Collaborative planning, Shaping places in fragmented societies. 2nd Edition, Palgrave MacMillan

Helmer, W. (1999). Natuurlijke veiligheid: visie op de Rijntakken in het perspectief van stromende berging. Studie in opdracht van Staatsbosbeheer en Wereld Natuur Fonds, Arnhem. (in Dutch)

Henderson, R. and Clarke K. (1990). Architectural Innovation: The Reconfiguration of Existing Product Technologies and the Failure of Established Firms. *Administrative Science Quarterly* Vol. 35, No. 1 (Special Issue: Technology, Organizations, and Innovation): 9-30.

Holling, C.S. (1978). Adaptive Environmental Assessment and Management. London, John Wiley and Sons.

Hommels, A., Peters, P., Bijker, W.E. (2007). Techno therapy or nurtured niches? Technology studies and the evaluation of radical innovations. *Research Policy* 36(7): 1088-1099.

Hoogerwerf, A. (1998). Het ontwerpen van beleid. Een handleiding voor de praktijk en resultaten van onderzoek (in Dutch). Alphen aan den Rijn, Netherlands, Samson HD Tjeenk Willink.

Hoogma, R., Kemp, R., Schot, J., Truffer, B. (2002). Experimenting for Sustainable Transport. The approach of Strategic Niche Management. London and New York, Spon Press.

Hooper B.P., McDonald, G.T., Mitchell, B., (1999). Facilitating Integrated Resource and Environmental Management: Australian and Canadian Perspectives. *Journal of Environmental Planning and Management* 42(5): 747 - 766

Huitema, D., Mostert, E., Egas, W., Moellenkamp, S., Pahl-Wostl, C., and Yalcin. R., 2009. Adaptive water governance; Assessing adaptive management from an institutional perspective. *Ecology and Society* 14(26)

Huitema, D. and Meijerink, S. (eds) (2009). Water policy entrepreneurs: a research companion to water transitions around the globe. Edward Elgar Publishing, Cheltenham, UK.

Huisman, P., Cramer, W. , van Ee, G. , Hooghart, J. C. , Salz, H. and Zuidema, F. C. (1998). Water in the Netherlands. Netherlands Hydrological Society. , Delft, The Netherlands

Huisman, P., De Jong, J., and Wieriks K. (2000). Transboundary cooperation in shared river basins: experiences from the Rhine, Meuse and North Sea. *Water Policy* 2: 83-97.

ICPR (2004). No frontiers for the Rhine. Inventory 2004 for the Rhine river basin. Koblenz.

ICPR (2008). The Rhine: A river and its relations. Koblenz. http://www.iksr.org/fileadmin/user_upload/Dokumente_en/Rhein_08_E.pdf: 33 pp.

Karstens, S. (2009). Bridging boundaries: making scale choices in policy analysis studies in water management. Delft, Delft University of Technology.

Kater, E. and Smits A.J.M. (2005). Putting the cyclic rejuvenation strategy into practice: symbiosis between nature and safety. Proceedings of the NCR days 2004, November 4-6 In: Makaske, B., and Van Os, A. Research for managing rivers: present and future issues, 2005.

Ker Rault, P.A. (2008). Public participation in Integrated water management – a Wicked concept for a complex Societal Problem. PhD Thesis, Cranfield University.

Kingdon, J. (1995). Agenda's, Alternative and Public Policy. Boston, Little, Brown and Company.

Knall, J. (2006). Akzeptanz durch Mitwirkung? Das Beispiel Auenrevitalisierung.Eine räumlich orientierte Wirkungsanalyse des partizipativen Ansatzes im transdisziplinären Naturschutzprojekt Stellimatten. Physiogeographica, Basel, University of Basel: 220. (in German)

Kolb, D.A. (1984). Experiental Learning: experience as the source of learning and development. New Jersey, Englewood Cliffs, NJ: Prentice Hall.

Koppenjan, J. (1993). Management van de beleidsvorming. Een studie naar de totstandkoming van beleid op het terrein van het binnenlands bestuur. Den Haag, VUGA BV. (in Dutch)

Kuhn, T.S. (1987). What are Scientific Revolutions? The probabilistic revolution. In: L. Kruger, L. J. Daston and M. Heidelberger (eds). Cambridge MIT Press. 1: Ideas in history: 7-22.

Landesanstalt für Umweltschutz (1999). Auswirkungen der ökologischen Flutungen der Polder Altenheim. Ergebnisse des Untersuchungsprogramm 1993-1996. Materialen zum Integrierten Rheinprogramm Band 9. Sudlicher Oberrhein/ Hochrhein Gewässerdirektion. Karlsruhe, Germany.

Lee, K. (1993). Compass and Gyroscope: Integrating Science and Politics for the Environment. Washington D.C., Island Press.

Lee, K. (1999). Appraising Adaptive Management. *Conservation Ecology* 3(2): 3.

Leeuwis, C. (2000). Re-conceptualizing participation for sustainable rural development: towards a negotiation approach. *Development and Change* 31(5): 931-959.

Leeuwis, C. (2002). Making explicit the social dimensions of cognition. Wheelbarrows full of Frogs: Social Learning in Rural Resource Management. In: C. Leeuwis and R. Pyburn (eds) Emmen, van Gorcum: 391-406.

Liebowitz, S. and Margolis, S. (1995). Path dependecy, Lock-in and History. *The journal of law, economics and organization* 11(1).

Likens, G. (1992). The ecosystem approach: its use and abuse. In: Kinne, O. (ed.) Excellence in ecology, Vol. 3. Ecology Institute, Oldendorf/Luhe."

Lindblom, C. (1993). The policy making process, 3rd ed. London, Prentice Hall.
Loorbach, D. (2007). Transition management, New mode of governance for sustainable development. Erasmus University Rotterdam, International Books.

Martin, S. and Sanderson, I. (1999). Evaluating public policy experiments: Measuring outcomes, monitoring processes or managing pilots. *Evaluation* 5: 245.
Mannaerts, J. (2004). Beuningse uiterwaard rivierkundige toets 2003. Rijkswaterstaat Directie Oost Nederland, Arnhem. (in Dutch)
Mayer, I., Van Daalen, E., Bots, P., (2004). Perspectives on policy analyses: a framework for understanding and design. *International Journal of Technology, Policy and Management* 4(2).
McCutcheon, D. and Meredith, J. (1993). Conducting case study research in operations management. *Journal of Operations Management* 11(3): 239-256.
Meijer, K.S. (2007). Human Well-Being of Environmental Flows. Enhancing social equity in Integrated Water Resources Management. PhD thesis Delft University of Technology, Delft, The Netherlands.
Menzies, T. (1996). Applications of abduction: Knowledge level modeling. *International Journal of Human Computer Studies* 45: 305-355.
Meredith, J. (1998). Building operations management theory through case and field research. *Journal of Operations Management* 16(4): 441-454.
Middleton, B.A. (2002). The Flood Pulse Concept in Wetland Restoration. Flood Pulsing in Wetlands: Restoring the Natural Hydrological Balance. B. A. Middleton. Louisiana, John Wiley and Sons, Inc.
Miles, M. and A. Huberman (1994). Qualitative Data Analysis: An expanded sourcebook. Sage Publications, Thousand Oaks.
Ministry of Agriculture Nature and Food Quality (1990). Natuurbeleidsplan, Regeringsbeslissing. Den Haag, The Netherlands. (in Dutch)
Ministry of Agriculture Nature and Food Quality (2005). Natuurbescherming in Nederland. Den Haag, The Netherlands. (in Dutch)
Ministry of Transport, Public Works and Water Management (1985). Omgaan met water (Dealing with water). The Hague, The Netherlands.
Ministry of Transport Public Works and Water Management (2008). EU KRW Internationaal. Relevante ontwikkelingen in de internationale stroomgebieden, Brussel en de rest van Europa. RWS Waterdienst rapport 2008.025. (in Dutch)
Miser, H. and E. Quade (1985). Handbook of Systems Analysis, overview, uses, procedures, applications and practice. New York, Wiley.
Mitchell, B. (1990). Integrated Water Management. Integrated Water Management: International experiences and perspectives. B. Mitchell, (ed). London, Belhaven Press.
Mitchell, B. (2005). Integrated water resource management, institutional arrangements, and land-use planning. *Environment and Planning A* 37: 1335 - 1352.
Mittleton-Kelly, E. (2003). Ten Principles of Complexity & Enabling Infrastructures. In: Mitleton-Kelly (ed) Complex Systems & Evolutionary Perspectives of Organisations: The Application of Complexity Theory to Organisations. Elsevier, Amsterdam.
Mostert, E., C. Pahl-Wostl, Y. Rees, B. Searle, D. Tàbara, J. Tippett (2007). Social Learning in European River-Basin Management: Barriers and Fostering Mechanisms from 10 River Basins. *Ecology and Society* 12(1).
Muro, M., and Jeffrey, P., (2008). A critical review of the theory and application of social learning in participatory natural resource management processes. *Journal of Environmental Planning and Management* 51(3): 325.

Nilsson, M.A. (2005). Connecting Reason to Power. Assessments, learning and Environmental Policy Integration in Swedish Energy Policy. Policy Analysis. Delft, Technical University of Delft.
Nonaka, I. and Takeuchi, H. (1995). The knowledge creating company. New York: Oxford University Press.
Norris, R. and Thoms, C. (2001). What is river health? *Freshwater Biology* 41(2): 197-209.

North, D. (1990). Institutions, Institutional Change and Economic Performance. New York, Cambridge University Press.
Nowotny, H., Scott, P., Gibbons, M. (2006). Re-thinking science- Knowledge and the public in an age of uncertainty. Polity Press- Blackwell.

Oberrheinagentur (1995). Grundsatzpapier. Auenschutz und Auenrenaturierung. Materialen zum Integrierten Rheinprogramm Band 4 (in German)
Oberrheinagentur (1996). Rahmenkonzept des Landes Baden-Württemberg zur Unsetzung des Integrierten Rheinprogramms. Materialen zum Integrierten Rheinprogramm Band 7. (in German)
Olsson, P., C. Folke, and T. Hahn. (2004) Social-ecological transformation fro ecosystem management: the development of adaptive co-management of a wetland landscape in Southern Sweden. *Ecology and Society* 9(4):2. [online] URL:http://www.ecologyandsociety.org/vol9/iss4/art2
Overmars, W. (1993). Historisch-morfologische atlas van de Rijntakken in de Gelderse Poort; Millingerwaard, Kekerdomse Waard en Erlecomse Waard. Bureau Stroming. In opdracht van Grontmij b.v. (in Dutch)

Pahl-Wostl, C. (2006). The importance of social learning in restoring the multifunctionality of rivers and floodplains. *Ecology and Society* 11(1): 10.
Pahl-Wostl, C. (2007). Transitions towards adaptive management of water facing climate and global change. *Water Resources Management* 21: pp. 49-62.
Pahl-Wostl C., Craps M., Dewulf A., Mostert E., Tabara D., Taillieu T., (2007). Social Learning and Water Resources Management. *Ecology and Society* 12(2).
Pahl-Wostl, C. (2008). Requirements for Adaptive Water Management. In: C. Pahl-Wostl, Kabat, P., Moeltgen, J. (eds) Adaptive and Integrated Water Management: Coping with Complexity and Uncertainty. Berlin, Springer-Verlag.
Patterson, M.E. and Williams, D.R. (1998). Paradigms and problems: The practice of Social Science in Natural Resource Management. *Society and Natural Resources* 11. p. 279-295.
Pauli, S. (2001). Ambiguïteit in het spel. De casus PolyVinylChloride, Eburon Delft. (in Dutch)
Pawson R. and Tilley N. (1997). Realistic Evaluation. London, Sage Publications.
Peters, B., Vreugdenhil, H.S.I., Kater, E., Helmer, W. (2005). Cyclische verjonging Ewijkse Plaat: Inrichtingsplan. Radboud Universiteit Nijmegen. (in Dutch)
Peters, B., Kater, E., and Geerling, G. (2006). Cyclisch Beheer in Uiterwaarden. Natuur en veiligheid in de praktijk. Radboud University Nijmegen. (in Dutch)
Postel, S., and Richter, B. (2003). Rivers for Life: Managing Water for People and Nature. Washingtion, Island Press.
Pretty, J. (1994). Alternative systems of inquiry for sustainable agriculture. *IDS Bulletin* 25(2): 37-48.

Querner, E. and Mulder, H. (2007). Hydrological analysis for meeting climate change effects and European Water Framework Directive targets. *Environmental Science* 11: 59-69.
Quevauviller, P., Balananis, P., Fragakis C., Weydert M., Oliver M., Kaschl A., Kroll A., Galbiati L., Zaldivar Comenges J., Bidoglio G. (2005). Science-Policy Integration Needs in Support of the Implementation of the EU Water Framework Directive. *Environmental Science and Policy* 8 p. 203-211.
Quist, J. and Vergragt, P. (2006). Past and future backcasting: the shift to stakeholder participation and a proposal for a methodological framework. *Futures* 38: 1027-1045.
Quist, J. (2007). Backcasting for a sustainable future - the impact after 10 years. Faculty of Technology, Policy and Management. Delft, Delft University of Technology: 284.

Radboud University Nijmegen (2005). Symbiotic relation between flood protection and nature in the floodplains of the large rivers in the Netherlands. Research plan (draft). Version 1.3.

Raven, R.P.J.M. (2006). Towards alternative trajectories? Reconfigurations in the Dutch electricity regime. *Research Policy* 35: 581-595.
Raven, R. (2007). Niche accumulation and hybridisation strategies in transition processes towards a sustainable energy system: An assessment of differences and pitfalls. *Energy Policy* 35: 2390-2400
Raven R., Van den Bosch S., Fonk G., Andringa J., Weterings R., (2008). Competentiekit Transitie-experimenten Versie april 2008. C. Transities. Utrecht: 145. (in Dutch)
Rein, M. and Schön D. (1977). Problem setting in policy research. In: Weiss, C. (ed) Using social research in public policy making, 235-251, Massachussetts, Lexington Books.
Rogers, E. (1995). Diffusion of Innovation. 4th edition. New York, The Free Press.
Rotmans, J., Kemp, R., van Asselt, M. (2001). More evolution than revolution. Transition management in public policy. *Foresight* 3(17).
Rüetschi, D. (2004). Basler Trinkwassergewinnung in den Langen-Erlen - Biologische Reinigungsleistungen in den bewaldeten Wässerstellen. *Physiogeographica* 34. (in German)

Sabatier, P.A. (1988). An advocacy coalition framewrok of policy change and the role of policy-oriented learning therein. *Policy sciences* 21: 129-168.
Sabatier, P.A., and Jenkins-Smith, H.C., (1999). The advocacy coalition framework: an assessment. In: P. Sabatier (ed.). Theories of the policy process. Boulder, Colorado, Oxford Westview Press: 117-166.
Sabatier, P.A., (2007). Theories of the policy process, 2nd ed. University of California, Davis, Westview press
Saeijs, H. (2006). Weg van Water. VSSD publicatie, Delft, the Netherlands. (in Dutch)
Salomon, G. and Perkins D. (1998). Individual and Social Aspects of Learning. *Review of Research in Education* 23: 1-24.
Sanderson, I. (2002). Evaluation, Policy Learning and Evidence-based policy making. *Public Administration* 80(1): 1-22.
Scheffer M., Carpenter. S., Foley JA., Folke C., Walker B., (2001). Catastrophic shifts in ecosystems. *Nature* 413.
Schön, D. (1993). The reflective practitioner - how professionals think in action. Basic books.
Schön, D. A., Rein, M. (1994). Frame reflection. Toward the resolution of intractable policy controversies. New York, Basic Books.
Scott, W. (1987). Organisations: Rational, natural and open systems. Englewood Cliffs: NJ: Prentice-Hall. 2nd ed.
Schneider, A., Ingram H., (1990). Behavioral assumptions of policy tools. Journal of Politics 52(2).
Schwandt, T. (2003). 'Back to the Rough Ground!' Beyond Theory to Practice in Evaluation. *Evaluation* 9(3): 353-364.
Searle, J. (1995). The construction of social reality, Penguin, London
Sendzimir, J., Magnuszewski, P., Flachner, Z., Balogh, P., Molnar, G., Sarvari, A., Nagy, Z., (2007). Assessing the Resilience of a River Management Regime: Informal Learning in a Shadow Network in the Tisza River Basin. *Ecology and Society* 13(1): 11 online:http://www.ecologyandsociety.org/vo13/iss1/art11/.
Siepe, A. (1994). Regeneration of floodplain biotopes on the Upper Rhine - The 'Polder Altenheim' case. *Water Science and Technology* 29: 281-288 In: J.A. Van der Kraats (ed) Rehabilitation of the River Rhine.
Simon, H. (1977). The new science of management decision. Prentice Hall, NJ, USA.
Smits, A.J.M., Havinga, H., Marteijn, E.C.L. (2000). New concepts in river and water management in the Rhine river basin: how to live with the unexpected? In: A. J. M. Smits, Nienhuis, P.H., Leuven, R.S.E.W.(eds) New approaches to river management. Leiden, Backhuys Publishers.
Stacey, R. (1996). Complexity and creativity in organisations. Berrett-Koehler Publishers.
Stoll, R. (2006). The Integrated Rhine Program in Baden-Württemberg. Themes Communication, Participation and Acceptances. Successes and Failures of the Past. Freude am Fluss/ Component B5: The development of a joint planning approach. Leutershausen, Umweltforschungsinstitut.

Strauss, A. L. and Corbin J. (1998). Basic of Qualitative Research: techniques and procedures for developing Grounded theory. In N.K. Denzin & Y.S. Lincoln (Eds.), Handbook of Qualitative Research. Sage, Thousand Oaks.

Stuart, I., McCutcheon, D., Handfield, R., McLachlin, R., Samson, D., (2002). Effective case study research in operations management: a process perspective. *Journal of Operations Management* 20(5): 419-433.

Sule, M. and Casteren van Cattenburch, I. (2009). WINN-Projectinventarisatie 2008. Deltares. Delft: 1-95. (in Dutch)

Swanborn, P. (1994). Het ontwerpen van case studies: enkele keuzen. *Mensch en Maatschappij* 69(3): 322-325. (in Dutch)

Teisman, G. (1995). Complexe Besluitvorming. Een pluricentrisch perspectief op besluitvorming over ruimtelijke beslissingen (in Dutch). Den Haag, VUGA BV.

Ten Brinke, W. (2004). De beteugelde rivier: Bovenrijn, Waal, Pannerdensch Kanaal, Nederrijn-Lek en IJssel in vorm. Natuur Wetenschap en Techniek Veen Magazines, Diemen, The Netherlands. (in Dutch)

Termeer, K. and S. Meijerink (2008). Klimaat bestendig of klimaat neutraal bestuur? Een essay over het adaptief vermogen van instituties. Raad voor Verkeer en Waterstaat. (in Dutch)

The Rand Corporation (1982). Policy Analysis of Water Management for the Netherlands." The Rand Corporation, Santa Monica, California, USA.

Turnhout, E., Hisschemöller, M., Eijsackers, H. (2008). Science in Wadden Sea policy: from accomodation to advocacy. *Environmental Science and Policy* 11: 227-239.

UNEP (2004): Freshwater in Europe -Facts, Figures and Maps. http://www.grid.unep.ch/product/publication/freshwater_europe.php

UNESCO (2006), Water: A shared responsibility: The United Nations World Water Development report 2, UNESCO, Berhahn Books

Van den Bosch, S. and Rotmans, J., (2008). Deepening, Broadening and Scaling up: towards a Conceptual Framework for Transition Experiments KSI report.

Van der Brugge, R., Rotmans, J., Loorbach, D. (2005). The transition in Dutch Water Management. *Regional environmental change* 5: 164-176.

Van der Grift, R.E. (2001). How fish benefit from floodplain restoration along the lower River Rhine. PhD Thesis. Wageningen University, Wageningen. ISBN 9058084884.

Van der Heijden, J.J. and Vreugdenhil, H.S.I. (2009). Naar een vernieuwd systeem van bouwtoezicht. Delft: TBM/TU-Delft (in commission of Ministry of Housing, Spatial Planning and Environment) (in Dutch)

Van der Poel, I. (2003). The transformation of technological regimes. *Research Policy* 32: 49-68.

Van Eeten, M.J.G. and Roe, E.M. (2002). Ecology, Engineering and Management: Reconciling Ecosystem Rehabilitation and Service Reliability. Oxford, Oxford University Press.

Van Lente, H. (1993). Promising Technology: the Dynamics of Expectations in Technological Development.

Van Mierlo, B. (2002). Kiem van Maatschappelijke Verandering. Verspreiding van zonnecelsystemen in de woningbouw met behulp van pilotprojecten. IVAM. Amsterdam, University of Amsterdam: 324. (in Dutch)

Van Sandinck E., and Weterings, R. (2008). Maatschappelijke Innovatie Experimenten: Samenwerken in baanbrekende initiatieven. Assen, van Gorcum. (in Dutch)

Viessmann, W. (1997). Integrated Water Management. *Water Resources Update* 106(2-12).

Vreugdenhil, H., Slinger, J.H, Kater, E (2008). Adapting scale use for successful implementation of Cyclic Floodplain Rejuvenation in the Netherlands. In: C. Pahl-Wostl, Kabat, P., Moeltgen, J. (eds). Adaptive and Integrated Water Management. Berlin, Springer-Verlag.

Vreugdenhil, H.S.I., Slinger, J.H., Smits, A., Kater, E., (2008). Tensions bows as a tool to assess the impacts of institutional change: an example from Dutch floodplain

management. International Association of Impact Assessments, 4-10 May Perth, Australia.
Vreugdenhil, H.S.I., Ker Rault, P.A. (2009). Pilot Projects as a Platform for exploring Participative Accountable and Transparent Governance in Water Management: Some Insights on the Diffusion of Experience. 7th International Science Conference on the Human Dimensions of Global Environmental Change, 26-30 april 2009. Bonn, Germany.
Vreugdenhil, H.S.I., Slinger, J.H., (2009). Cross-Comparing Three Pilot Projects in the Rhine Basin. 7th International Science Conference on the Human Dimensions of Global Environmental Change (IHDP Open Meeting), 26-30 April 2009, Bonn, Germany.
Vreugdenhil, H., Frantzeskaki N., Taljaard, S., Ker Rault P.A., Slinger, J. (2009a). The next step within policy transitions: Patterns and mechanisms of scaling up of pilot projects. Thirteenth Annual Conference of the International Research Society for Public Management, Copenhagen Business School, 6-8 April 2009, Copenhagen, Denmark.
Vreugdenhil, H.S.I., Slinger J.H., Rüetschi, D. (2009b). The role of problem perceptions in the evolution of a floodplain restoration initiative in the Rhine Basin, Basel. 'IAIA09 Conference Proceedings', Impact Assessment and Human Well-Being 29th Annual Conference of the International Association for Impact Assessment, 16-22 May 2009, Accra International Conference Center, Accra, Ghana.
Vreugdenhil, H.S.I., Slinger, J.H., Kater, E., and Thissen, W.A.H. (2010a). The Influence of Scale Preferences on the Design of a Water Innovation. A case in Dutch River Management. *Environmental Management* 46(1): 29-43 http://www.springerlink.com/content/q684357605212537/.
Vreugdenhil, H., Slinger, J., Thissen, W., Ker Rault, P. (2010b). Pilot projects in water management. *Ecology and Society* 15(3).

Walker, W. E. (2000). Policy Analysis: A systematic Approach to Supporting Policymaking in the Public Sector. *Journal of Multi-Criteria Decision Analysis* 9: 11-27.
Walters, C. (1986). Adaptive management of renewable resources. New York, Macmillan Publishing Company.
Walters, C. (1997). Challenges in adaptive management of riparian and coastal ecosystems. *Conservation Ecology* 1(2): 1.
Weaver, A., Pope, J., Morrisson-Saunders, A., Lochner, P. (2008). Contributing to sustainability as an environmental impact assessment practitioner. *Impact Assessment and Project Appraisal* 26(2): 91-98.
Wenger, E. (1998). Communities of Practice. Learning, Meaning and Identity. Cambridge, UK, Cambridge University Press.
Weiss, C. (1975). Evaluation Research in the Political Context. Pages 13-26. In E. L. Struening and M. Guttentag (eds). Handbook of Evaluation Research. Sage Publications, California, USA.
Weiss, C. (1977). Research for policy's sake: The enlightenment function of social research. *Policy Analysis* 3: 531-545.
Weiss, C. (1980). Knowledge creep and decision accretion. *Knowledge and Policy* 1: 381-404.
Wildavsky, A. (1979). Speaking Truth to Power: The Art and Craft of Policy Analysis. Little, Brown.
Wüthrich, C., Huggenberger, P., Gurtner, A., (1999). Machbarkeit, Kosten und Nutzen von Revitalisierungen in intensiv genutzten Auenlandschaften (Fallbeispiel Lange Erlen). MGU-Forschungsgessuch F2.00, 1-39. (in German)
Wüthrich, C., Geissbühler,U., and Rüetschi, D. (2001). Revitalisierung und Trinkwasserschutz in der dicht genutzten Wiese-Ebene. Feuchtgebiete als Reinigungsstufe. *Regio Basiliensis* 42(1): 97-116. (in German)
Wüthrich, C. and Geissbühler, U., (2002). Auenrevitalisierung in einer stadtischen Grundwasserschutzzone. Probleme und Chancen transdisziplinarer Forschung. *Regio Basiliensis* 43(1): 29-41. (in German)
Wüthrich, C., Huggenberger, P., Freiberger, H., Geissbühler, U., Regli, C., Stucki, O. (2006). Revitalisierung urbaner Flusslandschaften. Schlussbericht zum MGU-Forschungsprojekt F1.03 2003-2005. Geographisches Institut, Institut für Geologie und Paläontologie, Universität Basel. (in German)

Yin, R. (2003). Case Study Research: Design and Methods. 3rd ed. Sage Publications, Thousand Oaks, California.

Young, O. (2002). The institutional Dimensions of Environmental Change: Fit, Interplay and Scale. Cambridge, Massachusetts, MIT Press.

Zonneveld, W. (1991). Conceptvorming in de ruimtelijke planning. Amsterdam. Amsterdam, Planologisch en Demografisch Instituut van de Universiteit van Amsterdam. (in Dutch)

Appendix 1: Data sources

Table 1: People with whom I interacted (Case: G=General, Be=Beuningen, A=Altenheim, Ba=Basel, W=WINN) (Contact: I=interview, E=email discussion, D=documents provided, R=regular discussions, P= joint paper writing)

Interviewee	Organisation & position	Case	Contact	Date
P. Berends	Ministry of Agriculture, Nature and Food Quality, Project bureau Hollandse Waterlinie	G	I	07-2007
D. de Bruin	Rijkswaterstaat (retired) Designer Plan Stork	G	I, E	06-2007
J. Buntsma	Ministry of Water Management	G	I	07-2007
J. Dijkman	Deltares	G/ Be	I	10-2007
G. Geldof	Consultant, Scientist on Complexity Theory	G	I, D	01-2008
T. de Haan	Rijkswaterstaat, Director DWW (now Waterdienst)	G	I	06-2007
R. Hekkenberg	TU Delft – sustainability in navigation	G/ Be	I, D	08-2008
P. Huisman	International Committee for the Protection of the Rhine, former secretary Delft University of Technology	G	I, E, D	07-2008
J. de Jonge	Wageningen University, researcher transitions in river management	G	I, D	06-2007
J. Karssemeijer	Ministry of Agriculture, Nature and Food Quality, Project bureau Space for River	G	I	08-2008
R. Oates	Thames River Restoration Trust	G/ Be	I	04-2008
H. Saeijs	Rijkswaterstaat Zeeland, director/ ecologist (retired)	G	I (2x), E, D	06/07-2008
K. Schuijt	World Wildlife Foundation, Economist	G	I	08-2008
Wim Silva	Rijkswaterstaat-Riza	G	I	10-2007
B. van de Wetering	International Committee for the Protection of the Rhine, Secretary	G	I, E, D	07-2008
W. Helmer	Ark	Be	I	09-2004
T. Smits	Radboud University Nijmegen	Be	I, R, P	2004-2008
E. Kater	Radboud University Nijmegen	Be	I, R, E, P (3)	2004-2009
H. Havinga	Rijkswaterstaat	Be	I	09-2004
M. Mols	Staatsbosbeheer	Be	I	01-2005
M. van Dijk	Gemeente Beuningen	Be	I	11-2004
D. van der Graaf	Rijkswaterstaat	Be	I	11-2006
J. Mannaerts	Rijkswaterstaat	Be	I, R	07-2004, 2007
B. Peters	Consultancy (Drift)	Be	R, P	2004-2006
B. Beekers	Ark (Millingerwaard)	Be	I	07-2006
M. de Groot	Radboud University Nijmegen	Be	E, R	2007
J. Bekhuis	Ark	Be	I, R	2004-2007
G. Geerling	Radboud University	Be	R	2004-2005
W. de Wit	Contractor	Be	R	2007
T. Vos/ A. de Joode	Rijkswaterstaat (WAQUA)	Be	R	2004
J. Armbruster	ILN Buhl	A	I, E, D	01-2007
G. Meiners	RP Freiburg	A	I	11-2007
Markus Moser	RP Stuttgart	A	I, D	01-2007
Andreas Ness	IUS Weisser	A	I	01-2007
L. Neumann	Burgerinitiative Breisach	A	I, D	10-2009
A. Siepe	LUBW	A	I, E, D	01-2007
V. Spaeth	ILN Buhl	A	I	01-2007
H.M. Staeber	RP Freiburg	A	I, D	01-2007
H.M. Waldner	Umwelt Ministerium	A	I, D	01-2007

D. Rüetschi	University of Basel	Ba	I, E, D, P	11-07, 01-08, 03-08, 04-09
C. Wüthrich	University of Basel	Ba	I, D	03-2008
R. Neher	AUE	Ba	I	04-2009
R. Wuelser	IWB	Ba	I, D	04-2009

Table 2: Other important empirical data

Source	**Data specification**	**Organisation**	**Case**	**Date**
Workshop	WINN participants, highlighting 3 projects	Rijkswaterstaat, Deltares	W	12-2008
Meetings	WINN participants and control team (4)	Rijkswaterstaat, Deltares	W	2008-2009
WINN project documents	16 project descriptions	Rijkswaterstaat, Deltares	W	Downloaded at 08-08-2008
WINN internal document: interviews on WINN diffusion	28 transcribed interviews on WINN projects and innovation in dutch water management	Deltares	W	2009
Meetings	Pilot participants: discussion on progress of the project	Radboud University Nijmegen, Rijkswaterstaat, State Forestry, Ark	Be	2004-2005
Workshops	Communication with participants and other current and future stakeholders	Radboud University Nijmegen	Be	2005-2007
Citizens-workshops Beuningen	Series of 4 workshops with citizens, water managers, local policy makers, experts	Radboud University Nijmegen	Be	09-2006
Intervision and conferences	Meeting with FaF partners (2)	Nevers, Nijmegen	G/Be/A	2006-2008
Documentation	Development of management of the Rhine	Rijkswaterstaat, ICPR	G/Be/A/Ba	-
Documentation	Diverse reports on pilot and diffusion (WaalWeelde)	Radboud University Nijmegen	Be	2006-2008
R. Stoll	Citizens perspectives, process analysis	University of Freiburg	A	2008
Burgerinitiative Breisach	Document with statements, illustrated with impacts and proposed new plans	Report Internet publication	A	08-2009
Intervision Team Freude am Fluss	Flood retention and spatial planning in the Rest Rhine	report	A	04-2006
WWF Germany	Internet publication EF	Internet publication	A	01-2007
Umweltministerium	IRP, Polder Altenheim	Internet Publication	A	07-2007
Bild	Flood damages	Newspaper article	A	-
Diverse reports – Umweltministerium, LAWA, GwD SO/HR	EF, IRP, Altenheim	Study reports	A	1990-2010
J. Knall	Dissertation on actor perspectives in Lange Erlen: data from all actors at diverse moments	University of Basel	Ba	2006
Regio Basiliensis	Expression of their view on the process in articles	University of Basel	Ba	2001, 2002, 2004

Reports	Project reports and follow up	University of Basel	Ba	2003, 2006
Policy documents	Spatial planning Lange Erlen	Kanton Basel-Stadt	Ba	1999
Poster, Brochure	Systems explanation Interview R. Wuelser	IWB	Ba	2007
Conference participants	Discussion on floodplain revitalisation in Basel	University of Basel, IWB, Policy-maker	Ba	2007
Site visits			Be/A/Ba	

Appendix 2. Interview guide scoping interviews

These interview questions or issues were addressed in interviews with national and international water management experts. They focus both on water management developments and experiences with pilot projects. The list depicted in this appendix functioned as a guide during the interviews. This means that they provided starting points for discussions, but that whenever the interview allowed for it and it was expected to provide additional information, second or third order questions were asked.

1. General questions

- Background of interviewee
- Involvement in water management

2. Water management development

- Development in policies (national and international)
- Development in values
- Organisational/ Institutional changes
- Explanations why and how developments occurred
- Your role in developments
- Critical factors of influence
- Sources of change (which layers?)
- Which other changes would be desired
- Which are positive/ negative developments for IWM

3. Pilot projects

- Personal experience with pilots
- How much does your organization uses pilots – for which purposes/why
- Criteria and conditions used for starting pilots – who initiates and approves/pays them
- Usefulness of pilots (examples + and -)
- How do they differ from other projects?
- Different examples of pilots reaching different stages (e.g. only design, implementation, follow up) and with different functions (e.g. first-phase, ‘innovative idea’)
- Role pilot projects in the water management changes described above

Appendix 3. Interview guide case studies

In this appendix the questions addressed in the interviews are displayed, clustered in four themes. However, not in every interview all questions have been addressed. For every individual interview I designed a specific interview scheme. Questions were selected depending on the actor interviewed and the moment in the pilot process. For example, some questions are specifically relevant to participants or opponents, more than initiators. Additionally, questions were tailor-made to the interviewee. For example, in interviews for Polder Altenheim, questions about the policy were fine-tuned towards the IRP and specific questions could be posed with respect to diffusion to new areas both from an initiators and citizen's perspective. Moreover, the list depicted in this appendix functioned as a *guide* during the interviews. This means that they provided starting points for discussions, but that whenever the interview allowed for it and it was expected to provide additional information, second or third order questions were asked.

0. General questions

- Background of interviewee
- Involvement and role in pilot project

Theme A: The pilot project

- Project and area development (history)
- Key questions of pilot
- Underlying philosophy of the concept/ pilot project: how innovative?
- Research program or policy to which it is related
- Pilot Design: scale, measures, technological support, monitoring, process management
- Trade-offs and boundaries in design
- Why pilot here?
- Organisational structure and actor involvement/ who initiated the pilot
- Type of pilot (e.g. 'first-phase of policy' or mere bottom-up)
- Operational management in area (non-pilot conditions)
- Main risks of concept
- Effects of projects (physical and non-physical): perception, expectations and surprises
- Adaptations made during process in design of measures, plans, approach and concepts
- Major obstacles and drivers for implementation (e.g. resources, actors)
- How would you design without limitations
- Re-doing the process: what could you have done differently?

Theme B: Relation Pilot to other projects/ policies (diffusion)

- Policy development (e.g IRP) and underlying ideas and choices made in the policy
- Water management arrangements: local, national, international
- Values in water management (nature, flood defence, drinking water)
- What differentiates the pilot from other projects: what was special? (e.g. scale, media, innovation, attitudes)

- Impact of pilot on policy
- Which problems arose in the pilot/ when and why did it stop, who decided
- What is transferable and to where?
- How and when did you encourage diffusion/ strategies to convince actors?
- Who opposed or supported diffusion?
- What would you like to be different in the policy, what is good
- Impact pilot elsewhere in the country
- Nature management and flood control before existence IRP/ RvR/ IWB presence
- How do you make sure lessons are being used
- What did you personally learn
- What are major benefits of the pilot in your eyes

Theme C: Participation

- When did you first learn about the project: what was the status of the project then?
- How did you get involved?
- What is your motivation to participate/ organize opposition?
- What are your goals: when will you be satisfied? Which strategy do you follow to achieve that?
- How is your role/initiative organized (e.g. how much interaction with the pilot initiators, who do you represent)
- Which resources do you and pilot initiator have?
- Impression of the concept and pilot project: is it useful/ under which conditions. Representativeness for new areas (how applicable?)
- Why do you think there is a difference in perspective upon the problem
- How do initiators attempt to convince you to diffuse the pilot? Did you speak to users of the pilot area (if not involved themselves)
- What do you think the initiators could do differently: both in content and in process?
- What do you expect or hope to achieve?

Theme D: Pilot projects in general

- Personal experience with pilots
- How much does your organization uses pilots – for which purposes/why
- Criteria and conditions used for starting pilots – who initiates and approves/pays them
- Usefulness of pilots (examples + and -)
- How do they differ from other projects?
- Examples of pilots reaching different stages (e.g. only design, implementation, follow up) and with different functions (e.g. first-phase, ‘innovative idea’)

Appendix 4: Interview guide validation interviews

Introduction:

- Who am I, what do I study (PhD at TU Delft, research in pilot projects in Rhine Basin, 3 cases. Research goals (concept, use, effects, challenges)
- Why this project (e.g. clear defined project, IWM, complex, dispute)
- Current status (e.g. when first contact and with whom, first exploration)
- Goals of today (learn more about project and your organisation, hear your view on the project + discuss the pilot and diffusion models that I developed)

The themes addressed:

1. the pilot project: process, activities, use
2. roles of actors and their relations
3. effects (particularly diffusion)
4. hurdles and enabling factors

0. General

0.1 Major water management challenges for your organisation
0.2 Person: role, involvement and responsibility

1. Pilot Project

1.1 Objective of the pilot for your organisation?
1.2 Description of development of project from your view
1.3 Which purposes with pilot project

Pilot type	Use	T=start (give value from 0-5)	T=end (give value from 0-5)
Research	Exploration		
	Evaluation		
Management	Insurance		
	Problem Mitigation		
	Communication		
Political-Entrepreneurial	Incentive		
	Advocative		
	Policy Implementation		
	Political game		

1.4a Rationale pilot project: Advantages of project being a pilot project (e.g. creativity, freedom, flexibility, resources?). Or: why was the project undertaken in a pilot format?
1.4b Disadvantages

2. Actors and policy

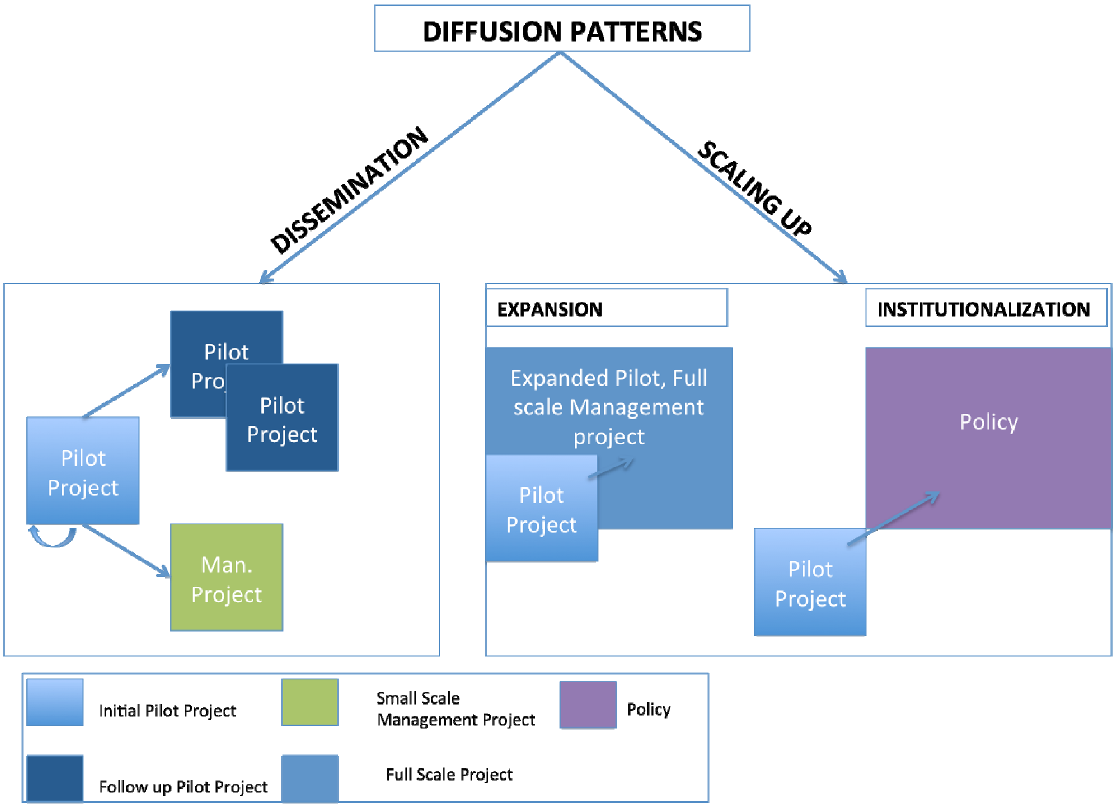
2.1 Description role of own organisation in the project: changes observed?
2.2 Motivation to participate: expectations and hope
2.3 Attitude towards project
2.4 Opinion on what could be improved in the design of the project
2.5 View on roles and responsibilities other actors in the process + dynamics in this

2.6 View on relations between actors
2.7 End of the project: who decides, when and why

3. Effects of the pilot project

3.1 Indication of effects on/ change in following aspects:
- a. Biophysical system
- b: Actor-Network (changes, relations, shared/diverging values)
- c: Knowledge and Learning (what and who? How does it show?)
- d. Pilot/ Innovation, Policy

3.2 Diffusion: three key aspects are the nature, patterns (see figure) and channels
- a. What was diffused (artefacts, knowledge, experience)
- b. Patterns: where to
- c. Channels: who



3.4 Diffusion strategies used or to be used (if diffusion would be strived after)
3.5 Personal learning points
3.6 Change in opinion on concept as result of pilot?
3.7 Surprises

4. Hurdles and Enabling factors

4.1 Recognition of following hurdles + which others?
- a. lack of support from decision making actor
- b. lack of democratic quality process

c. lack of active diffusion management

4.2 Enabling factors for initiation and diffusion

4.3 Role 'evidence' deriving from the pilot: how convincing was it

4.4 Recognition of dilemma of institutionalization: standardization vs flexibility/creativity – how to institutionalize?

Curriculum Vitae

Heleen Vreugdenhil (Hoogland, 5 March 1981) studied Systems Engineering, Policy Analysis and Management at Delft University of Technology, the Netherlands, from 1999 to 2005, specializing in water resources management and in sustainable development. In 2003 she undertook fieldwork in Kenya for ITC Geo-information Science and Earth Observation where she worked on a hydrological model of Lake Naivasha. For her MSc thesis, she studied the hydraulic and institutional consequences of Cyclic Floodplain Rejuvenation measures in the floodplains of Beuningen, the Netherlands, in collaboration with the Radboud University Nijmegen and Rijkswaterstaat. In 2005, she commenced her PhD research at the Faculty of Technology, Policy and Management of Delft University of Technology, the results of which are reported in this book. She contributed to the EU project 'Freude am Fluss' and worked for the Deltares/Rijkswaterstaat WINN program. In November 2010, she joined the International Centre for Integrated Assessment and Sustainable Development (ICIS) of Maastricht University, to work on the exploration of sustainable river management pathways into the uncertain future.

Scientific Contributions

Journal Publications

- Vreugdenhil, H.S.I., Slinger, J.H., Thissen, W.A.H., Ker Rault, P.A. (2010) Pilot projects in Water Management. *Ecology and Society* 15(3): Article 13. http://www.ecologyandsociety.org/vol15/iss3/art13/
- Vreugdenhil, H.S.I., Slinger, J.H., Kater, E. and Thissen, W.A.H. (2010) The influence of scale preferences on the design of an innovation. A case in Dutch river management. *Environmental Management* 46(1): 29-43. http://www.springerlink.com/content/q684357605212537/
- Vreugdenhil, H.S.I. and Ker Rault, P.A. (*forthcoming, 2011*). Pilot projects in Evidence Based Policy Making. *German Policy Studies.*

Book chapter

- Vreugdenhil, H.S.I., Slinger, J.H., Kater. E. (2008). Adapting scale use for successful implementation of Cyclic Floodplain Rejuvenation in the Netherlands. In: C. Pahl-Wostl, P. Kabat, J. Moeltgen (eds). *Adaptive and Integrated Water Management.* Springer-Verlag, Berlin

Conference contributions

- Vreugdenhil, H.S.I., Sule, M., Slinger, J.S., Karstens, S. (2010) The role of pilot projects in innovation processes in Deltas. *Deltas in times of Climate Change, Rotterdam 29 September-1 October 2010, Rotterdam, the Netherlands*
- Kwakkel, J., Vreugdenhil, H.S.I., Slinger, J.H. (2010). Paradigms in sustainability research. *ERSCP-EMSU 2010 Conference, 25-29 Oct. 2010, Delft, The Netherlands*
- Vreugdenhil, H.S.I., Slinger, J.H., Rueetschi, D. (2009). The role of problem perceptions in the evolution of a floodplain restoration initiative in the Rhine Basin, Basel. *Annual Conference International Association of Impact Assessments 17-22 May 2009, Accra, Ghana*

- Vreugdenhil, H.S.I. and Ker Rault, P.A. (2009). Pilot projects as a platform for exploring Transparant, Accountable and Particapative governance in water management: Some insights in the diffusion of experience. *UN IHDP open meeting. 7th international science conference on the Human Dimensions of Global Environmental Change, 26-30 April 2009, Bonn, Germany*
- Vreugdenhil, H.S.I. and Slinger, J.H., (2009). The role of pilot projects in Integrated Water Management: a cross-comparison of three pilot projects in the Rhine Basin. *UN IHDP open meeting. 7th international science conference on the Human Dimensions of Global Environmental Change, 26-30 April 2009, Bonn, Germany*
- Vreugdenhil, H.S.I., Frantzeskaki, N., Taljaard, S., Slinger, J.H. and Ker Rault P.A. (2009). Pilot Projects as the Next step within Policy Transitions. *13th annual conference International Research Society for Public Management (IRSPM), 6-8 April 2009, Copenhagen, Denmark*
- Vreugdenhil, H.S.I., Slinger, J.H.,(2008) Understanding Pilot Projects and their Contribution to Water Management. *Joint Sessions of the European Consortium for Political Research, 11-15 April, 2008, Rennes, France*.
- Vreugdenhil, H.S.I. Slinger, J.H., Smits, T., and Kater E. (2008) Impacts of Governance Styles on River Restoration in NW Europe. *Annual Conference International Association of Impact Assessments, 4-10 May, Perth, Australia*
- Vreugdenhil, H.S.I. Slinger, J.H., Smits, T., and Kater E. (2008). Tension Bows as a Tool to Assess the Impacts of Institutional Change. An example from Dutch floodplain management. *Annual Conference International Association of Impact Assessments, 4-10 May, Perth, Australia*
- Vreugdenhil, H.S.I. Slinger, and Kater E. (2006) Cyclic Floodplain Rejuvenation. Creating synergy between nature development and safety from flooding in the Netherlands. *Conference of Restore America's Estuaries, 6-11 December 2006, New Orleans, USA*
- Vreugdenhil, H.S.I., Meijer, L., Hartnack, L., and Rijcken, T. (2006). FloodHouse: a new approach in reducing flood vulnerability. *Netherlands Centre for River Studies days 2006. Enschede, Netherlands*