spatial water management

supporting participatory planning and decision making

Hasse Goosen

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Preface and acknowledgements

The painting on the cover shows the Krimpenerwaard. Why is this painting on the cover of this thesis? Firstly because the Krimpenerwaard is a fen meadow (veenweide) area similar to the case study described in chapter 5 of this thesis. In 2006 a treaty (the 'Veenweidenpact Krimpenerwaard') was signed by all parties (municipalities, nature and agricultural organizations, water authorities and the Province of South Holland). This treaty was a breakthrough after a long period of deadlock. It is to some extent an example of what I bring forward in this thesis as a 'platform approach'. In this platform approach different parties jointly develop strategies for complex issues in water management. The province and national government facilitate and stimulate the process so that proposed measures meet goals and boundary conditions at a supra-local level, and parties at the local level are challenged to jointly develop innovative solutions.

That explains why the Krimpenerwaard is on the cover of this thesis. But why a painting? I believe that images are essential in communicating knowledge. Maps, graphs and images are important in communicating ideas and plans. This is the reason why maps (GIS), spatial design and evaluation tools have always played an important role in my research. I am continuing the use of tools to aid interactive spatial planning in my work at the province of South Holland. So that explains why I wanted a painting of the Krimpenerwaard on the cover of my thesis: it symbolizes many aspects of this thesis.

But the most important reason for having this painting on the cover is because a very special painter, Frits Goosen, painted it. He painted it especially for my thesis. I remember the many occasions where we went outdoors in search for subjects for his paintings and this is where my interest in environmental sciences originated. I want to thank my parents for always supporting me and for being such great grandparents for Mara.

The work presented in this thesis was largely conducted within the 'Wetlands in the Randstad' project, which started in 1998, and partly within other projects I was

involved in at the Institute for Environmental Studies (IVM) at the Vrije Universiteit in Amsterdam. Pier Vellinga was my supervisor when I first joined IVM as an intern in 1995, and later also became my PhD supervisor. Pier has always been an inspiration and I want to thank him for his support over the years. I owe a tremendous amount of gratitude to Jan Vermaat, who read and commented on draft chapters and papers in great detail. Although being critical and precise he kept my spirits high. I also wish to especially thank Ron Janssen for his continuing encouragement. Ron was always very clear on what should and what shouldn't be the scope of my research, which prevented me from going into too many directions. Our missions abroad have always been a joy, where Romania stands out as a 'top-event' and our experiences with rather poor water management in the hotel in Barcelona are also worth mentioning here.

My colleagues at IVM have been great and I would like to thank everyone for making it such a nice place to work. The daily meetings with the 'lunch cluster' were inspirational. Especially in the period of finalizing the thesis, Michiel, Pieter, Marjan, Xander, Peter and last but definitely not least Marja kept me going. The numerous social events and 'borrels' I have enjoyed immensely. I will always remember the secretariat as the 'gezelligste secretariaat van Nederland'. Especially Els, Elleke, Paula created an unforgettable atmosphere and I want to thank them for their help and friendships over the years. Els Hunfeld has been amazing and was always there to help me. Working together with Marjan van Herwijnen en Nancy Omtzigt in the many workshops that we held has always been a joy, and a lot of the work described in this thesis we did together and I am very grateful for this co-operation.

Outside IVM I especially enjoyed working with Mariken Verhoeven and the other colleagues on the Evaluwet and Eurolimpacs projects. Oddrun Uran helped me by reading the final draft and preparing me for the defense. Ansje Löhr was always there to lighten up my day over a cup of coffee.

My new colleagues at the Province of South Holland have been very supportive and I wish to especially thank Tom de Bruïne and Paul van Eijk for their feedback and understanding during the last few months of finalizing the thesis. I thank the Province of South Holland their support and flexibility that was required to finish the PhD.

In the case of writing a PhD thesis it is impossible to separate work from private life. Although I minimized working in the weekends and evenings, it did keep the mind busy day and sometimes night. Chantal, thanks for always being there to listen to my problems, ideas and worries and for your support and belief in me. Mara, just by getting older and demanding more and more of my attention you set a hard deadline for finishing this thesis which stimulated me to work extra hard near the end.

Hasse Goosen,

Eemnes, 11 March 2006

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1. Introduction

1.1 Spatial water management

Geographically the Netherlands has a strong relationship with water. The country's coast faces the North Sea and three major rivers – the Rhine, Meuse, Scheldt and Eems – have outlets in the country. Without dikes and dunes, more than half the area of the Netherlands would be permanently or regularly inundated (Figure 1.1).

Figure 1.1 The Netherlands below sea level. The dark area indicates which parts of the country would be flooded should there be no protection by dikes and dams (Anon., 2004).

To the Dutch, water has always been both a friend and an enemy. The relationship with the water has brought the Dutch prosperity. Natural conditions were and still are ideal for agriculture - the soil is fertile and there is plenty of fresh water – but also commerce, transport and urbanisation have flourished and in the golden age of the seventeenth century, per capita income was higher then anywhere else in the world (Kaijser, 2002).

But water also brought disaster. Devastating floods have had large effects on the history of the country, and although the latest major event dates back to 1953 when a catastrophic flood killed almost two thousand people, they still remain a threat today (Vellinga, 2003; Brouwer and van Ek, 2004; Bouma et al., 2005). In the past decade, flooding has occurred along the major rivers. In 1993 and 1995 water levels in the major rivers rose to extreme levels. In 1995 this led to the evacuation of 200,000 people from the areas of the Ooijpolder, het Land van Maas en Waal, de Bommelerwaard, de Nederbetuwe, de Tieler- en Tulemborgerwaard en de Alblasserwaard and also along the river Meuse a smaller number of people was evacuated (Driessen and De Gier, 1998). These extreme events have strengthened the opinion that climate change has started to take effect in catchment basins of the major European rivers. Sea level rise, increasing discharge of the large rivers, higher frequency of peak precipitation and land subsidence increase the susceptibility to floods.

This growing awareness of the severity of the problem has caused a shift in water management policy (Helmer et al., 1996; Van Rooy et al., 1998; Commission on water management for the 21st century, 2000; De Wilt et al., 2000; Rathenau Institute, 2001). The new approach to water management was adopted by the government in 2000 (Ministry of Transport and Water Management, 2000). The policy shift encompasses changes in the technical way in which water is managed and controlled but also in the way water management is organised: the institutional setting and political arrangements. The new water policy distinctly emphasises the lateral, spatial dimension (Ministry of Transport and Water Management, 2000). Water is to be stored ‘horizontally’, making use of natural processes and a natural capacity to adapt to and absorb extreme events (Helmer et al., 1996), at the same time increasing the 'spatial quality' of the landscape (Jansen, 2005).

Spatial water management is not meant as a replacement of *integrated* water management. Integrated water management requires water quantity, water quality and social dimensions of water (resources) to be considered simultaneously (Geldof, 1995). Spatial water management is a way to better anticipate and adapt to future threats, which does not mean that dikes no longer necessary. However, constructing larger dikes is believed to be less sustainable and preferable from a long-term perspective. With the change of the millennium, these new ideas were adopted in national policy (Ministry of Transport and Water Management, 2000) and commitment of different governmental bodies has been formalised in the National Policy Treaty Water ('nationaal bestuursakkoord water'). This thesis takes the new spatial approach as a starting point, since it has been adopted in water policy.

Box 1.1 Spatial water policy (www.nederlandleeftmetwater.nl; Commission on water management for the 21st century 2000).

The new spatial water policy is described as follows by the ministry responsible for water management (Ministry of Water Management, Public Works and Transportation): "The essence of water policy for the 21st century is that water should be given more space, before it will take this space itself. Creating space for water means that water will enter both rural and urban areas to increase storage capacity. Controlled flooding will be allowed in designated areas at times of extreme water levels. This is no easy message to bring across in a country with a history of combating against the water, which has created land where there used to be water. In addition, temporary flood storage can enhance aquifer recharge and alleviate seasonal water shortages."

Spatial water policy imposes larger claims on land. Traditionally, measures were taken in or directly along the rivers itself, whereas the new water policy requires more room for rivers themselves and space for temporary storage of water. The implementation of water policy has become a complex process involving decisions that directly affected agriculture, infrastructure, safety, urbanisation, landscape and nature quality. The Netherlands is a highly populated and economically developed country and land has become a scarce and highly priced commodity. Apart from city–states such as Hong Kong, The Netherlands is one of the most densely populated and urbanised countries in the world. With around 466 inhabitants per km^2, The Netherlands compares to countries like Taiwan and South Korea (Van der Valk, 2002). Implementation of water policy thus requires both technical and political knowledge and skills. Given the threats of climate change together with land subsidence on one hand, and the continuing economic development on the other, spatial water policy implementation is identified as one of the major challenges of the coming decades for the Netherlands (Commission on water management for the 21st century, 2000; De Wilt et al., 2000).

1.2 Governance and spatial water policy

At the national level, the principles of spatial water policy have been adopted and are formalised in national policy. However, the implementation at the local level is faced with a number of constraints and the general feeling is that this implementation is wearisome (Van Rooy, 1997; De Wilt et al., 2000; Rathenau Institute, 2001; Wiering and Driessen, 2001; Verbeek and Wind, 2001; Goosen and Vellinga, 2004). In search for explanations for the wearisome implementation, a distinction can be made between issues regarding the organization of water management (governance and decision making processes) and those regarding technical aspects (content-related). With the broadening of water management policy and the fact that the involvement of stakeholders and interested parties is becoming common-practice, the governance issues are receiving more attention lately (e.g. O'Riordan and Ward, 1997). An illustrative example is the case of the deepening of the Western Scheldt (box 1.2).

Box 1.2 Stakeholder interference in top-down decision making: the case of the Western Scheldt

To compensate for the ecological damage due to the deepening of the Western Scheldt, the Dutch ministry responsible for water management proposed to restore nature in agricultural areas. Land would be given back to the sea ('ontpoldering'): dikes would be removed.

Stakeholders became involved *after* the decision had been made to take agricultural land out of production, to discuss what precise areas were to be given back to the sea. Farmers and the inhabitants of the province of Zeeland heavily opposed to these plans and emotions ran high. The people of Zeeland have always felt strongly connected to water. This part of the country suffered many casualties and damage from the tragic flood of 1953. The 'delta-works' – a series of dams and hydro-technical measures to protect the province against floods – were built after the dramatic event and was considered a major achievement in the battle against the sea. Giving back land to the sea was (and still is) a highly sensitive issue and probably more sensitive then in other parts of the country. For instance, in the province of Friesland, there were also plans to give back land to the sea.

A keyword search in newspaper articles on the website www.krantenbank.nl (that contains articles of a large number of (regional) Dutch newspapers) shows the number of hits of the word 'ontpoldering' (giving land back to the sea) and on the words 'water management' in combination with in the different coastal provinces in The Netherlands (Figure 1.2). It is clear that 'ontpoldering' is mentioned significantly more often in the context of the province of Zeeland than in the context of other coastal provinces, while this is not the case when looking at 'water management' in general.

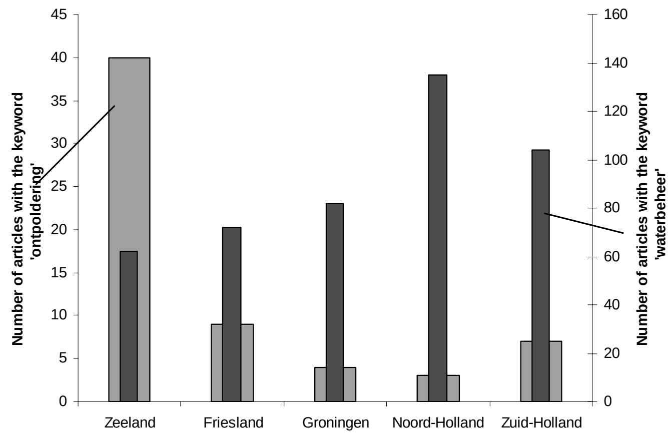


Figure 1.2 The number of newspaper articles about giving land back to the sea ('ontpoldering') as compared to the number of articles on water management in general, in the different coastal provinces in The Netherlands.

Hence giving back land to the sea has been more of an issue in Zeeland than it has been in any of the other coastal provinces. The opposition against the government plans regarding 'ontpoldering' in Zeeland was overwhelming and the ministry eventually had to withdraw its plans.

This example in box 1.2 shows how a lack of involvement of local stakeholders early in decision making processes may cause unexpected heavy conflicts in a later stage. Involvement of stakeholders in early stages might prevent such heavy conflicts, especially when the emphasis is on creating values rather than on responding to threats (Keeney, 1992).

Box 1.3: Stakeholder involvement in land relocation for the Crailo ecoduct

The importance of being involved in an early stage of planning appeared to me personally in my own 'experience' as a stakeholder. As a member of the board of a cricket club, we were invited to take part in a planning process aimed at relocation of sports clubs that was necessary for the construction of a 'nature bridge' or ecoduct (http://www.natuurbrug.nl/). The bridge was to be constructed to connect two nature areas between the towns of Hilversum and Bussum. The nature areas were intercepted by a road, a railway and a number of sports grounds. As a first step in the planning process we were asked to present our preferred future (how could we become better off?) and to lay out our minimum requirements. The preferences and boundary conditions formulated by the various parties in the area were used as guidelines. The project organisation attempted to develop a plan that would meet the demands of the different parties in the best possible way. Despite some hick-ups in the process, the plan was developed in a relatively short period of time, satisfying most parties involved. What I conceived as an important aspect of the process was that parties were not confronted with the threatening image of a bridge being built in the middle of their club grounds, but rather were asked to identify opportunities to become better off (of course within the reasonable). This type of approach is an example of what Keeney (1992) describes as 'value-focussed thinking'. This experience as a stakeholder raised my interest in applying the concept of value-focussed thinking to spatial water management. Value-focussed thinking is an attempt to prevent projects of entering a stage of conflict and deadlock.

Value-focussed thinking and involvement of local stakeholders (see box 1.3) can contribute to identification of bottom-up solutions, but this is probably more difficult when the spatial and temporal scale of the policy problem do not match with the scale at which actual measures are taken. Bottom-up generated plans may be supported locally, but may not contribute to solving supra-local problems (for instance at the level of river basins and catchments). Involvement of local stakeholders is nowadays more or less common practice; still one of the main constraints in implementing spatial water policy are the often conflicting interests of local stakeholders and landowners. As a result, many projects enter a situation of deadlock, as will be demonstrated in Chapter 2. It is commonly felt that active participation of stakeholders in early phases of decision making is an important prerequisite for success, but how to best achieve and organise this participation when the scale of the problem to be solved does not match the scale at which measures need to be taken is a challenge addressed in this study.

Policy is generally phrased in generic fashion at a national scale, where it is implemented in the reality of local communities where interventions have serious consequences at the household and village scale. For example, the Ministry of Water Management, Public Works and Transportation launched ideas for assigning certain areas for flood storage (controlled flooding) along the rivers Rhine and Meuse. In a newspaper article (Volkskrant, 2002) a number of areas (Rijnstrangen, Ooijpilder and part of the Beersche Overlaat) were coloured blue to indicate where potential areas for flood storage were located. The ministry argued that such measures were required in order to protect larger areas against the risks of floods. Obviously this was alarming for the people living in those areas. To date there still is major opposition against the plans. Would early involvement of the local people and stakeholders before the launch of plans in the newspapers, have led to more support? It may have caused the development of alternative plans only solving a smaller part of the problem, and probably using more traditional measures such as constructing new dikes.

Dealing with the conflicting interests of stakeholders, whilst at the same time attempting to solve supra-local problems keeping the general principles of spatial water policy in place, appears to be a major struggle. The key is to find a balance between good control over the water management system as a whole on the one hand, and giving room and devote power to influence decisions to local stakeholders on the other hand. In this thesis I develop the argument that good control at the general (national) level is needed in order to cope with supra-local problems, such as long-term threats of climate change and to deal with large-scale developments in spatial planning. Involvement of and interaction with local stakeholders is also needed to increase support for decisions, to reach a higher level of integration in policy, to increase the quality of the decision and to increase the problem solving ability. A balance needs to be found between top-down control and bottom-up development of plans. Platforms for collaborative planning could offer such a balanced type of governance, a point addressed in chapter 3.

1.3 The use of scientific information in spatial water policy implementation

An important aspect of organising participation is the provision of information in the participatory process (Boogerd, 2005). How can all the stakeholders be informed? Over the years many tools have been developed and applied in attempts to support decisions and trade-off's in this complex setting of water management (chapter 4 deals with such tools). Among the variety of tools are multi-criteria analysis tools, spatial optimisation models, integrated assessment models, eco-hydrological models, and spatial ecological models. All these tools have one thing in common: they are used and developed to support decision makers in their complex task of balancing different interests, risks, pro's and cons, costs and benefits, which all together are beyond what the human brain can grasp. Support tools allow decision makers to 'play' with possible (aspects of) decisions, with alternatives and investigate impacts or gain insight into the possible response of potential opponents and proponents.

Given the variety of tools that have been developed one would expect to find many successful applications of such tools in water management. This, however, does not seem to be the case. Various authors have reported on failures or rather modest achievements of tools for decision support in water management (Van de Ven et al., 1998; Ubbels and Verhallen, 1999; Uran and Janssen, 2003) and also outside water management (Langendorf, 1985; Lyytinen and Hirschheim, 1987; Cox, 1996; Walker, 2002).

A distinction can be made between 'hard' approaches that analyse and evaluate data and 'soft' approaches that stimulate and facilitate discussion among policy makers, stakeholders and scientists. Tools to support decision making should adapt to a growing focus on integrated thinking and participation (Van de Ven et al., 1998). Decision support efforts should avoid a technocratic analytical perspective (decision support tools as 'problem solvers') and move towards more participatory usage and focus more on collective learning and design research (Van Eijk, 2003). Instead of viewing support tools as a means to legitimize decisions (a single decision maker wants to make a good decision and requires tools for processing all available data), decision support tools should stimulate the exchange of ideas, dialogue and help towards reaching common ground (Van de Ven et al., 1998; Hämäläinen et al., 2001;

Collentine et al., 2002; Walker, 2002; Pereira and Quintana, 2002; De Kok and Wind, 2003; La Jeunesse et al., 2003). Thus, interactive decision making requires different quantities and formats of information provision, a point elaborated on in chapter 4.

1.4 Research objectives

The argument developed above digests briefly into a) an approach towards stakeholder participation in implementation processes of spatial water policy, and b) an assessment of tools to support this implementation process. Together they form the main objective of this study:

“to explore and develop tools to support stakeholders at the local level to generate solutions to supra-local problems”.

This overall objective is approached by addressing a number of research questions:

- What are the main constraints in the implementation of spatial water policy? This question is addressed through an analysis of water policy implementation projects. A number of cases have been analysed to arrive at an overview of constraints and conditions for success.
- How can decision processes and governance in spatial water policy be approached in order to speed-up the implementation and to overcome deadlocks in decision making process? Theories and case studies have been analysed to answer this research question.
- Which tools and methods can be applied to support implementation of spatial water policy, what are their characteristics, are they successful and how can they be improved? A review of existing tools has been performed in order to reveal opportunities and limitations of scientific tools and to define requirements of tools to support the specific characteristics of implementation of spatial water policy.
- What tools can be recommended for offering support for spatial water policy implementation at the local level? Based on what is learned from real world problems, theory and attempts to implement tools, two different decision support systems have been built. The two decision support tools have been developed and applied in two case studies and conclusions are drawn.

1.5 Scope and limitations

This thesis aims at a specific area of water policy. With the term 'spatial water policy' it is intended to capture the shift that is taking place in water policy towards 'horizontal' storage and integration of water and other land use functions, to replace the traditional 'vertical' water defence approach. Because of the spatial context, projects touch upon land use planning, and involve aspects such as agriculture, nature conservation, urbanisation, recreation and infrastructure. Implementation of spatial water policy at the local level affects and involves a variety of stakeholders and institutions, which increases the complexity of decision making and planning processes. Limiting the study to this type of water management projects implies a focus on to decisions concerning land use planning, flood defence and safety. Water quality management is not the main focus of the study although quality issues may be relevant to decision making.

Climate change, soil subsidence, increased frequency and peaks in precipitation and river discharge are problems occurring at a supra-local level. At the local level measures are required in response to these problems. This study focuses in the implementation of such measures at the local level. The aim is not to analyse the principle of spatial water policy. Here we focus on the question how spatial water policy, as a new paradigm in water policy, can be implemented and established.

This study explores and develops decision support tools for water management decisions. Decision making and planning can be supported with specific types of tools. A wide range of tools exists within environmental science. In this thesis decision support tools are considered to help people involved in the decision making process to analyse often large amounts of information on various aspects of problems. Because of the nature of spatial water policy, such tools are 1) spatially explicit; 2) integrative; and 3) supportive to interactive processes. A hydrological model as such will therefore not qualify, but a GIS tool for integrated analysis of policy alternatives, will.

1.6 Outline of the thesis

The research questions as listed in section 1.4 are addressed and together, they create a partly parallel structure exploring both practical implementation experience in and theories on decision processes and the role of decision support tools in decision making processes in spatial water policy. Below, the subsequent chapters are briefly outlined within this framework presented in Figure 1.3.

Chapter 2 addresses the main constraints in the implementation of spatial water policy. The analysis is based on an inventory of 100 water management projects that represent the new 'spatial' approach to water management. From this list of projects, twenty were analysed in more detail. Chapter 2 aggregates the empirical findings from these projects, leading to an identification of potential areas where decision support systems can contribute.

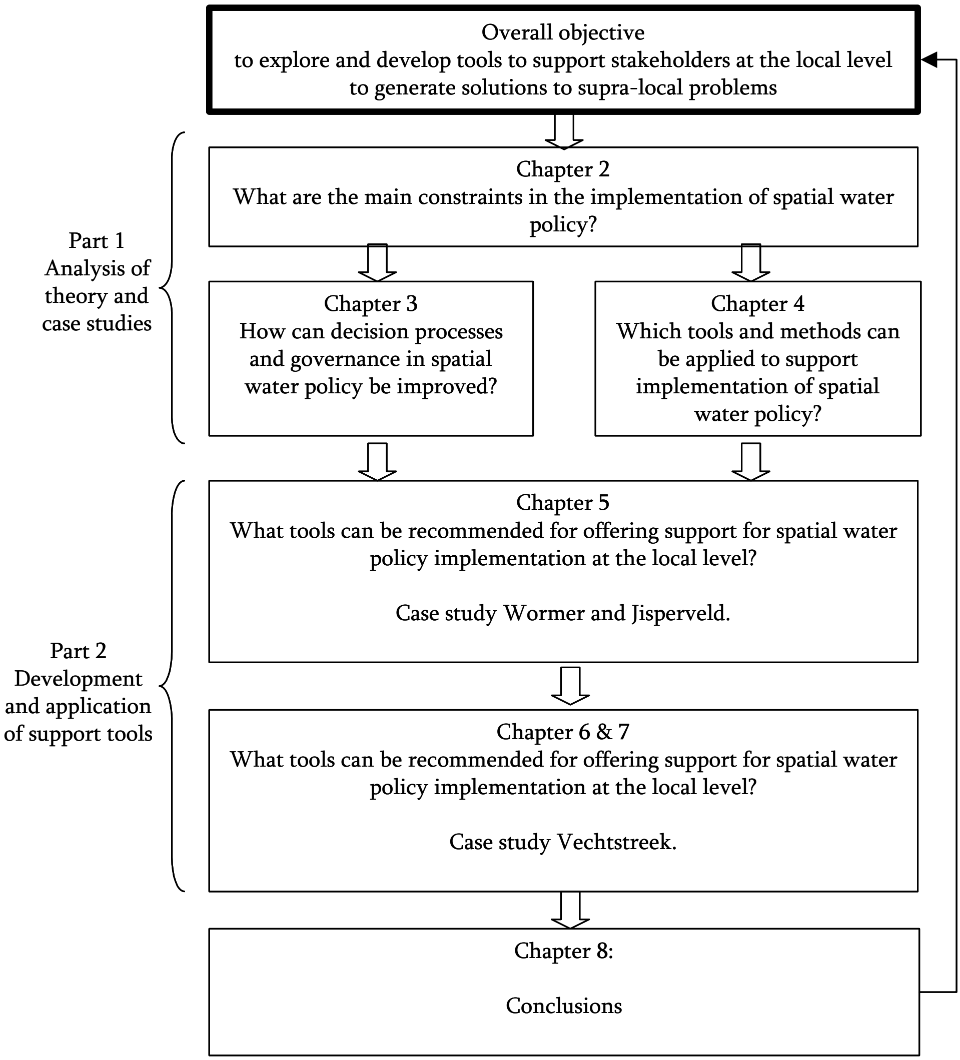
Chapter 3 explores governance and decision processes for water policy implementation. Different perspectives on decision making are explored and analysed. Platforms for collaborative management are analysed as a potentially effective way to break deadlocks in policy implementation.

In chapter 4 a review is made of the scientific tools that have been used till date (the third research question). It provides an overview of the 'supply-side' of existing support tools for spatial water policy: which types of decision support tools are available that are capable of addressing the issues in spatial water policy? What are the potential pitfalls for the use of these tools and which types of tools are more suitable to support which types of policy questions? Knowing what the main issues in spatial water policy are and given the lessons learned from application of support tools, Chapter 4 proposes a framework for selecting specific tools for specific purposes. This chapter also finalizes the analysis of case studies and theory.

Chapters 5, 6 and 7 describe the practical and applied part of the research. Chapters 5 and 6 describe two different decision support tools that have been developed during the research projects underlying this thesis. In building the decision support tools, the insights from the first four chapters have been integrated. The first decision support effort has been developed for spatial water policy in the Wormer- and Jisperveld (chapter 5). Lessons from this experience, obtained from interviews with potential end-users, are taken into account in the development of a second decision support effort for the Vechtstreek (chapter 6). This second decision support effort is considered to be better suited for spatial water policy implementation. The effectiveness of the latter tools is tested in a series of workshops (chapter 7).

Finally, Chapter 8 summarises the findings of all previous chapters and addresses how spatial water policy implementation can be organised and supported to assist stakeholders at the local level in generating solutions to supra-local problems.

Figure 1.3 The structure of the thesis with each chapter addressing a research step.



Part 1

An analysis of case studies and theory

2. Conditions for successful implementation of spatial water policy[1]

2.1 Introduction

Implementation of national water policy goals at the local level appears to be a major struggle (De Wilt et al., 2000; Rathenau Institute, 2001; Goosen and Vellinga, 2004). This chapter identifies and explores conditions critical for the implementation of spatial water policy. Critical conditions are identified and explored on the basis of an analysis of twenty case studies. The results of three consecutive projects[1] are brought together in this chapter in an attempt to identify general opportunities and constraints for successful implementation of water policy (critical conditions).

2.2 Methodology

In brief, the approach follows a number of steps: 1) an inventory of spatial water management projects; 2) an analysis of general characteristics of the state of spatial water policy implementation; 3) selection of projects for in-depth analysis; 4)

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[1] This chapter aggregates the results of a number of consecutive research projects described in:

Goosen, H., R. Lasage, M. Hisschemöller, N. van der Grijp (2002). Experiences with multiple use of land and water (in Dutch). IVM R-02/01. Amsterdam.

Huitema, D., H. Goosen, P.P. van Hemert, L. Bos, R.A. Hoekstra (2003). Combining functions with water (in Dutch). IVM R-03/11. Institute for Environmental Studies, 120 pp. Amsterdam.

Van Herwijnen, M., H.D. van Asselt, F. H. Oosterhuis, J.E. Vermaat, H. Goosen (2003). Critical conditions for combining nature restoration and water management (in Dutch). IVM R-03/12. 79 pp. Amsterdam.

Goosen, H., P. Vellinga (2004). Experiences with restoration of inland freshwater wetlands in the Netherlands: Lessons for science and policy. *Regional Environmental Change* 4, 79-86.

development of a checklist of potentially important conditions for success; and 5) analysis of case studies through interviews and review of background material.

The inventory of water management projects in the Netherlands resulted in a long-list of hundred projects and initiatives in the Netherlands (Appendix I). The inventory was completed through an extensive internet search, telephonic interviews with water authorities, provinces and relevant departments of the ministries. Projects were selected that met two conditions: 1) the projects aimed at improving the functioning of the water system according to the recommendations of the Commission Water Policy in the 21st century (Commission on water management for the 21st century, 2000); and 2) the projects also contained a spatial element by contributing to at least one other land use function. The inventory was performed over a one-month period of full-time searching. Although such an inventory will never be complete, the impression was that most ongoing initiatives had been found at that particular point in time.

General characteristics of the projects were identified during the inventory-phase. For 23 projects the information was very limited and they have been left out of the further analysis. The remaining projects were classified in a number of categories:

- Stage of the project (preparatory phase, planning phase, in execution, completed).
- The spatial extent of the project (local level or regional level).
- Land use functions involved in the project (forestry, mining (gravel, sand or clay), agriculture, nature, recreation, urban development, cultural historic sites, nature restoration and conservation, transportation and sludge storage).
- Measures in the water system (flood storage, restoration of meanders, groundwater and seepage, water retention, water purification, drinking water, water quality and flood safety).

A selection of projects was made for further analysis. The selected projects offer a cross-section of the long-list. In total, 20 projects were selected and these included variation in type of water system, spatial extent, organisational complexity, and implementation success and cover most of the Netherlands. The twenty different spatial water management projects were classified along two axes: technical complexity of the problem and political complexity. Technical complexity reflects on the content of the project: is scientific knowledge available, are there many different aspects involved or is the project more straightforward? Technical complexity was indicated by obtaining scores on a scale from 1 to 5 on the criteria ‘availability and uncertainty of scientific information’, the ‘number of different aspects involved (such as nature, recreation, infrastructure etcetera)’, and the ‘clarity of objectives of different parties’. Political complexity refers to the complexity of the decision making process. This is indicated by scoring the number of different decision makers or institutions involved, the clarity of their goals and the spatial scale level of the project. Obviously, this classification is highly subjective and qualitative and is only meant to illustrate the diversity of the projects in the analysis.

From the literature an initial list was generated of potentially important conditions for success (O'Riordan and Ward, 1997; Meijer et al., 1999; Rathenau Institute, 2001; Habiforum, 2001; Ministry of Transport and Water Management, 2001; Goosen et al., 2002). In a number of open interviews (7) this list was discussed and expanded. The list served as a basis for a questionnaire to obtain the overview of conditions for successful implementation. The checklist is given in Table 2.1.

Table 2.1 Checklist for critical conditions that resulted from the interviews in seven case studies.

Critical conditions	Checklist
Local conflicts on land use change	Did local stakeholders play a role in the project? Did they oppose to the plans or were they in favour of the proposed measures? Was it a problem to acquire land?
Sense of urgency	Was there a shared sense of urgency among relevant parties? Was the project well timed?
Institutional coordination and organisation	Was it clear to all parties who was responsible for what? How did different institutions cooperate? How were stakeholders involved in the project? Was there active or passive participation? Did stakeholders feel their interests were sufficiently taken into account? Were the goals of different stakeholders and parties clear? Did these goals change during the process?
Knowledge	Was knowledge sufficient, did uncertainties play a role?
Financial compensation and subsidies	Did subsidies play a role? Were the conditions clear? Was there money available for compensation schemes?
Legal aspects	Were laws and regulations limiting? Did contaminated soils play a role?

In total, twenty case studies were analysed using the questionnaire. Interviews (2 per project) were held with professionals involved in these projects (a project manager of the responsible leading party or parties and a representative of a non-leading party). The consequence of choosing interviewees from the leading and non-leading parties is that they both give different answers to the same question. A leading party might feel satisfied over the organisation of the process whereas a non-leading stakeholder might have a very different opinion. In such cases, both answers are included. This is not problematic since the goal is to gain insight in all relevant aspects that influenced the course of the projects perceived in either a positive or negative way. The interviews resulted in a list of different aspects that had either influenced projects positively (opportunities) or negatively (constraints). These have been grouped to six categories of critical conditions for water policy implementation. The frequency of occurrence of conditions indicates the relative importance of critical conditions for the success of implementation of spatial water policy. For each of the 20 projects studies, the checklist (Table 2.1) was used in the interviews to assess what conditions were relevant, in what sense (positive or negative) and to what extent (were the aspects essential or did they play a minor role in the realisation of the given project).

2.3 A characterisation of the state of spatial water policy implementation

The majority of the projects were still in either the planning or preparatory stage at the time of the survey (Figure 2.1).

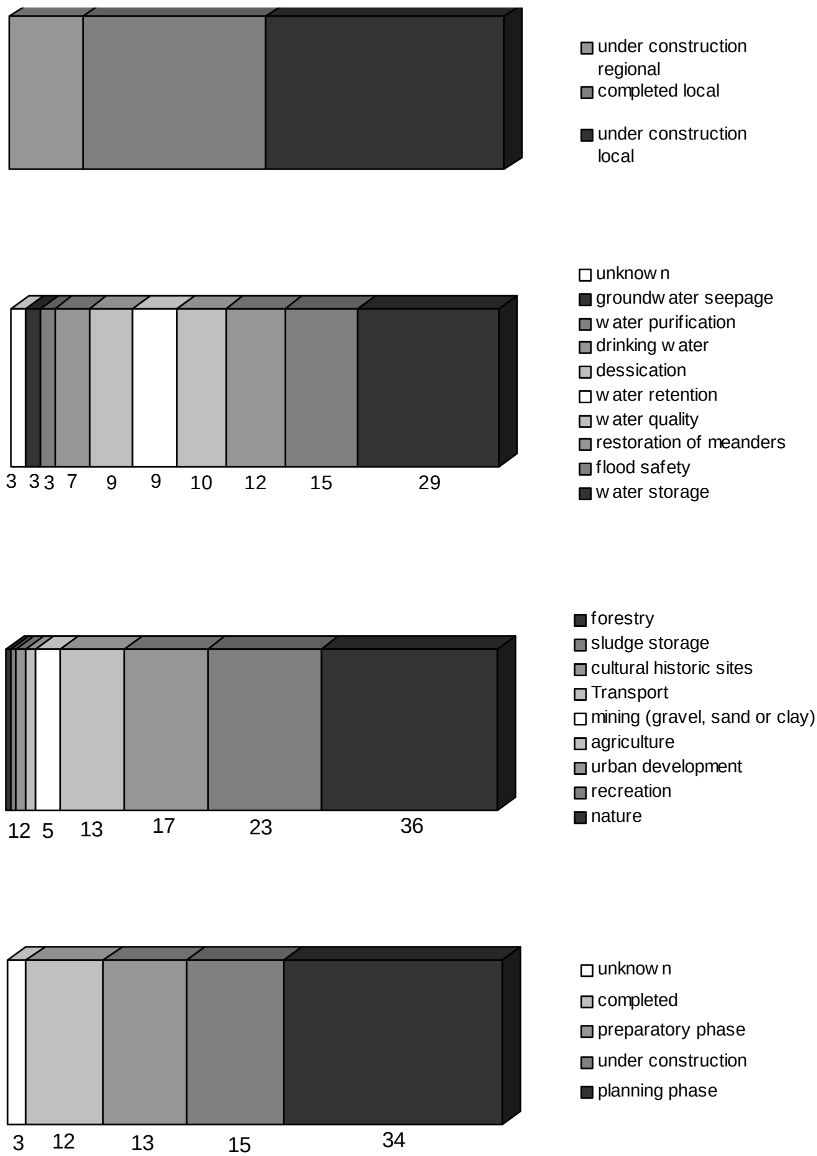

Figure 2.1 Water projects and the a) spatial extent of completed projects b) the types of water measures; c) the types of other land use functions involved and d) stage of the projects. A large number of projects are in either the preparatory or planning stage (61%) and completed or projects under construction are mainly found at the local level. Measures often include water storage in combination with nature development.

Projects that were finalised or in the process of being realised were found at the local level. Only four such projects were found at the regional scale. The larger projects require longer preparation and were generally still in the planning phase at the time of the inventory. The projects in the list are all examples of multiple use. Most commonly, combinations are sought with nature and recreation functions, but also with urban development and agriculture.

The inventory was carried out in 2002. It shows that many projects aimed to combine ambitions to improve the water system with contributions to other land use functions. Only relatively few projects had reached the stage of implementation, and those that were generally had a local spatial extent, i.e. floodplain restoration measures along parts of the rivers Rhine, Meuse and IJssel and brook restoration projects in the eastern, higher parts of the country.

2.4 In-depth qualitative survey of projects: critical conditions for success

Our selection of 20 projects for further analysis contained a cross-section from the long-list of projects. Figure 2.2 shows the location of the analysed projects.

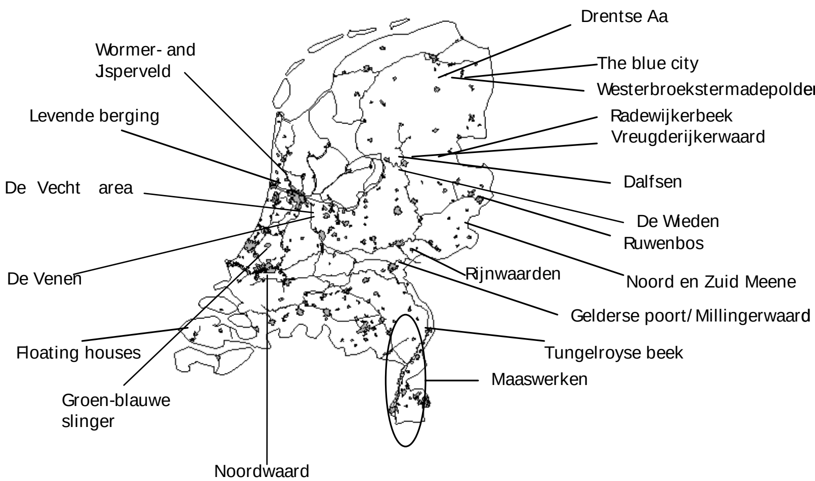

Figure 2.2 Location of the 20 water management projects that were analysed in three successive projects.

The twenty projects are thought to be representative for the breath of the long-list and include variation in type of water system, spatial extent, organisational complexity, perceived implementation success and they cover most of the Netherlands (Figure 2.2). Table 2.1 summarises the general characteristics of the selected projects.

Table 2.2 General characteristics of the analysed projects. The scale refers to the size of the project. The scale goes from 1-10 hectares (very small) to areas of > 3000 hectares (large). The satisfaction over the result of the project was indicated in interviews and background material. Political and technical complexity is scored on a number of criteria (see text below).

Aspect	Category	Number of projects
Scale	Very small	5
	Small	7
	Medium	4
	Large	4
Result of the project	Satisfactory	13
	Unsatisfactory	7
Political complexity	High	8
	Low	12
Technical complexity	High	11
	Low	9

The categorization into political complexity and technical complexity (see section 2.2) shows that projects range from relatively simple and clear-cut problems to complex situations where both the political setting and the problem itself are complex. Projects that are technically complex are usually also politically complex (although the correlation shown in figure 2.3 is weak).

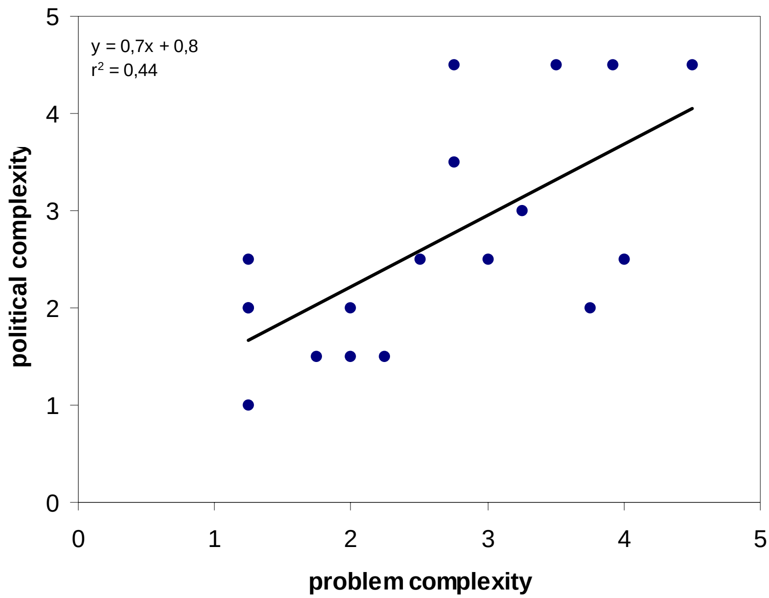

Figure 2.3 Complexity of 20 water management projects in the Netherlands along two axes: technical complexity and political complexity.

Figure 2.4 shows the frequency of conditions encountered in the interviews. It shows that organisational aspects, stakeholder involvement and the sense of urgency are especially important conditions for successful implementation of water management projects (since they were mentioned in at least 2/3 of the cases). Stakeholder involvement, for example, is mentioned in almost every case. Stakeholder involvement counts as a success factor when dealt with properly, bit is also often mentioned as a serious constraint in the project, when not dealt with properly. Note that the frequency of conditions being mentioned in the interviews can be higher than the total number of cases. This is because the conditions can be perceived as a positive factor by one interviewee and as a negative one by the other. These conditions are further discussed below.

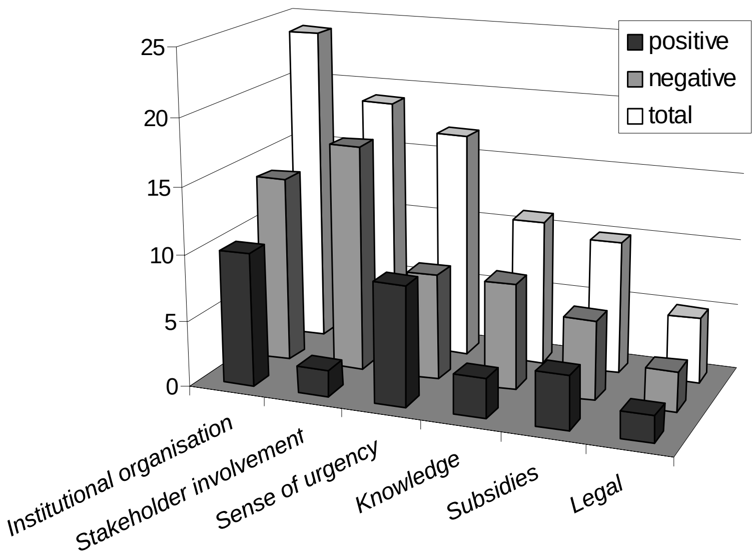

Figure 2.4 Frequency of critical conditions mentioned to have had a significant (positive or negative) impact on project success. A condition can have a negative impact if not dealt with properly, or positive when the condition is met.

The qualitative and subjective nature of the analysis has implications for the conclusions that can be drawn. Firstly, the differences between the various projects (in terms of size, complexity, stage and type of water system) were high, which makes them difficult to compare. Secondly, conditions for success are not independent and difficult to separate. For instance, stakeholder satisfaction depends on institutional organisation of the decision making process, and a sense of urgency could also change the position of the stakeholders towards initiatives. It is therefore difficult to point the finger at one specific aspect of the project, success is more likely to result from a whole range of aspects that are interrelated. Finally, judgement of project success or failure is subjective, and can be different among parties. Consequently, our analysis provides an overview of the variety of relevant conditions, and gives some indications of the relative importance of conditions. It helps to better understand the possible explanations for the sometimes difficult implementation of water policy. The overview provides insight into the difficulties that are generally encountered, but does not aim to be a recipe for successful project design.

The critical conditions are elaborated on below, and illustrated by some examples form the twenty case studies. Other case descriptions can be found in the reports and publications on the three projects mentioned earlier (Goosen et al., 2002; Huitema et al., 2003; Van Herwijnen et al., 2003).

Institutional organisation

The most frequently mentioned condition for success in the interviews is institutional organisation. The importance of good institutional organisation can be illustrated by two projects, the Meuse Works Project (Maaswerken; Box 2.1) on the one hand and the Vreugderijkerwaard project (Box 2.3) on the other. The Maaswerken project is an example of an institutionally complex project. The Maaswerken project is an example of a 'large infrastructural project' and such projects generally have substantial technical, financial, social, environmental and spatial consequences. The Maaswerken project is no exception. A separate project organisation (125 employees) has been established to coordinate the implementation project, since planning, organisation and management are very demanding in such a complex context. Currently, expectations are that the project will finalise in 2022 (www.maaswerken.nl).

During the preparatory and planning phase numerous conflicts occurred. There was disagreement over the distribution of costs and benefits of the project. Especially the Grensmaas project (a subproject for a specific trajectory of the river) encountered some major drawbacks during the planning phase. In 1998 the regional spatial planning procedure (streekplanprocedure) was interrupted because the project organisation and the gravel industry were in conflict over finding an integral plan of action, which had to be economically self-sufficient. This was an important prerequisite imposed by the national government. Because of the neutral budget condition, economic revenues had to be high and therefore a large amount of gravel had to be abstracted. The mining of such large quantities of sand and gravel would cause great nuisance for local communities and would have negative impacts on the landscape. The province of Limburg developed an alternative plan in 2001. This plan was more modest in ambition and reduced nuisance caused by the gravel abstraction and reduced the overall claim on space. The ministries involved approved this alternative plan, and at this moment it is expected that the actual construction can start in 2007.

Box 2.1: The Meuse Works Project

Figure 2.5 Location of the project 'Maaswerken'.

The Maaswerken project was initiated around 1990 and was originally mainly intended as a local nature restoration project. Currently, the plan includes a large part of the Dutch valley of the river Meuse, from the city of Maastricht to the city of 's-Hertogenbosch. Triggered by the floods along this part of the Meuse in 1993 and 1995, a large plan was developed to safeguard the area against floods. The overall goal to reach a flood protection level of 1:250 years (meaning that a flood event should not exceed a chance of happening more often than once every 250 years), is to be reached in combination with creation of new nature, gravel abstraction and navigation. The project consists of two subprojects: the Grensmaas and the Zandmaas. Given the extent and complexity of the project, a special project organisation was formed. The planning phase ended in 2002 and currently the plan is being implemented. The plan consists of a variety of measures. Around the populated areas, dike construction and reinforcements are necessary. In the less populated areas, retention areas and flood channels (diverting flood water) are being created. Gravel abstraction and nature can both profit from enlargement of the riverbeds and the creation of flood channels.

The checklist (Table 2.1) was used to identify the most important conditions that were encountered during the planning and preparatory phase of the Maaswerken project. The results are summarised in Table 2.3

Table 2.3 Major opportunities and constraints in the planning and decision making process of the Maaswerken project.

Major success factor in the project	Major constraint in the project
Shared sense of urgency	Lack of stakeholder involvement; passive and late participation
Timing of the project	Heavy opposition of local inhabitants
Combination with sand and gravel abstraction generated finances	Unclear responsibilities of different institutions
	Bad cooperation between institutions
	Changing goals during the process
	Uncertainties in the knowledge
	Insufficient legal framework
	Contaminated soils

The Vreugderijkerwaard project has been an initiative of the Ministry of Agriculture, Nature and Food Safety together with the Provincial authority. The project was co-funded by the Ministry of Transport, Public Works and Water Management. The EU contributed via the IRMA-programme (Interreg Rhine Meuse Activities). The project also aimed at increasing flood safety through the creation of a channel and restoration of a river floodplain along the river IJssel. The required land was acquired on a voluntary basis: farmers were not forced to sell their land. An intermediate organization facilitates this process of land trade (Dienst Landelijk Gebied).

Compared to the Maaswerken project, the Vreugderijkerwaard project involved considerably less parties and the extent was also smaller than that of the Maaswerken project. The goals of the various institutions could be united relatively easily. The measures planned to improve nature, to a large extent overlapped with the goals for the water system: creating more room for the river by stimulating the development of new habitats. The critical factors that were encountered in this project are somewhat different from the previous example.

Technically, there already was considerable experience with the creation of new river habitats along the river IJssel. A drawback was the fact that the sand and clay that became available was heterogeneous in composition and could not be sold easily. In addition, the top layer was slightly contaminated. An important stimulus for the project was the fact that it matched well with existing policies (nature policy plans at the national and provincial level) and water policy (room for rivers policy and the IRMA program). The timing was therefore right. However, the involvement of different governmental bodies also complicated the project. For instance, flood safety posed restrictions on the goals for nature restoration.

The organisation of the project was not as complicated as in the Maaswerken project. There were no major conflicting views and there was a cooperative attitude among the leading parties. Considerable attention was given to the communication of the plan to local inhabitants. There was no opposition from the local inhabitants, who in fact were all positive towards the creation of a nature area in combination with increased safety levels. The agricultural sector was not involved in the actual planning process but acquisition of the necessary land was time-consuming though did not encounter major drawbacks.

Box 2.2: The Vreugderijkerwaard Project

The 'Vreugderijkerwaard' is a floodplain area of about 130 hectares located to the east of the river IJssel, north-west of the town of Zwolle (see Figure 2.2). Within this floodplain area, a new channel was created alongside the river IJssel. The purpose of this channel, which is 1800 m in length, is to lower river height (increased capacity of the river) and to increase the ecological value of the area. A new dynamic river ecosystem is created offering opportunities for the development of specific river habitats. It is expected that many bird, fish and plant species will be attracted by the area. Different habitats are created such as shallow areas for wading birds and breeding places for fish, reed lands and river dunes. The digging of the channel started in 1999, and in the summer of 2002 the channel was opened up through the removal of the dike.

The project is considered a success and no major constraints were reported in the interviews. Compared to the Maaswerken project, the project was relatively straightforward and less demanding with regard to the planning and organization. The only reported constraint was the unforeseen disability to sell the sand and clay that became available, due to the heterogeneous composition and contamination of the top layer. The availability of different sources funds was an important stimulus, since this created financial arrangements for reaching multiple goals. However, the primary aim to contribute to flood safety restricted the development of the nature areas. Table 2.4 summarizes the main findings.

Table 2.4 Major opportunities and constraints in the Vreugderijkerwaard project.

Major success factor in the project	Major constraint in the project
Timing of the project	Contaminated and heterogeneous soils
Clear institutional responsibilities	
Good institutional cooperation	
Clear goals of different parties	
Availability of subsidies and funds	

In many of the twenty case studies institutional organisation and coordination were mentioned as important in either a positive or negative way (Figure 2.4). Where there was satisfaction about the organisation (9 out of 20 projects), special arrangements were made to involve different parties in the decision making process. In these cases a special project bureau was initiated to lead the project and in each of these cases this was felt to be an important condition for success.

In other instances insufficient coordination and organization led to serious constraints. Insufficient institutional coordination was mentioned as being a major constraint in 13 of the 20 analysed projects. The operational management of water is a responsibility of the local water authorities. But since the allocation of areas for controlled flooding or increasing water levels will have a wide range of impacts on society (agriculture, nature areas, urban areas, infrastructure) water management is a very complex policy process in which different departments share responsibilities, which increases the complexity and poses high demands on the coordination of projects. This raises the question whether local water authorities are capable of dealing with the water management issues that have such broad societal, ecological and economic consequences. The Rathenau Institute (an independent advisory board to the Dutch government) promoted a more important role of the provincial governments in the coordination of regional water management and planning (Rathenau Institute, 2001).

Besides the often-difficult institutional coordination between different national institutional levels, international coordination across river basins is still in its infancy. Currently, most initiatives in the water sector are taken at national level and it appears that river management strategies are often not addressed within larger – transboundary - river basins (Kabat and Schaik, 2003; Aerts and Droogers, 2004). The Water Framework Directive (2000) is a European initiative aimed at establishing a framework for harmonizing community action in water policy (European Community, 2000). The Directive requires water management plans, programmes of measures and environmental quality objectives to be pursued on the scale of entire river basins. Achieving the objectives within the deadlines set within the directive will require a degree of cooperation and negotiation with other policy fields very unfamiliar to water managers in many Member States (Moss, 2004).

Within the Rhine river basin there is some experience with internationally coordinated water management by the nations. Especially where it comes to implementation of measures at the local level, problems occur. Where Germany has already started with developing flood retention areas, The Netherlands at that moment struggled with finding adequate solutions to deal with extreme flood events (Middelkoop and Asselman, 2000; Hooijer et al., 2003). Authorities at the regional and local level were reluctant to implement measures, which were imposed by the higher institutional levels. For example, in the Dutch province of Gelderland (which borders with Germany), areas were designated for flood retention or storage. This led to heavy conflicts with local stakeholders as they found that it was not only their responsibility to implement adaptations but that countries upstream, in this case Germany and Switzerland, should also undertake additional measures.

Involvement of local stakeholders

In many cases the involvement of local stakeholders is being identified as a crucial condition for success. One project, the 'Levende Berging' project (Box 2.3) illustrates how a lack of involvement can lead to heavy opposition. In this plan, a spatial solution was proposed for storage of surplus water at times of high flood risk. Because the spatial solution would also affect other land users, the water authority asked the Province of North Holland to coordinate the initiative. In the mean time, opponents to the spatial solution organized themselves into an action committee opposing against the plans. The province developed an alternative solution where only 75 hectares instead of the initial 200 would be assigned to controlled flooding. Finally, because of the lack of support from citizens and local stakeholders the plan was voted off in the general assembly of the water authority. Instead the technical solution of increasing the pumping capacity was chosen. The active involvement of local action groups forced the policy makers to choose a solution that would cause less commotion.

Table 2.5 Major opportunities and constraints in the Levende Berging project.

Major success factor in the project	Major constraint in the project
Shared sense of urgency	Stakeholder opposition
Timing of the project	Lack of cooperation between institutions
	Changing goals during the project
	Lack of technical knowledge
	Uncertainties on the effectiveness

Involvement of local stakeholders is often mentioned in the interviews and in most cases in a negative sense, leading to serious constraints to the implementation of spatial water projects. In 15 of the 20 projects that were analysed, conflicts with local stakeholders were reported as being one of the main constraints in the projects. Local inhabitants fear the possible problems associated with higher groundwater levels, perceive an increased risk of floods and fear further nuisance by for instance mosquitoes. Furthermore, spatial water policy generally requires changes in land use. Often agricultural land is being transformed and acquisition of land is a costly and time-consuming process requiring careful planning and preparation. Farmers are often not willing to sell their land and are not always convinced of the necessity of proposed changes in the area. This is not to say that when local stakeholders are involved, these issues will not exist. We only observe that the way in which stakeholders are involved is often mentioned as being an essential aspect to determine project success.

Box 2.3: The project Levende Berging

The 'Levende Berging' project in Noord Holland Midden area, is a project where opposition of local stakeholders has played a decisive role. The Noord Holland Midden area is located in the province of North Holland (Figure 2.2). This area consists of typical Dutch landscapes with agrarian polder areas (reclaimed lakes) such as the Schermer and the Beemster polder, and fen meadow areas such as the Wormer- and Jisperveld and Waterland. The area has important landscape, nature and cultural heritage values that are recognized nationally (it is considered a National Landscape) and internationally (the Beemster is on the UNESCO world heritage list). In 1994 due to high rainfall intensity, water threatened the area and agricultural production was damaged. The local water authority commissioned a research project to study flood safety and the reliability and capacity of the water defense system in the area. The project also investigated the capacity of the water system to cope with predicted impacts of climate chance. The results of the study pointed out that additional measures were required. A choice had to be made between a more traditional technical solution (construction of a new drainage pump) or to assign water storage areas for temporary storage of surplus water. Out of 52 different potential locations, an area of 200 hectares near the town of Schardam was identified as most suitable. The area was capable of storing 4 million m^3 of water, if water levels were periodically allowed to rise up to 1.5 meters above surface level. This was estimated to happen once per century, but annually parts of the area could be periodically inundated as a means of controlled flooding. The water authority was prepared to invest the same amount in an area for controlled flooding as was reserved for investments in more pumping capacity.

In many of the cases studied, the need was identified for an open, participatory process. Active participation of stakeholders in open plan processes may help to overcome or decrease the level of conflict (Grimble and Wellard, 1997; O'Riordan and Ward, 1997). Stakeholder participation is however not a guarantee for success. Conflicts may still lead to constraints in the planning process. However, communication and participation helps to build up trust relationships and the likelihood for cooperative actions.

Sense of urgency

In 8 of the projects a lack of urgency was mentioned as an important constraint, on the other hand a shared sense of urgency was also 9 times mentioned as an important stimulus. In the case of the 'Westerbroekstermade Polder', the events of 1993 and 1995 made inhabitants of the area realise that something had to be done to prevent further damage in the future. In 1995 people needed to evacuate and the dikes were deliberately opened to inundate the polder. This caused considerable damage to infrastructure and agricultural property. Farmers complained over the suddenness of the measure and the little time they got for safeguarding all their machines and livestock, but there was little doubt over the need the measure.

Box 2.4 The Westerbroekstermade Polder project

In the polder Westbroek project, the objectives were similar, but opposition was not as heavy as in the previous Levende Berging example. The project involves an area of 200 hectares to be used for temporary storage of excess water, with an estimated frequency of once every 25 to 30 years. The polder, situated in the province of Groningen (Figure 2.2), is now a nature reserve that can be used for water storage. In 1995 and 1998 the area suffered flood damage. Due to heavy rainfall the canals no longer had the capacity to discharge the water to the Wadden Sea. Two polders were flooded to prevent damage in urban areas. This event raised awareness in the area, also among farmers, that additional measures were required.

Photo: The Westerbroekstermadepolder in 2000.

The Westerbroekstermadepolder area used to be agricultural land (dairy farming) but a nature conservation group ('het Gronings Landschap') had bought the land from the farmers since their plan was to establish new nature in the polder. The new plans of using the area for periodical storage of water had to be united with the goals of the nature conservation group. Since both the water manager and the nature manager had plans to redesign the area, the time was right to combine the two objectives. Due to good cooperation and the availability of different funds (because there were two objectives there were different sources of money available), the project has been successful. Another advantage was that the area was already owned by a nature conservation agency.

Table 2.6 Opportunities and constraints in the Polder Westerbroek project.

Major success factor in the project	Major constraint in the project
Shared sense of urgency	
Timing of the project	
No land acquisition required	
Good cooperation between the different institutions	
Availability of funds	

In the case of the Meuse Works project (box 2.1), initially a high sense of urgency was commonly felt. The flood events of 1993 and 1995 speeded up the planning procedures because the threat of the water that called for structural and large-scale measures. However, there was a turning point in the project. Opposition among local inhabitants started to grow as other goals besides flood safety began to take over. Profits of the gravel industry began to dominate the discussions and the local inhabitants feared the nuisance from the large-scale gravel mining. The local community felt to be excluded from the negotiations and they felt they had to pay for everyone else's benefits. In 1998 the regional spatial planning procedure (streekplanprocedure) was interrupted because the project organisation and the gravel industry were in conflict over finding an integral plan of action. This caused further delay of the project.

A general sense of urgency might be lacking when measures are aimed to prevent problems in the far future. Issues like climate change and loss of biodiversity have a long-term perspective. The urgency to undertake immediate action often follows directly after an event, but disappears quickly. In cases where there is a direct need for action (for instance the floods of 1993 and 1995), a window of opportunity opens and calls for immediate action. However, in the case of spatial water policy, solutions are socially, ecologically and socio-economically complicated (de Vriend and Iedema, 1995; Geldof, 1995; Van Ast, 2000; De Wilt et al., 2000; Rathenau Institute, 2001; Aerts and Droogers, 2004; Brouwer and van Ek, 2004). Generally such solutions require longer planning periods where momentum can be lost easily. Although a high sense of urgency may speed up the decision making, the risk exists that only short-term measures are taken. People in threatened areas demand immediate action and will prefer short-term measures that they are familiar with. Such measures can only be traditional ones that have proven their effectiveness. A strong sense of urgency can, in this sense, also work against spatial water policy. To overcome this, the Dutch Ministry of Transport, Public Works and Water Management started a nation-wide campaign in 2004 to raise awareness of the water problem and to familiarise the public with the new types of measures the government is proposing to take (www.nederlandleeftmetwater.nl).

Knowledge

A lack of technical knowledge is commonly not thought to be a major constraint in Dutch water management (Van Rooy, 1997; De Wilt et al., 2000; Rathenau Institute, 2001). However, the nature of water management has changed and the scope of water management has broadened. The spatial approach to water management requires an integration of different disciplines including social sciences and economics. In an advisory study to the government, the advisory committees for agriculture (the former NRLO), nature (RMNO) and technology and science (AWT) reported a need for such integration of disciplines (De Wilt et al., 2000). The results of our project analysis support this need for a broader science and integration of disciplines. However, in 7 of the 20 analysed cases, there still appeared to be a lack of technical knowledge, which led to questions with regard to the effectiveness of the proposed measures. In a number of projects it was unclear whether the spatial approach to flood protection (through creating areas for controlled flooding) would provide sufficient protection. This proved to be a very important question in the Levende Berging project (box 2.3). An additional problem here is that information on the effectiveness of proposed measures is sometimes not accepted. People are familiar with the traditional way of dealing with flood protection and do not believe that the new approach will indeed provide them with the same level of safety.

Subsidies and compensation schemes

Subsidies and availability of financial resources for compensation schemes are an important condition, especially in cases where landownership has to be changed. A problem is that in general, the funds will have to be made available by different government departments. Especially in cases where an area is used in multiple ways (multiple land use) it is unclear which government agency is responsible for what (De Wilt et al., 2000; Teisman et al., 2001). The conditions for achieving subsidies are sometimes unclear or are not suited to multiple land use situations where there is multiple ownership. A lack of funds was mentioned in six projects as an important constraint whereas in four cases, the availability of funds increased the opportunities.

Legal framework

In two cases laws and regulations speeded-up the decision making process. According to the evaluations of Wiering & Driessen (2001) the legal framework has been critical to the way the dike reinforcements were carried out. Indeed, the quality of the legal framework was identified as a key factor of success for the acceleration of the procedures as intended in the Major Rivers Delta Act and the Embankment Act. The guidelines set forth in the Major Rivers Delta Act (Deltaplan Grote Rivieren) and the Embankment Act were specifically formulated to secure safety by reinforcing dikes. However, these guidelines are not appropriate to a spatial policy that seeks to give rivers more room. The Embankment Act deals with dikes, and not with the land they safeguard. Another problem is that this legislation is both temporary and geared to an emergency, making it static in character. The Embankment Act might therefore not be the best legal framework for the new policy of making room for rivers (Wiering and Driessen, 2001).

2.5 Discussion

The aim was to identify critical constraints for a successful implementation of spatial water policy. A variety of interrelated and often context-specific conditions has been found in the literature and the analysis of the case studies shows that these conditions are indeed important for successful implementation of spatial water policy. A good institutional organisation stood out as the prime factor. Stakeholder involvement ranks second and is almost always mentioned as a negative condition. A sense of urgency is the third important condition. The analysis provides an overview of important conditions, however these conditions are not independent, they are interrelated. A good institutional organisation can contribute to a good relationship with local stakeholders. Without a shared sense of urgency among participants, their willingness to cooperate will probably be low and it will be harder to find financial support. Technical knowledge is necessary to justify proposed measures and can help create a sense of urgency. Finally, there has to be a sound legal framework to support proposed measures. The critical conditions are highly intertwined and substitution between conditions is not always possible. For example, bringing in more money can probably not always compensate for a lack of organisation or bad communication.

To conceptualise the results, we made a distinction between process-related conditions (institutional organisation and communication and stakeholder involvement), content-related conditions (shared knowledge and a sense of urgency), and financial-legal conditions (legal framework and finances). Successful policy implementation depends on these three sets of conditions.

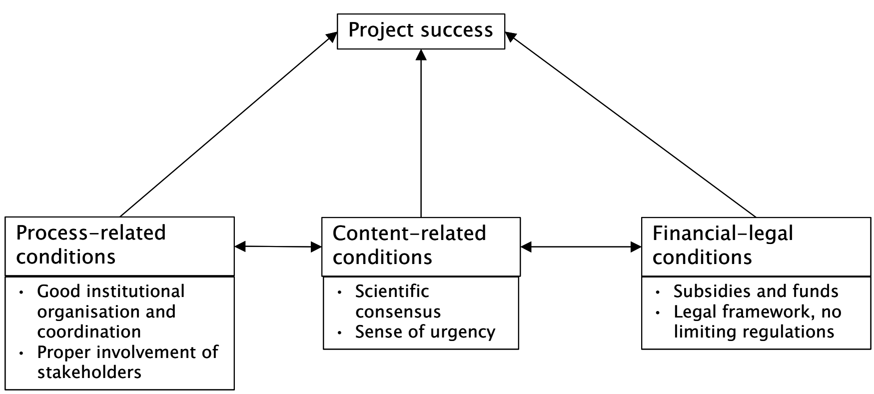

Figure 2.6 Conditions for successful implementation of spatial water management projects. The conditions are interrelated and not fully substitutable.

Looking at the frequency of the conditions mentioned in the interviews, it appears that it is especially difficult to meet the process-related conditions in spatial water policy implementation. This does not mean the other conditions are not important.

For example, in some of the cases (notably the Levende Berging project, box 2.3) there was a lack of convincing scientific information on the effectiveness of proposed measures. It does seem that the content-related and financial-legal conditions are more familiar to water managers. How to involve local stakeholders, how to achieve good communication and cooperation between different decision making bodies are relatively new questions to water managers who are more familiar with technological issues.

Implementation success of spatial water policy is likely to benefit from a good coordination and institutional organisation, proper involvement of local stakeholders at the right time, a clear sense of urgency, sufficient knowledge on the effectiveness and potential impacts of proposed measures, sufficient funds available especially for compensation, and finally a legal framework which allows for the proposed measures and reinforces the need for action.

In an ideal case, all these criteria for success are met, but in practice this will hardly ever be the case. Problem complexity in the field goes hand in hand with political complexity in the decision making process. In those more complex cases it will be almost impossible to sufficiently address all the aspects listed here. Questions which now arise are related to how decision processes and governance in spatial water policy be approached in order to speed-up the implementation and to overcome deadlocks in decision making process. Following this, which tools to improve the exchange of information can be applied to support implementation of spatial water policy? The remainder of this thesis will deal with these aspects in more depth.

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3. Decision processes for spatial water policy

3.1 Introduction

Institutional organisation and involvement of local stakeholders were identified in the previous chapter as being important determinants of project success or failure (see § 2.3). This chapter addresses decision processes for spatial water policy. In water policy the trend has been to decentralise and to delegate implementation tasks to regional and local authorities. The importance of involving stakeholders in decision making processes is widely recognised and becoming common practice (O'Riordan and Ward, 1997; Nunes Correia et al., 1998). Top-down centralised water management has a risk a risk of running into heavy conflicts with various stakeholder groups (Renn et al., 1995), whereas a decentralised more bottom-up approach may not be suitable to deal with longer-term problems at the larger scale (of river catchments for instance). How to govern water and organise decision making processes for water policy implementation has been the subject of ongoing debate in the Netherlands (Van Rooy, 1997; Wiering and Driessen, 2001; Verbeek and Wind, 2001; Goosen and Janssen, 2002; Huitema et al., 2003).

This chapter first defines some of the terms used in this chapter on decision making processes. Next, it explores different perspectives on decision making taken from policy sciences literature. It then discusses spatial water policy implementation in the context of the different policy perspectives. Finally, a specific approach to decision making is discussed and recommended for spatial water management.

3.2 Policy, policy objectives and decision making

Policy can be seen as a composition of means and time-choices aimed at meeting certain objectives. These objectives result from the process of thinking about how to create certain values (Keeney, 1992). Besides creating values, an objective can be to solve, diminish or prevent a problem. A problem can be defined as a situation where an individual or group perceives a difference between the present and the desired state (Janssen, 1991). In this definition an opportunity, such as creating value is also a problem. Policy-making thus aims at reaching objectives such as creating values, preventing future undesired states and solving present undesired states.

Management alternatives or management options are ways (sets of measures, rules and regulations) to reach policy objectives. Management options are a plan of action. If no management options exist (i.e. there is no solution to a problem) there are no alternatives to choose from and in that case an undesired state cannot be considered a decision problem (Janssen, 1991). A decision process is a set of actions and dynamic factors that begins with identification of a stimulus for action and ends with a specific commitment to action (Mintzberg et al., 1976). Decision processes thus involve the whole process of identification of objectives, investigating management options and finally selecting a management option that best meets the policy objectives. A decision on a certain policy is a specific commitment to action. In Figure 3.1 a simplified representation of decision making is given. There are different views on processes of decision making. Figure 3.1 only shows the components of decision making, the process and sequence in which these elements take place require more elaboration. Paragraphs 3.3 and 3.4 will describe some of the different perspectives on decision making processes.

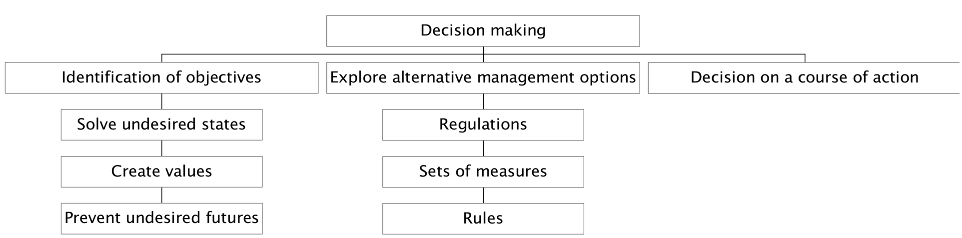


Figure 3.1. A simple representation of decision making which involves identification of objectives, exploring alternative options and a decision on a course of action.

Policy- and decision making take place at different levels of scale (Figure 3.2). At the international level (the EU level), the Netherlands together with the other member states have adopted the water framework directive to harmonize water management actions at the water catchment level. At the national level 'water policy for the 21st century' was adopted by the parliament, and the spatial approach to water management was formally adopted by the national government, the provinces and municipalities in the national policy agreement water ('nationaal bestuursakkoord water'). At the level of Provinces (regional level) the general principles of water management are translated to more concrete management plans for catchments ('stroomgebiedsplannen'). The provinces are taking the lead in translating general policies to the operational level. At the operational level, local water authorities are responsible for the implementation of plans by taking the necessary measures (the local water authorities prepare a water management plan every four years). Between the different levels of scale there is interaction. However, an often-heard complaint is that communication between these nested levels of decision making is problematic (Van Rooy, 1997; De Wilt et al., 2000; Rathenau Institute, 2001; Huitema et al., 2003).

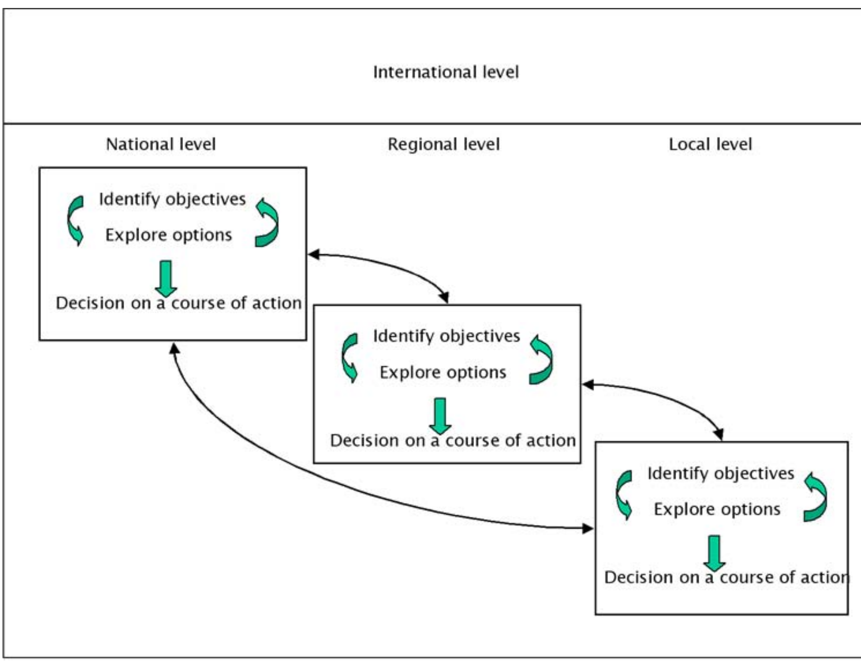


Figure 3.2. Decision making on water management at different levels of scale

3.3 A 'top down' perspective on decision making processes

Different perspectives can be identified on how decision making processes should be organised. The perspectives can be grouped somewhat simplistically under a top-down perspective and a bottom-up perspective. In fact, there is a range of different approaches to policy-making, where top-down and bottom-up are at the end of the extremes.

The top-down style of decision making is also referred to as hierarchical (Huitema and Hinssen, 1998) or unicentric (Teisman, 1995). For the sake of simplicity and to avoid a semantic discussion, we here refer to it as the top-down perspective. In a top-down perspective on policymaking, a centralised actor is the main decision maker who develops a certain policy to reach certain objectives. Other parties play a role, but do not take actual decisions. This group of other parties is often referred to as the policy network (Klijn et al., 1993). The existence of policy networks is in sometimes considered as a constraint to decision making in the sense that policy networks decrease the power of the decision maker to take necessary decisions (Glasbergen, 1989; Nelissen, 1992). Characteristically, in the top-down perspective the centralised actor defines (a set of) objectives and that this actor will make choices on the final course of action. Other parties can influence this decision. A top-down perspective does not mean that other parties have nothing to say. However, participation in the top-down perspective is generally one-way communication or notification. The centralised actor may want to convince the policy network or seek support actively. Good communication by the centralized decision makers can help to increase support. In gaining support, a centralised decision maker will wish to account for the values of other stakeholders and can ask other parties to participate in an advisory manner. The network may feel powerless because of the limited influence on the decision to be taken. Such a top-down style of consultation can be counterproductive. A study by the German sociologist Ortwin Renn and colleagues (Renn et al., 1995) concluded that traditional top-down consultative styles are unsatisfactory to many of the parties involved. This style of consultation can prove counterproductive because they can generate even greater conflict. Top-down may also imply a sectoral approach. In the centralized perspective there may not be equality between issues, a single problem or policy terrain may dominate the process.

Figure 3.3 presents degrees of participation along a continuous scale. The degree of participation is linked to the different desired outcomes of the participation process, which in turn is linked to the type of decision making process. This figure is one example, and the literature offers various similar classifications (Klijn et al., 1993; Teisman et al., 2001; Edelenbos et al., 2001).

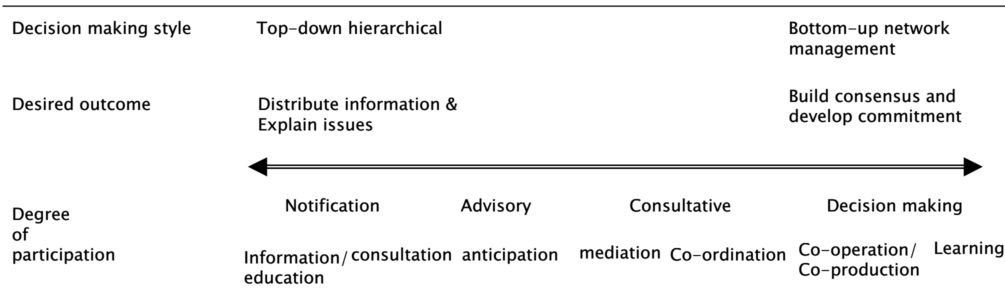


Figure 3.3 Decision making styles and desired decision making outcomes placed along a scale of increasing degrees of stakeholder participation. The bottom row contains degrees of participation according to Mayer (1997), and the row above shows participation degrees as given by Cowie and Borrett (2005).

Moving to the right of the scale in figure 3.3, there is more two-way interaction between decision makers and stakeholders. It becomes a process where there is mutual learning, exchange of information and outcomes are the result of co-production. This means that both decision makers and stakeholders should be open to other ideas and be prepared to change their mind frame. In the top-down perspective, interactions are more 'one-way'. The basis for this top-down perspective on policy making is found in the decision sciences (Simon, 1960; Mintzberg et al., 1976; Miser and Quade, 1985), where policy making is often viewed as a rather linear process towards a certain goal. In this perspective people (and decision makers) have cognitive limitations and decision support can be used to be better able to process large amounts of data.

In the top-down perspective on decision making, the design of a consistent policy follows a rational problem solving approach. This rational approach follows a series of steps undertaken to reach a level of structuredness and completeness of information based on which a responsible and legitimate decision can be taken. Knowledge plays an important role in evaluating the options and helping the decision maker in taking a rational decision. The literature on systems analysis generally identifies three or four distinct phases or steps in decision making, which would take place more or less chronologically. Simon (1960) identifies 1) intelligence, 2) design and 3) choice. Mintzberg et al. (1976) use a somewhat different terminology: 1) identification, 2) development and 3) selection. Design or development of alternatives contains activities of creating and specifying alternatives, which is generally followed by analysis or evaluation of the alternatives generated (Miser and Quade, 1985), and thus four phases can be distinguished (box 3.1). The rational problem-solving approach suggests phases which are distinct and occur chronologically but Mintzberg et al. (1976) argue that these phases do not always occur in sequence, but that, especially in more complex decision making contexts, decision making goes through a number of cycles. For instance, evaluation of alternatives may result in a need to adjust the alternatives or the outcome of the evaluation may even change the perspective on the initial problem. The more complex and the less clear the problems, objectives and values are, the more cycles the decision making process will go through before a choice will be made.

Box 3.1 The four steps of rational decision making according to Miser and Quade (1985); Simon (1960) and Mintzberg et al. (1976)

1. Problem definition/problem recognition

In this phase problems and trends are identified and an inventory and analysis of different parties with different stakes is often done. The initiator(s) want(s) to convince other parties of the need to undertake action. The problem, for instance an increased chance of floods to occur, will have to be made explicit. This can be done through risk assessment maps, extrapolation of trends, calculating potential damage across different socio-economic sectors, and integrated impact assessments. In some cases, different parties may jointly identify problems and opportunities. For instance, in river management water managers, nature conservation agencies and private sand, gravel or clay digging companies work together in identifying opportunities through a combination of objectives.

2. Creating or specifying alternatives

The decision maker(s) will try to translate objectives into management alternatives. In the process of defining possible solutions the decision maker will take into account the possible impacts on other stakeholders. One of the objectives of decision makers is often to satisfy, as much as possible, the objectives of other parties that may be affected by the decision. In such situations it is important to identify explicitly the interests and preferences of the stakeholders involved (Keeney, 1992). Alternatives may be adjusted during the process as more knowledge will become available, and usually they will become more detailed as the process evolves.

3. Analysis or evaluation of alternatives
In this phase the effectiveness and impacts of alternatives are estimated and analysed: how well do the alternatives contribute to reaching objectives, and what are other effects of management alternatives. Tools such as integrated impact assessments, cost benefit analysis, or expert systems can be used. If all the objectives and their relevant importance were completely understood by the decision makers (and stakeholders), and if characteristics of the system are clear and agreed upon by the experts, an optimisation model or decision tree could be used. However, in integrated water management there is often no such agreement and objectives and values are often not well understood (Feuillette et al., 2003). In such cases tools could be used to clarify objectives and values, such as policy exercises or games for instance.

4. Selection or choice
In this phase, the impacts of the alternatives are compared and impacts on different aspects or systems will have to be traded off. The decision makers will weigh the various impacts and stakeholders may be asked to respond to the proposed alternatives. This might give rise to changing the initial alternatives and the process repeats until the final alternative is chosen. In some cases there will be a negotiation process in where different parties attempt to reach a negotiated compromise. Various tools have been developed to help decision makers to make appropriate decisions, such as multi-criteria analysis, matrixes, decision trees, scorecards, comparative risk profiles and probability distributions (Ubbels and Verhallen, 1999).

3.4 A 'bottom-up' perspective on decision making processes

Since the late 1980's other concepts of decision making became more popular. These concepts can be grouped under what can be called a bottom-up or 'network' approach (Klijn et al., 1993; Teisman, 1995). In the bottom-up perspective, policymaking is no longer seen as a 'one actor dominated' and 'phased' process towards clearly formulated goals. Policy making is seen as a complex interactive process in which a multitude of actors operate with each different strategies, perceptions and interests (Klijn et al., 1993). This change was a response to the increasing complexity policy-making processes. The network perspective differs from the phased top-down perspective in its view that decisions do not always result from a sequence of well-defined phases and science cannot always provide unambiguous answers to complicated problems.

Moreover, there is no single decision maker who can choose from a range of clearly defined management options. These options are constantly changing as well as the objectives, political motives, societal attitudes and scientific insights. Kingdon (1984) argues that problems, solutions and decision makers and their choices are more or less independent streams. A choice or a decision depends largely on coincidental encounters of problems and solutions and depends on a series of decisions in a constantly changing context. In Kingdon's view, decision making is unpredictable and to a large extent dependent on timing of attention for an issue, the availability of possible solutions for this problem and the political climate at that moment. When the three streams come together (the problem, solution and political stream), a 'window of opportunity' opens up offering sudden opportunities for taking decisions. This process is to a large extent uncontrollable and unpredictable. The role of science will be different in the sense that will aim more at facilitating and mediating in an interactive process rather than offering information on the performance of plan alternatives.

Teisman (1995) also argues that decision making is not clearly structured and linearly directed towards a well-defined goal or set of goals. A goal can often not be set a priori, but a decision making process is in a way a journey to discover the goals to be achieved. From a 'unicentric' (centralistic) perspective there is a decision maker (central government) who's aim it is to find a best solution to serve the *general* interest. In a multicentric perspective (a market perspective) the basis for a decision is a collective interest, which is the result of adding up self-interests of individual parties. In a pluricentric perspective, policy making is a complex process aimed at finding a common interest. This common interest is not predefined, but is the result of an interactive process (Teisman, 1995). In this process gaining support (for a common interest) is emphasised, rather than on how to reach this. Hence, the social limitations of policy-making are stressed. Social limitations spring from the fact that there are many people with different views, interests and positions of power which have to be taken into account in the policy making process. Sufficient support has to be gained for a policy to be successful.

Table 3.1 summarizes some of the differences between the top-down perspective and the bottom-up perspective on decision making that are relevant to the way in which decision support systems can be used.

Table 3.1 Some of the differences between the 'top-down' perspective and the 'bottom-up' perspective on policy making.

Top down perspective	Bottom-up perspective
Decision making is controllable	Decision making is largely uncontrollable
Single decision maker	Multiple decision makers
Solving a problem by getting all the facts	Constant interplay between problems, possible solutions and political attitudes
Linear process towards a set goal	Dynamic process in which support for goals is sought

3.5 Spatial water management: top-down or bottom-up?

Both the top-down and the bottom-up approach have advantages and disadvantages. Teisman et al.(2001) have listed four motives for including interaction or participation in decision making, that will be explained briefly in box 3.2. Van Eijk (2003) demonstrates how, via a process of collective learning, participation can lead to greater insight into the complexity and dynamics of innovation processes.

Box 3.2 Motives for interactive decision making (after Teisman et al., 2001)

1 - Increase support for decisions

Interactive decision making is generally applied to create support during the process of decision making or policy preparation. Through involvement, participants become more aware of each others viewpoints, problems, values and preferences. Support for decisions and policies increases as more positive perceptions, attitudes and behaviour exist among more people, organisations and institutions. If there is no support among part of the people potentially affected by the decision or policy, there is a risk that the implementation will become problematic.

2 - A higher level of integration in policy

Interactive decision making can be used to connect different policy terrains, as a means to stimulate horizontal integration of policy areas (such as water, spatial planning and nature conservation for instance). Interactive decision making can aim at reaching synergy between different policy areas that would otherwise not work together or serve the same objectives.

3- Increase the quality of the decision

Through the involvement of more people and organisations the number of different ideas and viewpoints increase and the chances of developing a more sophisticated and well-thought out policy or decision may increase. Local stakeholders and the general public can provide valuable information that otherwise would have been left out.

4 - Increase the problem solving ability

Interactive decision making is according to some authors a necessity. Even if knowledge is complete, and stakes and values of all parties involved are known, problems can be too complex to be solved by a single decision maker and thus the assumption that knowing more about an issue leads to a better decision is problematic (Bots, 2001). As Gregory (2002) argues, the trade-offs that have to be made in complex environmental problems are often too difficult to address for decision makers: "It is not about comparing apples and oranges but comparing apples, paperclips and threatened vistas". Many trade offs are difficult to address because they bring up emotional, moral or ethical aspects that are fundamentally hard for individuals to think about and do not easily lend themselves to resolution (Gregory, 2002).

Besides arguments in favour of interactive decision making there are arguments for strengthening top-down elements in the decision making process. The first argument is that boundary conditions need to be established by higher levels of decision making to prevent spatial misfit (Moss, 2004). In spatial water policy, issues are often of greater magnitude and exceed the scope of stakeholders at a lower level. For instance, water policy often aims at the catchment scale to adapt to long-term impacts of climate change (Aerts and Droogers, 2004). However, participants at the local level will have a different spatial scope. In such cases decision making at higher levels of scale should determine the boundary conditions within which participants can manoeuvre. Without such boundary conditions formulated at the supra-local level, locally defined solutions may have repercussions on neighbouring areas. Problems may be transported to other areas. For example in the case of river management raising dikes in one area will lead to higher potential water levels in areas downstream.

A second argument is that of temporal fit. In general, the time horizon of local stakeholders or participants is shorter than that of the national government. Policy makers at the national level may strive for sustainable solutions taking consequences for future generations into considerations. Without top-down defined boundary conditions, locally defined solutions are unlikely to sufficiently deal with the long-term effects of climate change. Local stakeholders are naturally more concerned with the immediate problems, although they are not necessarily unconcerned with the wider context or the fate of future generations (Nunes Correia et al., 1998; Borsuk et al., 2001).

A third argument is that some institution will have to take the lead in the organisation of the decision making process, in the sense of whom may participate, when will a decision have to be taken and who is responsible (White and Runge, 1995; O'Riordan and Ward, 1997; Ravnborg and Pilar Guerrero, 1999; Cowie and Borrett, 2005).

There are thus arguments in favour of including top-down and bottom-up elements. As was argued in Chapter 2, local stakeholders can hamper implementation of spatial water policy. In situations without a mechanism of control or power and where different parties with opposing interests are involved, projects could run into a situation of deadlock. Stakeholders with conflicting interests may well be uncooperative and unwilling to participate. On the other hand, when control is too strong, stakeholders may attempt to block the decision making process and use their power to delay or hinder the process (‘hindermacht’). The style of decision making should be somewhere between good control and leaving room for active participation and coproduction. This is supported by Huitema et al. (2003) who specifically address the two perspectives on decision making in a context of spatial water policy. The study suggests that a combined approach can be successful, in which multiple stakeholders collectively work towards a consensus, but within certain boundary conditions posed by a strong leader or initiator. Goals must be clearly formulated and the initiator must convince the other parties of the need to undertake certain measures. Also Wiering & Driessen (2001) conclude that a balanced combination of both strict, transparent guidelines (top-down) and room for participation and integrative policy making (bottom-up) is an important condition for success.

The Water Framework Directive represents a similar type of interactive policy style. This framework law is presently being implemented in the member states of the European Union. The Water Framework Directive embodies some attributes of top-down, command-and-control but it also lays great emphasis on processes of inter-agency negotiation and public participation as well as allowing for regional diversity (Moss, 2004). A top-down policy enforces detailed procedural specifications, strict monitoring and reporting obligations, reduction of pollutants and improvement of environmental quality. At the same time several elements of the Water Framework Directive require and encourage a more open, consultative and participatory style of decision making.

Hence it appears to be important to find a balance between formulating top-down boundary conditions whilst leaving room for stakeholders and decision makers to interactively formulate policies and plans. The remainder of this chapter will deal with how such a balance can be achieved.

3.6 Co-management of common-pool resources

Co-management or collaborative management is a term given to governance systems that combine state control with local, decentralised decision making. Ideally the strengths of both are combined. Co-management is an approach to solving resource management problems by partnership (Carlsson and Berkes, 2005) but solutions are bounded to certain rules. In the past 15 years many examples of successful local co-management solutions have been reported in literature on management of common pool resources (Bromley et al., 1992; Ostrom et al., 1994; Ostrom, 2000). A common-pool-resource is defined as "a natural or man-made resource system that is sufficiently large as to make it costly (but not impossible) to exclude potential beneficiaries from obtaining benefits from its use" (Ostrom, 1990).

For a long time, conventional ideas about the management of common-pool resources were dominated by Hardin's Tragedy of the Commons thesis (1968), predicting overexploitation and the eventual ruin of common resources due to the users' rational incentive to maximise utility. Before Hardin, Olson (1965) already postulated that: "rational self-interested individuals will not act to achieve their common or group interest" (Olson, 1965, p.2). Privatisation or external control were seen as the only ways to solve this so-called 'commons dilemma'. Empirical research has shown that individuals with an interest in common-pool resources are not by definition locked in a position that leads to 'tragedy', but instead can work together in defining rules and regulations about management and use of the resource. Decision making arrangements, and a range of institutions, provide a mechanism to transcend the commons' dilemma and may prevent the resource from degrading (Bromley et al., 1992; Ostrom, 1999).

The study of various examples such as fishponds, forests and groundwater systems, revealed a number of conditions for successful common-pool resource management (Ostrom et al., 1994). Such conditions are related to:

- The existence of boundary rules. These rules determine which actors (land owners, non-governmental organisations, inhabitants, etc) can use the resource;
- The availability of allocation rules. These rules determine when, how and where the actors can use the resource;
- Active forms of monitoring and sanctioning. It is essential that actors that break the rules be sanctioned for their behaviour. The local actors themselves often do this. External control may have a negative effect;
- Trust between the actors involved. Lessons from resource of single-use common-pool resources indicate that communication helps to build up trust relationships and the likelihood for cooperative actions. When participants do not live up to the agreements, trust will decrease, but when they behave cooperatively and trustworthy, trust relationships will grow. When sanctions are enforced externally, this build up of trust relationships is less since the other participants do then not reward cooperative behaviour.

Lessons from co-management of common pool resources may also apply to water management, but this leads to the question of whether water can be considered a common-pool resource. Water as a natural resource performs many different ecological and socio-economic functions (Table 3.2).

Table 3.2 Ecological and economic functions of water as a natural resource and the types of values that are derived from the performance of these functions (modified after Brander et al., 2003)

Ecological function	Economic function	Value type
Flood and flow control	Flood protection	Indirect use
Storm buffering	Storm protection	Indirect use
Sediment retention	Storm protection	Indirect use
Groundwater recharge	Water supply	Indirect use
	Water for domestic use	Direct
	Water for industrial use	Direct
	Water for agricultural use	Direct
Water quality maintenance/nutrient retention	Improved water quality	Indirect use
	waste disposal	Direct use
Habitat and nursery for plant and animal species	Commercial fishing and hunting	Direct use
	Recreational fishing and hunting	Direct use
	Harvesting of natural materials	Direct use
	Energy resources	Direct use
Biological diversity	Potential future use	Option
	Appreciation of species existence	Non-use
Natural environment	Amenity	Direct use
	Recreational activities	Direct use
	Appreciation of uniqueness to culture/heritage	Non-use

Water is being used directly as being consumed or abstracted (as drinking water or used by industries or as irrigation water), it has habitat and nursery functions in ecosystems and serves as a buffer for flood control and water quality maintenance and is being used for waste disposal (sewage water). Water can also pose a threat. Too much water causes flood damage, to little available water threatens agriculture or drinking water supplies. Water thus can be seen as a multiply-used and heterogeneous resource (Steins and Edwards, 1999). As a result there are different types of users of the resource. Users appreciate different aspects of the resource in different qualities and quantities, depending on the function. Some users depend on certain water levels. Other users depend on water of a certain quality. Both quantity and quality of the water resource determine the availability of the resource to different users. For instance agriculture in the low areas of the Netherlands prefer low water levels especially early in the growing season. Nature areas, however, in these parts of the country are generally threatened by water loss (Runhaar, 1999), since their successful management depends on high water tables. As a second example, river water is used both for cooling power plants and as intake of raw drinking water. Both require water in great quantities but have different quality criteria (not too warm versus sufficiently clean).

Water differs from the more commonly studied common-pool resources such as grazing land and fisheries management, because of this heterogeneity in terms of functions and use. Therefore some authors point out that water is not a homogeneous common-pool resource in its traditional sense (Steins and Edwards, 1999; Kaijser, 2002). Still, although Dutch water systems, strictly speaking, are not common pool resources, the problems faced share quite similar characteristics (Kaijser, 2002).

3.7 Platforms for self-regulatory water management

Empirical studies of successful common-pool management generally deal with homogeneous common-pool resources (e.g., fishponds or forests for logging), used by a single type of user (e.g., fishermen or wood loggers), which is managed by a single type of regime, and show examples of sustainable management without strong top-down intervention and control (Bromley et al., 1992; Ostrom, 1999). In recent research (Steins and Edwards, 1999; Steins et al., 2000) the focus has shifted from traditional homogeneous resources towards multiply-used heterogeneous resources such as water. The principles of self-organisation may also apply to sustainable management of multiple used heterogeneous resources such as water. However, the management of such heterogeneous resources appears complicated and cooperative solutions cannot be reached through communication alone (White and Runge, 1995; Hodge and McNally, 2000). It is argued that a more formal structure is required to institutionalise management arrangements. Röling (1994) and Röling and Wagenmakers (1998) introduced the concept of 'platforms for resource use negotiation'. In such platforms, resource management issues are considered from a multiple-use perspective and stakeholders jointly work towards adaptive resource management through (i) fostering understanding about the resource base, (ii) minimisation of social dilemmas associated with collective resource use, and (iii) implementation and fine-tuning of action strategies with respect to perceived problems (Steins et al., 2000).

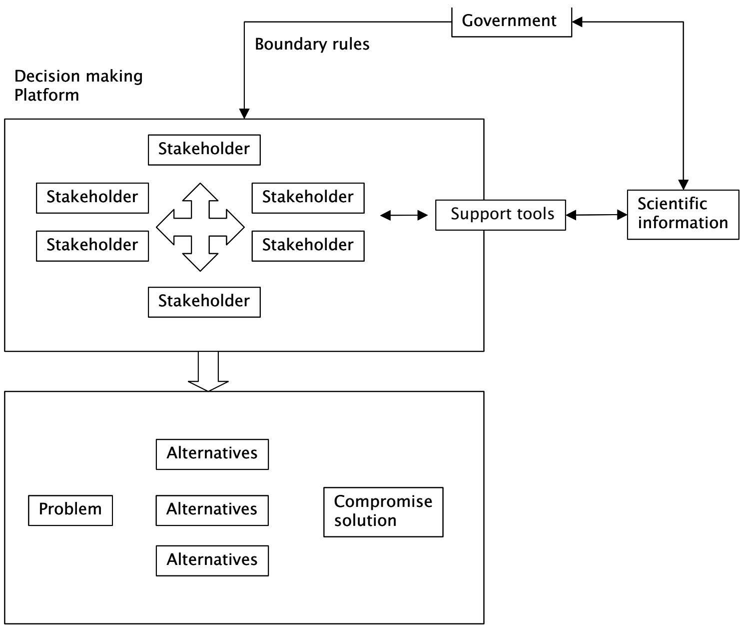


Figure 3.4 Platforms for collaborative planning. A centralised decision maker imposes boundary conditions and scientific information can be fed into the collaborative planning platform through decision support systems.

The following definition of platforms is adopted here: "a decision making body (voluntary or statutory) comprising different stakeholders who perceive the same resource management problem, realise their interdependence for solving it, and come together to agree on action strategies for solving the problem" (Röling, 1994). Based on an analysis of case studies, Steins and Edwards (1999) conclude that effective platforms should not only be an extension of existing means of stakeholder participation. The platform needs to be politically legitimised and acknowledged. An independent party should facilitate the platform to safeguard trust, objectivity and continuity. Such a need for an external agent or organisation was also identified by White and Runge (1995) in their analysis of collective action in watershed management in Haiti and by

Hodge and McNally (2000), who studied collective action and the role of water management institutions in the United Kingdom.

In the platform approach, stakeholders jointly develop a plan for a specific region. In our case, implementation of spatial water policy in a certain region can be delegated to a platform of local stakeholders who interactively develop solutions for the water problem. These solutions remain within boundary conditions defined by the higher government. The platform can be installed on an ad-hoc basis, it is not seen as a new institutional layer. Governmental agencies at the national level are not actively involved; they only formulate the boundary conditions. The development of plans for implementation at the local scale is fully delegated to local parties (such as ngo's, water authorities and local governments). Given the conditions for successful institutions for the management of common-pool resources (see above, p 61), the platform requires:

- Clear boundary rules. The initiator should clearly define boundary conditions. These conditions define geographical boundaries; they determine which relevant actors may participate; and finally they define the problem that needs to be solved.
- Allocation rules. These rules are the result of a negotiation process between the different participating parties;
- Active forms of monitoring and sanctioning. The participants should define a mechanism of monitoring and sanctioning.
- Trust between the actors involved.

The central government will play a more limited role and will delegate the tasks of plan design to the platform. If no agreement is reached by the platform, then the government may decide to implement a plan according to their boundary conditions and allocation rules. This may be an incentive for cooperative attitudes within the platform negotiations.

The concept of platforms for collective action or self-regulatory water management has successfully been applied in a number of case studies (White and Runge, 1995; Ravnborg and Pilar Guerrero, 1999; Hodge and McNally, 2000). The next section explores the effectiveness of platform-like policy styles as compared to top-down and pure bottom-up styles of decision making in an analysis of case studies.

3.8 Some empirical indications of the potential of interactive platform processes

The twenty case studies described in chapter 2 have been analysed to survey the potential of different policy styles (top-down, bottom-up and a mixed approaches). The twenty projects were classified as 'top-down', 'bottom-up' and a mixed approach to decision making. The interviewees judged this categorization of the projects. Top-down was interpreted as being initiated and dominated by one governmental agency. Bottom-up means the project was initiated and dominated by non-governmental organisations. A mixed approach means that both governmental and non-governmental agencies worked together in a project organisation. The sample of projects is a reasonable mix of different styles of policy making as can be judged from their frequencies (35, 40 and 25%). Classifying the different projects under the three categories is subjective and this has implications for the conclusions to be drawn. The analysis will provide some indications, but will not deliver 'hard' evidence.

We have used the collection of data from the case studies as a post-hoc test on the possible enhancement of the decision making process by more interactive forms of stakeholder involvement. Cross-tabulation statistics were applied and the substantial qualitative information base of the interviews (see section 2.2) has been reduced to numerical and categorical coding. This has obviously reduced the rich detail of the narratives. Our major response variable was perceived success as indicated by the interviews. The success of the projects can however be related to a number of variables. The perceived success of the project was measured by asking the interviewees about the primary goals and ambitions of the project and to what extent these goals and ambitions were achieved. Success is thus in our case defined as an outcome criterion rather than a process criterion. In other words, interview respondents may feel satisfied over the process, but when the overall result of the project has not met the initial goals, it is still considered a failure in our analysis.

In a cross-tabulation regression analysis it was tested which variables best explain the success or failure of projects in the analysis. Besides the decision making process, the scale of the projects, the technical complexity and the political complexity were tested. Technical problem complexity was estimated simply by scoring the number of different aspects involved (such as nature, water, recreation etcetera), the number of different parties involved, the degree of their participation, the clarity of their goals, the availability and uncertainty of scientific information. Political complexity was estimated by looking at the number of different decision makers or institutions involved and the clarity of their goals. The spatial scale of the project proved to be least important in explaining the success or failure of the projects in the analysis. All scores have been scaled between 0 and 5.

A cross-tabulation with the perceived success of the project and the type of decision making process shows that:

- Six projects that have not had a satisfactory result were in 4 out of 6 cases top-down organised, and in 2 out of 6 cases bottom-up.
- The thirteen successful projects were in 8 out of 13 cases combinations of top-down and bottom-up (mixed approaches), and in 3 out of 13 cases top-down and in 2 out of 13 successful cases bottom-up organised.
- All cases with mixed top-down and bottom up approaches (where governmental and non-governmental agencies worked together and formed a project organisation) have had satisfactory results.

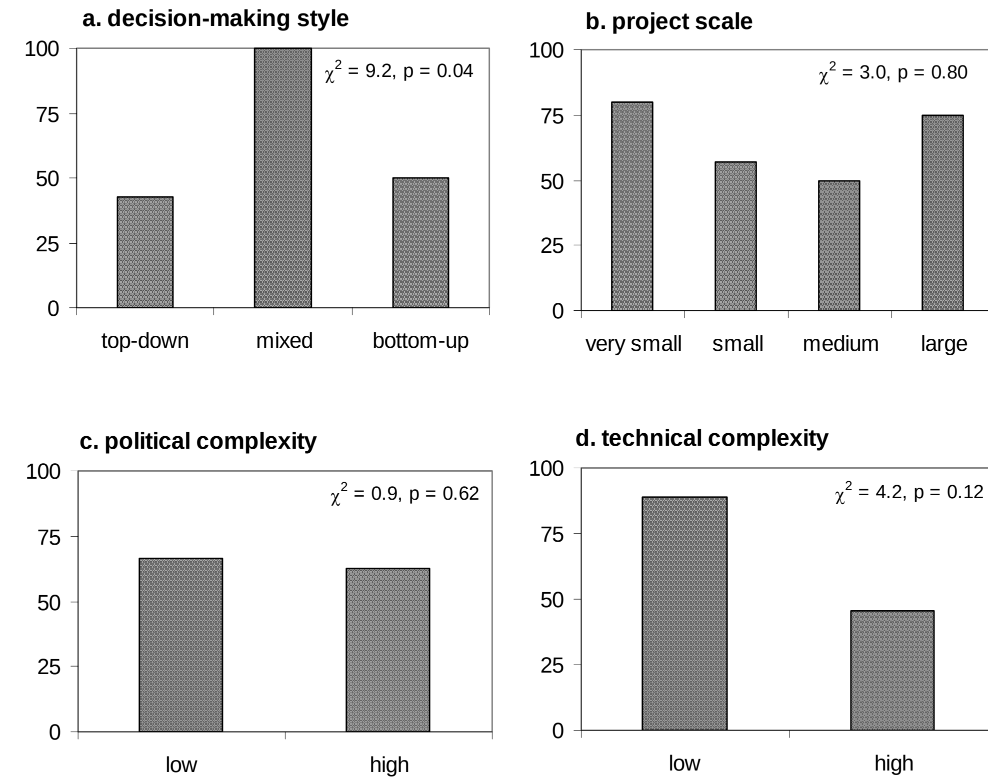


Figure 3.5 Cross-tabulation results of perceived project success in 20 spatial water management projects in the Netherlands as a function of a) decision making style; b) project scale; c) political complexity and d) technical complexity. The distribution of success was significantly different among the decision making styles categories ($\chi^2 = 9.2$; df = 4; p = 0.044). The other variables were not significant.

From Figure 3.5 it appears that only the decision making style significantly explains project success (p=0.04). The failure of projects cannot be explained by political nor technical complexity (p=0.62; p=0.12), although technically complex projects do succeed less easy. Also from our data, the general notion that larger projects have a higher chance of failure cannot be supported (not significant; p=0.80). Successful projects slightly more often have low political complexity (8 successful cases had a low political complexity versus 5 successful ones with a high complexity). Projects with a low technical complexity more often result in success (8 out of 9 projects with a low technical complexity were successful), but this effect is not significant ($p = 0.12$). Figure 3.6 shows successful and unsuccessful projects related to their complexity and planning and decision making style. The figure illustrates that all unsuccessful projects have been either top-down or bottom-up dominated. Each of the successful complex projects had a mixed style of decision making. The three complex projects that failed were purely top-down or bottom-up.

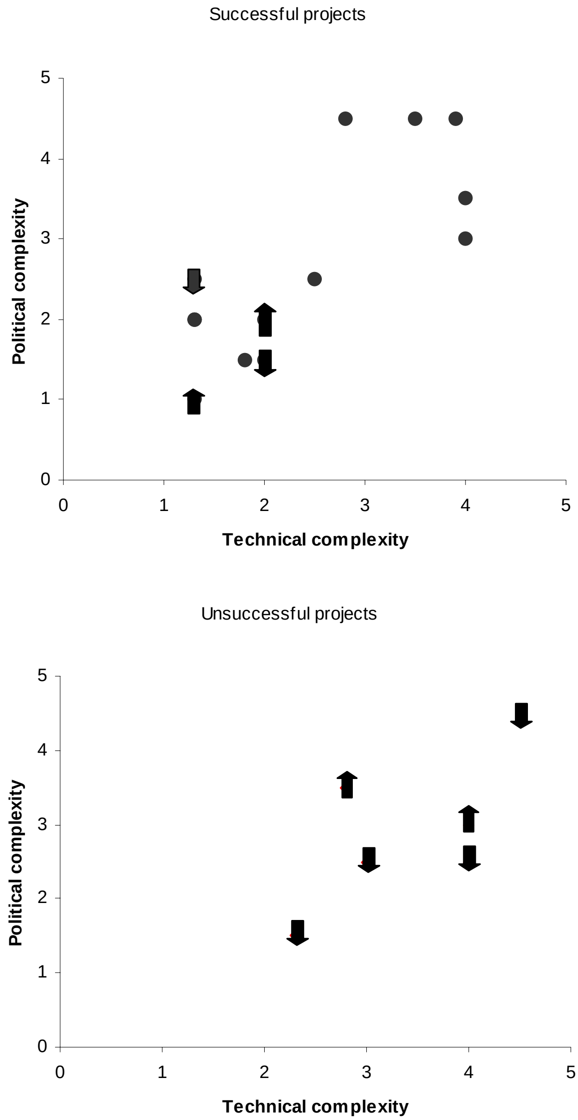


Figure 3.6 Successful (top) and unsuccessful (bottom) projects related to their complexity and planning and decision making style. The dots and arrows indicate the type of decision making (arrow down = top-down, arrow up = bottom-up dots = mixed). The mixed approach seems most successful, especially in highly complex projects.

In short, our analysis of specific project cases supports the literature in the notion that guided stakeholder participation enhances the possibility of project implementation success. For all the three other factors investigated we could not establish an overall significant influence. Hence, it is argued that balancing top-down and bottom-up elements in decision processes will increase the chance for success. This is based on qualitative information obtained from a limited number of interviews (two per project), and the classification has been subjective. However, these results do provide some indications and support for the need to strike a balance between top-down control and involvement of stakeholders. When such a balance has been found, the chances of project success seem to increase.

3.9 Conclusions

This chapter concludes that spatial water policy implementation requires good control (top-down elements) as well as room for participation (bottom-up elements). From the literature on common-pool management, successful examples of sustainable management of common-pool resources through bottom-up self-organisation have been reported. However, because of 1) the heterogeneity of water resources; 2) the supra-local nature of water management issues and 3) the variety of users, it is questioned whether a process of pure self-organisation could lead to sustainable management. For sustainable management of heterogeneous, cross-scale and multiply used common pool resources, some sort of facilitating, separate organizational form is required. Platforms for resource use negotiations are proposed. Applied to spatial water management, the platform concept can be placed somewhere in between top-down control and bottom-up. Multiple stakeholders are given the opportunity to jointly develop local solutions to supra-local problems. The platform has to be politically legitimised and acknowledged. An independent party should facilitate the platform to safeguard trust, objectivity and continuity. The government will only act by giving permission for the final outline. An empirical analysis of 20 case studies in the Netherlands suggests that implementation of water policy was more successful when top-down and bottom-up elements are mixed.

This then leads to the question of what types of scientific tools can be used to support such platforms for self-regulatory spatial water management. The next chapter deals with this question.

4. Decision support tools for spatial water policy: combining roles and requirements using a problem typology

4.1 Introduction

There is a growing awareness among policy makers and scientists that ecological, socio-economical and physical aspects of water management cannot be dealt with in isolation (Geldof, 1995; Van Rooy, 1997; O'Riordan and Ward, 1997; Steins and Edwards, 1999; Van Ast, 2000; De Wilt et al., 2000; European Community, 2000; Gijsbers, 2000; Welp, 2001; Hämäläinen et al., 2001; Middelkoop and Kwadijk, 2001; Goosen and Vellinga, 2004; Pahl-Wostl, 2005). This awareness has led to the development of a large number of tools to support complex decision making processes in water management, generally aimed at integrating multiple aspects of water management. A recent development is the increasing attention to the involvement of stakeholders in decision making (see the previous chapter), and therefore the interactive and participatory use of decision support tools is also relatively new (Dahinden et al., 1999; Luz, 2000; Talen, 2000; Pereira and Quintana, 2002).

Meaningful participation requires effective two-way communication between experts and laypeople that often find it difficult to understand each other (Cain et al., 2003). Decision support tools can contribute to this communication between experts, stakeholders, decision makers and laypeople. It is then important for decision support systems to be accessible, transparent and credible to people who may be unfamiliar with computer technology. If properly developed, decision support systems have a great potential in the increasingly complex setting of water policy. However, as will be demonstrated in this chapter, the achievements of decision support systems are repeatedly being reported as modest. There seems to be a mismatch between capabilities of decision support systems and the requirements of end-users. Too often, systems are being developed from a technological developers' push (supply-driven) rather than through a demand-driven process where the need for certain technologies to effectively support decision processes are being specified. This chapter explores ways to overcome such a mismatch, not by offering a clear-cut recipe for decision support development, but through an analysis of the role of decision support in various decision making situations and problems. A clearer understanding of the role of different types of decision support in different policy contexts may help developers and end-users to specify requirements for decision support.

The chapter begins with a brief introduction into decision support systems. Conditions for their successful application are abstracted from the literature. Decision support systems usually consist of a number of different tools (elements) for different purposes. A broad continuum of tools for different purposes can be identified. The design of a decision support system involves fine-tuning and selection of a set of tools for specific requirements. An analysis of the potential role of different tools for different decision making problems results in a framework that can help to specify decision support requirements. A particular category of tools is identified potentially suitable to support specific decision making problems and processes of spatial water policy implementation. This category of tools is further explored in the chapters 5, 6 and 7.

4.2 Decision support systems

One straightforward reason for the use of a decision support system is to be able to disclose large amounts of data and different types of information. Decision support systems couple the intellectual resources of individuals with the capabilities of the computer to improve the quality of decisions (Keen and Scott-Morton, 1978). A wide range of different systems are available and every possible kind of technology has probably been used somewhere at some time. Several definitions of what decision support systems are can be found in literature. Gijsbers (2000) and Janssen (1991) provide an overview of the richness of different definitions found in the literature. Scott-Morton's definition is widely used: 'interactive computer-based systems that help decision makers utilize data and models to solve unstructured problems' (Scott-Morton, 1971).

In technology-oriented literature, the term 'decision support system' has a specific meaning. For example, Adelman (1991) describes decision support systems as 'a diverse class of computer technology integrating database information and analytical modelling methods (artificial intelligence, decision analysis, optimisation models, etc.) to support decision making'. Outside the technology-oriented literature, decision support systems are taken on a broader meaning (Walker, 2002), e.g. sometimes as broadly as 'any system that makes some contribution to decision making' (Sprague and Watson, 1986). Decision support can indicate any kind of decision aid, whether computer based or not, and whether the problem it purports to address is more or less well structured (Cox, 1996). Both the technological and non-technological focus share an implicit input into the decision making process that is external (Walker, 2002). Here we adopt a functional definition of decision support rather than a technological definition. Decision support is here considered 'an external input to assist individuals or groups of individuals in their decision process' (Sprague and Watson, 1986; Janssen, 1991). The ways in which this external assistance can be offered are various. Every decision making process will have specific needs for assistance, for instance to process and store spatial data or to stimulate the exchange of information on preferences and objectives of parties involved. By nature, tools to support spatial water policy should be integrative (because of the complexity and diversity of relevant types of knowledge, see chapter 2); interactive (because of the need to include stakeholders in planning processes, see chapter 3); and spatially explicit (due to the focus on horizontal water storage, chapter 2). Thus, in this chapter the focus is on spatially explicit, integrative and interactive tools that offer an external input to assist participants in the decision making process.

A decision support *system* uses or consists of different *tools*. A great number of different tools exist, such as spreadsheets, databases, networks, geographical information systems, expert systems, virtual reality, intelligent agents, neural networks, etc.. A spreadsheet or a GIS map is considered a tool, and a decision support system may contain multiple tools. There has been a great advance in technological capacity and power of these tools, in terms of data storage, speed, capability (for instance through GIS) and presentation. A decision support system generally offers a toolbox for different stages in decision making, or may be specifically built to support one aspect of the decision making process.

In general a decision support system contains 1) tools for data storage such as GIS or a spreadsheet program; 2) tools for data analysis and processing and 3) tools for presentation. Because decision support systems can contain any mix of tools, it is difficult, if not impossible, to draw up a single generic and clear-cut categorization of decision support systems. However, it is useful to present the range of existing tools that can be selected for the toolbox (the decision support system). For understanding the possible role or function of tools within a decision making process, three partly contrasting attempts to categorize will be reviewed briefly. Ubbels & Verhallen (1999) identify three classes of tools:

- Gaming techniques and simulation role-playing;
- Tools with an emphasis on simulation and prediction
- Tools related to activities like stimulating discussion or consensus building (group decision, multi-criteria tools).

Collentine et al. (2002) identify two classes of tools:

- tools aimed at *evaluating* management alternatives using preferences and value statements of stakeholders;
- tools intended to support the process of *revealing* stakeholder preferences and stimulating stakeholder interaction.

In Horrevoets et al. (2001) and in Janssen and Horrevoets (2002) a distinction is made between an *analytical* and an *interactive* pathway in decision making and decision support can play a role in both. Decision support tools can be data-driven and used for analysis and problem solving, but can also be oriented towards design and obtaining better information about preferences and goals of different parties. Tools for problem solving and analysis may include mathematical optimisation tools or multi-criteria analysis tools and such tools generally require data input obtained from field measurements, literature, or experts. Tools can also be used for revealing preferences, specifying objectives and problems and designing possible alternatives, where the focus is on collective learning (Van Eijk, 2003), obtaining and exchanging information interactively from and between stakeholders and decision makers, rather than on offering information to decision makers and stakeholders on the performance of alternatives. Such tools are not necessarily computer-based. Examples are board games, policy exercises or focus groups. A range of different tools with different purposes exists. Figure 4.1 places different types of tools along a continuum.

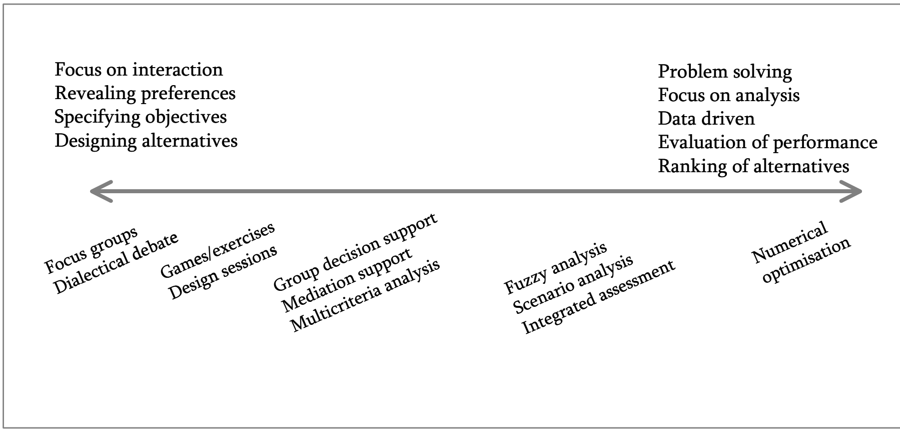


Figure 4.1 A continuum of decision support tools ranging from a focus on interaction to a focus on analysis. Some examples of decision support tools are qualitatively ranked between the extremes.

Analytical tools are more widespread and common-practice (Turban, 1990; Luz, 2000; Pereira and Quintana, 2002; Pahl-Wostl, 2005), but interactive use of tools in participatory processes is gaining popularity (Pereira and Quintana, 2002). Participatory use of GIS offers the opportunity to explore conflict situations and prepare disputants for a better understanding of the conflict, search for common interests, explore common concerns and facilitate the creation of joint gains and empowerment of local stakeholders (Harris et al., 1995; Cocks and Ive, 1996; Harris and Weiner, 1998; Cain et al., 2003; Van Eijk, 2003; Pahl-Wostl, 2005).

4.3 Conditions for successful application of decision support tools

To perform a detailed and quantitative evaluation of support tools is no easy task. Evaluation implies some judgement on the ‘internal’ characteristics of the tool (can I handle it easily?), as well as on the external role of the tool (is it the right tool for its purpose?). Usually, there is little reflection on the shortcomings of the described DSS as authors have also been the developers of the same DSS. The literature in this area has been criticized as biased (Sipe and Stiftel, 1995; Todd, 2001), because professional mediators often report on the successfulness themselves. Walker (2002) states: “Investigation of failure in decision support projects is a significant challenge in its own right as failure is rarely reported and analysed”. To measure the effectiveness of a decision support effort the impact of the tool has to be separated from that of the overall process including the way it is organised. Measuring the effectiveness of different decision making processes thus is a challenge and only few empirical studies have been published. Another problem is that there is no consensus within the scientific community in this field on how ‘success’ is to be defined and evaluated (Moore, 1996; Todd, 2001). Even if participants are enthusiastic about a decision making process, the question still remains whether this success can be attributed to the application of assisting techniques (would they have reached a satisfying outcome without application of the tools and techniques?).

Evaluation of the impact of the decision support tools within a policy process would require multiple experiments with control groups not using the tools. Practically, experimenting with control groups is difficult to organize, and such experiments with people in non-experimental settings are rarely reported. Only one example of such a rare opportunity has been found in the literature (Batenburg and Bongers, 2001). In an experimental set-up, the impact of a group decision support system on different citizen groups was measured, by exposing some groups to the tool and others not. The results showed that the process itself (facilitation and learning of the participants over time) had a bigger impact on the group than the use of the tool (Batenburg and Bongers, 2001).

Many authors promote participatory use of GIS as an effective tool in exploring conflict situations and preparing disputants for a better understanding of such conflicts, but also to search for common interests, explore common concerns and facilitate the creation of joint gains and empowerment of local stakeholders (Harris et al., 1995; Cocks and Ive, 1996; Harris and Weiner, 1998; Cain et al., 2003; Kwaku Kyem, 2004; Pahl-Wostl, 2005).

Discussions on the possible pitfalls of decision support efforts are reported in various areas such as in natural resource management (Walker, 2002); water management (Van de Ven et al., 1998; Ubbels and Verhallen, 1999; Gijsbers, 2000; Uran, 2002;

Wind and De Kok, 2002; De Kok and Wind, 2003; Uran and Janssen, 2003); agricultural systems (Cox, 1996; McCrown, 2002); urban and regional planning (Langendorf, 1985), and in information system projects in general (Lyytinen and Hirschheim, 1987; Beynon et al., 2002). Some of the explanations are related to the characteristics of the decision support system itself. Examples of technological shortcomings are data limitations, over-sophistication, inaccessibility, inflexibility and incomprehensibility. Technological shortcomings have obvious consequences for decision support use and are probably relevant in every attempt of decision support development. Besides technological shortcomings there are probably more fundamental, non-technological problems occurring during the design and application of decision-support systems that are related to the role of the decision support tool in decision making processes.

In pursuit of explanations for the failure of decision support efforts, literature has been studied to identify potential pitfalls found in literature. As can be seen in Table 4.1, often a mismatch occurs between the capabilities of the decision support tools and the requirements of decision makers and end-users. This mismatch has repeatedly been identified as an important bottleneck for decision support. A good understanding of the decision making process and the role of decision support in this process is a crucial factor for successful decision support. This role is difficult to establish *a priori*, possibly it needs to be identified in every individual case. Some authors argue that decision support development should become more part of the decision making process and not be a separate activity (Van de Ven et al., 1998; Gijsbers, 2000; Welp, 2001; Walker, 2002; Pereira and Quintana, 2002; Pahl-Wostl, 2005). What seems clear is that the development of decision support systems should be a demand-driven process rather than a supply-driven technological effort (Janssen, 1991; Walker, 2002). Instead of offering ‘standard’ products and pushing their own ideas (an example of such a case is described in box 4.2), decision support developers need to communicate and interact with end-users to gain insight in their needs and (technical) capabilities (Gijsbers, 2000). This communication is required during all phases of decision support development.

Box 4.2: The Metropolitan Debate decision support tool

I personally witnessed the rather unsatisfactory results of a typical supply-driven decision support tool that we developed for the purpose of the 'Metropolitan Debate' (Frieling et al., 1998). The decision support tool was a joint effort of a number of research institutes specializing in different fields. The goal of the support tool was to support rapid assessment of impacts of plan alternatives for long-term urban development. The tool was to be used in an interactive setting with representatives of a variety of organizations that play a role in spatial planning, It provided insight in the impacts of plan alternatives on a number of aspects: economy, water management, transport, quality of urban areas, biodiversity, landscape values and energy. The tool could be used as a stand-alone system for evaluating impacts of plan alternatives and strategies. It focused on spatial planning strategies for the Netherlands as a whole.

Although the decision support system was of good quality and was user-friendly, it was never really used. During the interactive sessions, the participants did not use the system at all (in the plenary debate the technology failed and in the preparatory sessions, the participants were not very interested in the output generated by the tool). Outside the workshop sessions, there seemed to be sufficient trust in the tool and each of the individual modules had been tested and verified. Apparently it did not produce results that appealed to the participants. The tool was very much supply-driven rather than demand driven.

Table 4.1 An overview of some of the pitfalls for decision support development as reported in the literature

Potential pitfall	Explanation	Source
Matching the original requirements and user-needs and timing them right	Tools may not deliver what they were originally supposed to do. It is important to have active involvement of end-users during DSS development.	(Kaden et al., 1989; Turban, 1990; Lund and Palmer, 1997; Van de Ven et al., 1998; Ubbels and Verhallen, 1999; Herrmann and Osinski, 1999; Lynch et al., 2000; Welp, 2001; Walker, 2002; Wind and De Kok, 2002; Pereira and Quintana, 2002; Thomas, 2002; Pahl-Wostl, 2005)
User-friendliness/ presentation of results	Users can not interact with software that is too complicated or lacks transparency.	(Ubbels and Verhallen, 1999; Dahinden et al., 1999; Bellamy et al., 2001; Beynon et al., 2002; Janssen and Uran, 2003; Uran and Janssen, 2003)
Practical value and urgency	There has to be a clear practical value and some sense of urgency of solving a problem for a tool to be useful. It is difficult to get participants interested and motivated ('participation fatigue').	(Bellamy et al., 2001; McCrown, 2002; De Kok and Wind, 2003; Cain et al., 2003; Pahl-Wostl, 2005)
Assumption of rationality	DSS aim to contribute to rational decisions, whereas political and emotional motives may play a role.	(Lund and Palmer, 1997; Bellamy et al., 2001; Pereira and Quintana, 2002; McCrown, 2002)
Political and institutional barriers	Politicians or decision makers may feel threatened or limited/bounded by the DSS.	(Lund and Palmer, 1997; Bellamy et al., 2001; Walker, 2002)
Simplicity/ over-complex-	DSS often attempt to be comprehensive and end up being too detailed and	(Bacon et al., 2002; Thomas, 2002)

ity/transparency	overwhelming.	
Lack of solid data and analysis	Practical considerations may lead to over-simplification resulting in high uncertainties and distrust.	(Parker et al., 1995; De Kok and Wind, 2003)
Flexibility	DSS should be able to adapt to changes in terms of data and assumptions as well as in values and objectives of end-users	(Ubbels and Verhallen, 1999; De Kok and Wind, 2003)
Reliability and confidence	Users may not rely on the DSS results and have little confidence in the system and its outcome.	(Walker, 2002)

4.4 Choosing decision support tools for different types of problems

One of the most important aspects of building a decision support system is choosing the right tools for the right problems. The selection of tools should be demand-driven and it is impossible to develop a recipe for tool selection. It is like ordering a Dell-computer: you first have to find out for what purposes the computer will be used to be able to make a good selection of the components of the computer. As Janssen (1991) states, choosing a tool is in itself a multi-criteria problem. Choosing tools usually requires a trade-off between comprehensiveness, objectivity, and simplicity. A tool that helps finding a ranking of policy alternatives aggregates all information and includes political weights. Such a presentation will be simple but is also subjective. A comprehensive overview of all impacts of all policy alternatives may be more objective, but will also likely be more difficult to comprehend. Kaden et al. (1989) point at the importance of keeping tools as simple as possible for solving the given problem (including the required precision of results). In the following sections it is attempted to link different tools for decision support to different types of policy problems.

Decision making problems can be categorised using a problem-typology (Hisschemöller, 1993). Hisschemoller (1993) identifies four ideal types of problems along two dimensions (Table 4.2). One refers to the (lack of) certainty concerning the knowledge that a solution to a certain problem may require. The other dimension refers to the (lack of) consensus on relevant values that are at stake. Every ideal type of problem requires a different approach. According to Hisschemöller (1993), in case of well-structured problems, a high degree of stakeholder participation is not recommended. Experts can solve these types of problems. When values and knowledge are unstructured, a high degree of participation is required. For example, if there is a clear problem (a road needs to be built) and there is a clear overview of the consequences of all alternative ways to build the road, then the main activity is to take a (formal) decision on building the best possible alternative. When it is not clear that building a road is necessary, or maybe other alternatives such as a railroad are suggested, such a formal decision is more difficult to make.

Table 4.2 The problem typology, relating the degree of structuredness of problems to the level of certainty and agreement on knowledge and to the level of agreement on values and objectives (from Hisschemoller, 1993).

	Agreement on values and objectives	Disagreement on values and objectives
Certainty and agreement on knowledge	Structured problem	Semi structured (ends)
Uncertainty and disagreement on knowledge	Semi-structured (means)	Unstructured problem

Verbeek and Wind (2001) have specified typical policy-making activities in water management. These activities can be positioned along the dimensions that define the type of problems according to Hisschemöller (1993). The policy activities are (1) the design of consistent policy; (2) gaining support for a policy; (3) achieving adequate information supply; (4) taking formal decisions. In unstructured situations, policy making should emphasise gaining support and designing consistent policies (Verbeek and Wind, 2001). Unstructured problems require interaction and an open, more bottom-up approach. In situations where problems are well-structured, formal decisions can be taken. In semi-structured problem situations, open and interactive processes are restricted by the boundaries of the problem.

Underwood (1989) has linked different methods in environmental science to types of problems. His typology of problems is very similar to the one used by Hisschemöller (1993). Underwood (1989) distinguished between two types of communities, which influence the decision process: the scientific community and the policy/institutional community and places various scientific tools and methods within the boxes.

		Institutional interests	
		Unified	Fragmented
scientific knowledge	Unified	Extrapolation Optimization models	Multi-criteria analysis
	Fragmented	Integrated Assessment Models Scenario analysis Uncertainty analysis	Policy exercise Games

Figure 4.2 Tools for decision support in the context of environmental management (modified after Underwood, 1989).

French and Geldermann (2005) also use the degree to which the decision making problem is structured to categorise a variety of methods for decision support. A good understanding of the nature of the problem in combination with a good understanding of the 'level' of decision support that is required leads to a better choice of a certain decision support method.

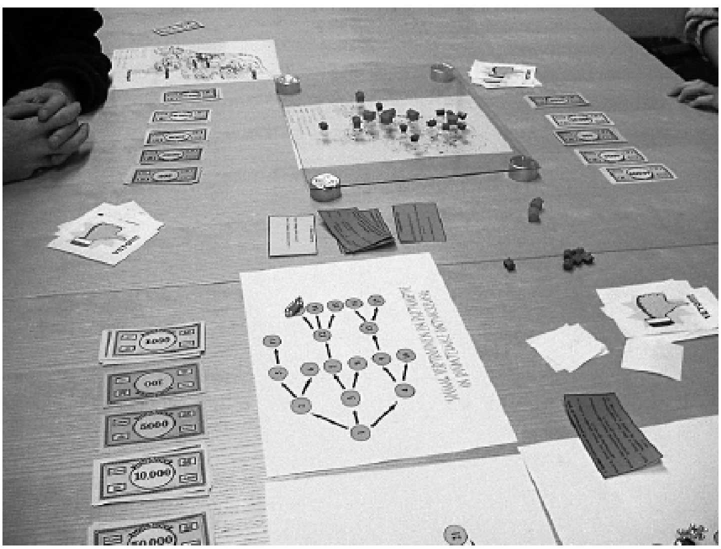
In cases where scientific information is inadequate, scientific insights are conflicting, or information is scattered, tools should primarily aim at structuring the knowledge and information. Even though the problem may be long standing, data may be lacking or incorrect. A decision support system can, in this case, bring together the available information and present it in a way, which enables users to develop an opinion even if data is incomplete. In an interactive process, discussions about gaps in the knowledge may lead to acceptance of certain assumptions and uncertainties are made explicit. The decision support system can also be used to obtain expert knowledge from the users, which is especially useful when knowledge is indeed incomplete.

When scientific insights are unified, and knowledge is sufficiently available, tools can be more analytical in their nature. In such situations tools are generally aimed at processing data to provide insight in the pro's and con's of policy options or alternatives. Such tools are generally more sophisticated and complex with a higher data requirement.

When the goals, objectives and preferences of the political/institutional community are fragmented and unclear, tools will primarily aim at facilitating interaction and discussion on values and objectives rather than on evaluation and choice. While participants in a decision making process usually have an idea of what is desirable, their statements of goals are often too vague to be captured in operational evaluation criteria. Tools can in such cases focus on deriving explicit value judgements and preference statements and to force the users to provide coherent and consistent information. When goals are clear and unified, and scientific knowledge is unified (knowledge is adequately accepted and available), formal models might be used to explore 'best solutions' or to gain more confidence in potential decisions. The more uncertainties are involved in the problem, the less formalized and exact approaches can be used (for example board games; see box 4.3), to stimulate dialogue between the different parties.

Box 4.3: The Water for Space Game (Carton et al., 2003)

I was involved in the development of a game to support long term spatial planning in relation to water management, as part of a prize-contest ‘Space for tomorrow’. The ‘Water for Space’ game was developed by a group of 13 researchers with different disciplinary backgrounds working at different knowledge institutes. The choice of a board game was based on the notion that very little organization is required to play; all that is needed is a game-box and instructions. In addition, the strength of board games lies in their simplicity. Board games follow relatively simple rules and all of the players can see what is happening in the game. A disadvantage of a board game is that it is inflexible and difficult to improvise or to react to the contribution of the other players.



The game can be played by 4 to roughly 10 people. The game’s target users include policymakers, scientists and other interested parties in the field of water management and spatial planning. The objective of playing the game is to organize the spatial design of the Netherlands as efficiently as possible against a background of climate and societal change. Although the competitive element is not the main aim of the game, at the end an individual winner will be pointed out. It also produces a group score every time it is played, which means that groups playing the game are also competing against their predecessors. The group score emphasizes that spatial planning is a joint process. The game itself is very playable, as was evident each time it was played. Making choices in relation to trends, gaining or losing resources and control options, and building on the scenario map all fit smoothly together.

Every trend choice generates a discussion about the probability, desirability and possible effects of that choice. Although the game has not been tested comprehensively, every time it was played it stimulated the players to hold (sometimes heated) discussions about future developments in water management. This provides some indication that the concept of a board game is effective in stimulating dialogue between people with different backgrounds. Because players are constantly forced to make concrete choices, the game inspires them to communicate underlying viewpoints and thought processes as coherently as possible. The game clearly displays the link between uncertainties on macro level and effects on smaller scales. The team members felt that the process of creating the game was very instructive, more instructive than actually playing the game. The design of the game led to a greater understanding of the complexity of and interdependencies between water management and spatial planning. This was found to be even more important than reaching a common vision. The value of the project lay more in the insights gained into how to arrive at a vision than in the vision itself. It is therefore also clear that a board game has limitations and should only be used to stimulate discussion and exchange of ideas. When it comes to later stages in decision making at the more detailed level, board games are probably no suitable tools. The Water for Space methodology has been further developed for municipal policy formulation projects. These efforts have led to an application of the game in the province of Zeeland (http://pzflash.ibuildings.nl/game/intro.html).

Following Underwood's classification, Hisschemöller (1993), identified quite similar roles of tools and methods for different types of problems:

Table 4.3 Types of problems related to the role of scientific information (After Hisschemöller, 1993)

Non-structured problems:	Tools should focus, help, identify and clarify. Interactive design, identification of values, preferences and potential conflicts and compromises.
Semi-structured (lack of knowledge):	Tools will have a role in advocating the knowledge they generate. Their contribution will lie in being able to translate information on the functioning of the system into a language the stakeholders and decision makers can understand.
Semi-structured (disagreement on the problem, values and objectives):	Tools have a role as mediators and for instance aim at illustrating impacts of different management alternatives or facilitating interactive design of possible alternatives.
Well-structured problems: science as a problem solver.	These problems are very much technical in their nature.

In Table 4.4 the frameworks of Hisschemöller (1993), Underwood (1989) and Verbeek and Wind (2001) have been combined. The table represents a framework for understanding the links between types of tools and different policy making problems.

Table 4.4 A framework linking types of problems, policy activities, policy styles to the specific role of a decision support tool, based on (based on Underwood, 1989; Hisschemöller, 1993; Verbeek and Wind, 2001).

	Agreement on values and objectives	Disagreement on values and objectives
Certainty and agreement on knowledge	Structured problem Policy activities: gathering support though analysis, empirics and ratio Support tools as problem solvers	Semi-structured problem (ends) Policy activities: consensus building Support tools as mediators
Uncertainty and disagree-ment on knowledge	Semi-structured problem (means) Policy activities: investigating uncertainty and sensitivity: Support tools as knowledge advocates	Unstructured problem Policy activities: investigating scenarios and alternatives, identification of preferences and goals. Support tools to help identify and clarify objectives and preferences

In a rational view on decision making, processes evolve from badly structured to well-structured situations. This is not necessarily the case. Although a tendency to reduce uncertainty and to bring structure to the decision making process will always exist, it can be questioned whether decision processes will eventually end up in a well-structured problem. Especially water management is inherently complex (Geldof, 1995; Van Rooy et al., 1998) and well-structured problems are probably rare. Even when the problem is clear and knowledge is unified, then still the trade-offs are often inherently less straightforward due to emotional, ethical and moral aspects (Gregory, 2002). The framework of table 4.4 provides some guidance in selecting the right type of tool given a problem context. Exceptions are possible, for example, it may be the case that right at the start of a planning process, there is disagreement over the need to undertake action which might require more quantitative data to reinforce the legitimacy for a course of action. Also, an event or new insight might lead to a readjustment of initial goals and objectives and might ask for a reopening of the debate with all stakeholders involved. Finally, decision makers may well force a decision despite uncertainty and confusion on values and objectives. The role and requirements of the decision support tools to be developed need specifying in each individual case. The framework may help specify the requirements through a better understanding of the role of tools in decision making.

4.5 Suitable tools for spatial water policy

Spatial water policy typically includes a multitude of aspects and affects a wide variety of stakeholders (see chapter 2 and 3). In such complex and badly structured situations, the use of analytical tools as 'problem solvers' is not recommended (Table 4.4). However, the technological-analytical types of approaches dominate water management (Turban, 1990; Luz, 2000; Gijsbers, 2000; Pereira and Quintana, 2002; Pahl-Wostl, 2005). Many state-of-the-art decision support systems have remained focused on the technical side of water management, paying relatively little attention to interaction between multiple actors (Gijsbers, 2000). A mismatch occurs between the type of decision support tools offered and the characteristics of decision making processes.

The tendency in policy making towards involvement of stakeholders and decentralisation, calls for a different role of decision support. Decision support systems in water management should move from a more technological-analytical towards a more participatory perspective. The focus is no longer on fully informing decision makers to legitimise their decisions, but it is shifting to facilitating the exchange of ideas, and stimulating dialogue for reaching common grounds. Such tools should pay special attention to being user-friendly, transparent, simple and flexible (Bacon et al., 2002).

4.6 Conclusions

A whole range of decision support systems exists and definitions are various. Decision support systems generally consist of a number of tools (or components) with different purposes. Such tools can be data-driven tools for analysis of discrete alternatives (optimisation and integrated modelling for example), or they can be 'soft' interactive tools for obtaining information from its users and focus on the process of obtaining and exchanging information interactively from and between stakeholders and decision makers. Over the past years a great number of decision support systems have been developed, but the efforts have led to unfulfilled expectations. The impact of decision support on decision making processes has been rather unsatisfying from a developer's point of view. Proper testing of decision support efforts is methodologically complex and rarely been done, but a list of potential pitfalls has been abstracted from the literature and summarised in table 4.1. This overview may be useful for future decision support design. It seems that the most frequently occurring omission is the lack of communication between the developers and end-users of decision support, and that as a result many decision support tools have been developed from a technological developers-push rather than being based on a demand-driven interactive process with end-users. Specification of the requirements of decision support tools requires a good understanding of the role of tools in different decision making processes. This role has been further explored and summarised in a framework (table 4.4). This framework may help to overcome the perceived mismatch between tool characteristics and user requirements.

In general, decision making problems in spatial water policy can be characterised as unstructured or semi-structured. Given the complexity of water management, a stage where the problem is well-structured and a decision involves only putting the pieces of the puzzle together, will probably never be reached. Decision support for water policy should aim at enlarging the understanding of the aspects of the decision making problem, in a way that is accessible to the actors involved in the process. To offer support to spatial water policy, tools should therefore be 1) integrative; 2) interactive and 3) spatial, and besides offering technical information to inform decision makers, pay more attention to stimulating dialogue for reaching common grounds. The role and requirements of the decision support tools needs specification in each individual case. The framework presented in table 4.4 offers some guidance, where it has to be stressed that decision support development should be a demand-driven process.

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Part 2

Development and application of support tools

5. Integrated evaluation of management alternatives using a tool for spatial multi-criteria analysis: the case of the Wormer and Jisperveld[2]

5.1 Introduction

This chapter describes a first trial at the development of support tools for spatial water policy implementation. The tool has been developed for water management in the Wormer- and Jisperveld area (Janssen et al., 2004; Goosen et al., 2004a; Goosen et al., 2004b; Omtzigt and Van Herwijnen, 2005). As was argued in the previous chapter, selecting suitable tools for decision support is a challenge in its own. The recommendations of the previous chapter have been taken into account in designing the tools and section 5.2 motivates the choice of tools for decision support, using table 4.4 for guidance. An introduction into the case study area follows in section 5.3. The approach and methods are described in sections 5.4, 5.5 and 5.6 and results are presented in section 5.7. The decision support effort is discussed in section 5.8.

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[2] This chapter aggregates the results of part of the EVALUWET project as published in:
Goosen, H., Janssen, R., M. Verhoeven, J.T.A. Verhoeven, A.Q.A.. Omtzigt, 2004. Spatial multicriteria analysis in fen meadows. Landschap 21 [3], 123-135;
Janssen, R., H. Goosen, M. Verhoeven, J.T.A. Verhoeven, N. Omtzigt, E. Maltby, 2004. Decision Support for integrated wetland management. Journal of environmental modeling and software 20 [2]. 215-229.
Goosen, H, Verhoeven, M.L., Janssen, R., Verhoeven, J.T.A., Omtzigt, A.Q.A., 2004. EVALUWET: Decision support for integrated evaluation of wetland management alternatives. Amsterdam, IVM-VU.

5.2 Selecting tools for decision support

In chapter 4 it was argued that the degree to which the decision making problem is structured and the main policy making activities are important guidelines for the types of decision support tools to be selected. The degree to which the problem is structured is determined by the availability of knowledge and by the clarity of values and objectives of the parties involved in the decision making. In the case of water management in the Wormer- and Jisperveld, knowledge and information are available but there is disagreement over values and objectives. In such cases there is a need for structuring the diversity of different types of information, to support discussions about values and objectives..

In the case of the Wormer- and Jisperveld, the functioning of the area is quite well understood. Interviews were held with the local manager of the nature conservation organisation (Natuurmonumenten) and with the local water authority (Hoogheemraadschap Uitwaterende Sluizen) during which the availability of information was discussed. In general, there seems to be no lack of data. Scientific information is available, especially at the local water authority and the province. However, a clear need has been identified for structuring the available information making it better accessible. Because of the range of interests and possible impacts of management alternatives, the required information is very diverse (i.e. data on hydrology, soil and water chemistry, agricultural production, ecology and recreation). There exists a rich literature on fen meadows, on the ecology and importance for biodiversity conservation (Westhof et al., 1971; Witmer, 1989; Natuurbeschermingsraad, 1991; Barendrecht et al., 1993; Verhoeven et al., 1993; Opstal et al., 1997; Van Leerdam and Vermeer, 2000; Bal et al., 2002), on their cultural historic importance and on the role of agriculture (Van der Ploeg et al., 2001), on soil subsidence (Schothorst, 1974) and on their potential role in storing greenhouse gasses (Born et al., 2002; Jacobs et al., 2003). It is also well known that a number of threats to their sustenance and political disagreement on how to solve the problems exist. Land subsidence (one of the problems in fen meadows) is caused by drainage of the land that is necessary for agriculture. One way to slow down the process of land subsidence would be to increase water levels. Farmers say that this would mean the end to farming in fen meadow areas. Without farmers the fen meadows will probably disappear because its management will be too costly for nature conservation groups.

Development of a consistent policy for the fen meadows is complicated because of the different conflicting interests. There are many stakeholders involved in the decision making process and the process is coordinated under the responsibility of the Province of North Holland. Their task is to make the trade-offs among different interests and to develop a policy that fits into the guidelines offered by national and international policy and legislation. In reaching such a policy, the province is attempting to incorporate as much as possible the interests of all parties involved. In such a case decision support should focus on mediating between stakeholders and policy makers to assist in finding innovative solutions and compromises (upper right cell of Table 4.4). A Geographical Information System is used (for visualisation and processing of spatial information) in combination with multi-criteria methods (to assist in processing a variety of information) are used to support comparison of alternatives in a participatory setting.

5.3 Description of the study area

The Wormer- and Jisperveld is a fen meadow area located north of Amsterdam. The area consists of wet pasturelands with drained peat soils alternated by natural and artificial lakes, ditches, reed swamps and quaking fens. Many characteristic bird and plant species are present and conservation values are high, both in national and international contexts.

Fen-meadows have originated from the drainage of a large peat system dating back from 1800 B.C. To keep the land suitable for agricultural use, the peat area has been drained deeper in recent decades. This drainage has resulted in a subsidence of the soil and as a result the polders with fen-meadows are now 1-2 m below mean sea level. In between the fen-meadows, deeper polders with a clay soil are found. These deeper polders originally were large lakes, which have been reclaimed in the 17th century for agricultural use. Presently these polders are 2-6 m below mean sea level.

As in other parts of the country, water tables in the Wormer- and Jisperveld are controlled to facilitate agriculture, urbanisation, infrastructure and other land-uses and to avoid damage and inconveniences caused by floods. However, problems with water surpluses as well as water deficiencies have recently had large economical consequences in the area. Based on predictions from climate change scenarios, the problems in the area are expected to increase in the future (Commission on water management for the 21st century, 2000).

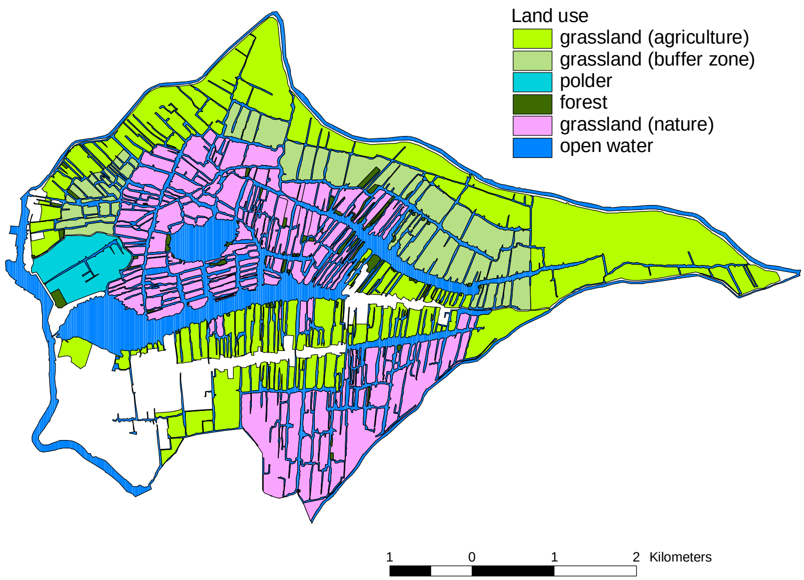


Figure 5.1. The Wormer- and Jisperveld

The Wormer- and Jisperveld (Figure 5.1) is an area of about 2500 hectares consisting of small lots of drained peat land within a network of ditches and shallow lakes. The area is mainly in agricultural use (low-intensity dairy farming) and offers an internationally important habitat for meadow birds (Bal et al., 2002). The outer belts of the area and land parcels connected to houses are private property and are in (more intensified) agricultural use. The central part is owned by a nature conservation NGO, Natuurmonumenten. The fen meadows of Wormer- and Jisperveld, with respect to their hydrology, are characteristic fen meadow areas which are both valuable and becoming rare in the Netherlands. Policy makers are faced with complex decisions about future land-use in these fen meadow areas. Different stakeholders, such as agricultural organisations, recreational organisations, nature conservation organisations and provincial/regional authorities, each have different and often conflicting interests and have their own ideas about land-use. However, most parties share the concern over the future preservation. In a business-as-usual scenario, the fen meadows are likely to disappear. The farmers in the area traditionally oppose heavily to increases in water tables. But also the farmers realise that measures need to be taken to prevent a loss of the typical fen meadows landscape.

There are roughly three alternative ways to manage water in the area. The local water authority identified three alternatives for the Wormer- en Jisperveld (IWACO, 2000):

- Modern fen-meadow (Figure 5.2, top): this is the current situation with 'un-natural' water management. Water levels are higher in summer (40 cm below ground level) than in winter (70 cm below ground level). The area can be used for (low-intensity) agricultural practices - mainly dairy farming - and the area is suitable for meadow birds. However, because of the relatively low water levels year round, the peat will oxidise and the soil will subside.
- Historical fen-meadow (Figure 5.2, middle): a more historical situation with management aimed at a more natural water level fluctuation: the groundwater level varies between 40 cm. below soil surface in summer and 20 cm. below soil surface in winter. Dairy farming is still possible, however less intensive (about 1.5 cows per hectare of land) than in the modern peat pasture scenario. The area is still suitable for meadow birds. Soil subsidence will still occur, but is slowed down considerably compared to the current rate that will continue in the modern fen-meadow alternative.
- Dynamic mire (Figure 5.2, bottom): water levels will fluctuate between 40 and 0 cm above soil surface in winter and summer. The area is no longer suitable for commercial agriculture. The inundation changes the habitat characteristics and will cause a shift in species composition (Runhaar et al., 2004). Typical meadow bird species (e.g., godwit, lapwing, redshank) may largely disappear. The area will change from mainly grassland to a system dominated by reed beds, carrs, quaking fens and open water. These habitats are also considered to be rare and of a high conservation value and may well be colonized by numerous red list birds and angiosperm wetland plants.

Figure 5.2 A typical 'modern' peat pasture area (top); a 'historic' fen meadow area with a higher % of surface water and higher water levels (middle) and a dynamic mire, periodically inundated and no longer suitable for dairy farming (bottom).

Evidently, these alternatives will have consequences for the various functions in the area. A decision support tool could prove useful in structuring the problem, and by providing insight in how proposed changes will be perceived by the various parties involved in or affected by future decisions.

5.4 A spatial multi-criteria approach

One of the objectives of the decision support effort is to provide insight in the impacts of management alternatives on functions of the area, and subsequently on the goods and services these functions provide for society. Maybe the easiest way to understand the impacts of management alternatives would be to have all impacts expressed in one and the same unit, and the most commonly used one is money. Several attempts have been made to systematically obtain the transfer of ecosystem functions to ecosystem values expressed in monetary units (De Groot, 1992; Costanza et al., 1997). A number of economic valuation studies focus directly on wetlands. Brander et al. (2003) performed a comprehensive meta-analysis of about 215 wetland valuation studies. Often economic values are only grasped partially, for example as monetarised values of direct human use (Turner, 2000; Van Beukering et al., 2001). Especially non-use values are difficult to express in monetary terms. Because it is difficult to transfer the monetary values from one place to another and because it is difficult or even impossible to quantify non-use values in monetary terms it can be questioned whether economic valuation can provide a comprehensive overview of the functions of wetlands.

An alternative is to use multi-criteria analysis to express the various ecosystem functions. In a multi-criteria analysis, a variety of different criteria expressed in different units can be included and compared (in different units, monetary or non-monetary, in absolute or in relative measures) and evaluated on the basis of economic efficiency or other (non-economic) perspectives. In this study, a spatial multi-criteria approach (Van Herwijnen and Janssen, 1998; Van Herwijnen, 1999; Joerin and Musy, 2000; Van Herwijnen and Janssen, 2001) was used to assess and evaluate impacts of three water management alternatives on functions performed by the wetland ecosystem. The steps in the approach are illustrated in Figure 5.3.

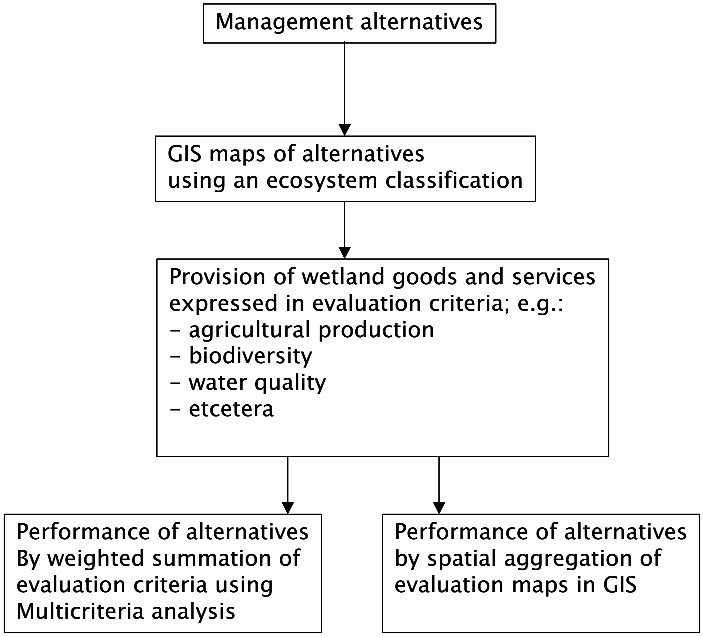


Figure 5.3 Steps in the decision support approach to evaluate management alternatives for water management in the Wormer- and Jisperveld.

Wetland structure and processes determine the functions the wetland can perform (Maltby et al., 1994), and these functions provide goods and services that are valued by society. In the multi-criteria analysis approach these goods and services are presented in various different units and can be compared by first standardising criterion scores and next adding weights to the criteria.

It was thus decided to develop a system for spatial multi-criteria analysis, to support policy makers in their attempt to reach consensus and find support for a course of action. The tool should serve as a mediator between policy makers and other parties involved in the decision making process. The tool was developed for this case study within the EU EVALUWET project (Goosen et al., 2004b; Omtzigt and Van Herwijnen, 2005).

A first step in the procedure is the definition of a standardised way to translate management alternatives to GIS maps. Spatial units are defined that are considered homogeneous with respect to hydrology and geomorphology, so called hydrogeomorphological units (HGMU's) (Maltby et al., 1994; Maltby et al., 1996;

Maltby et al., 1998). Based on soil characteristics, hydrology, geomorphology and management, the Wormer- en Jisperveld encompasses eight different HGMUs:

- Fen-meadows in agricultural use;
- Fen-meadows under nature management;
- Multi-functional fen-meadows (mixed agricultural and nature management);
- Woodland;
- Reed beds;
- Quaking fens;
- Surface water, including lakes and ditches; and
- Reclaimed lakes (polders).

Each management alternative consists of a set of HGMUs with a specific management regime. For instance, the present situation ('modern' fen meadow alternative, see section 5.3) consists mainly of grassland under agricultural, mixed or natural management. In the 'Dynamic mire' alternative, the area of grassland is smaller and replaced by woodland, reed land and quaking fens. Alternatives are defined by the area and configuration of the different HGMUs. When changes in water management occur, the configuration and size of HGMU's will change. For instance, in a 'dynamic mire' alternative the area of open water and reed beds increase compared to the current situation where the area is dominated by fen meadows.

The HGMU map for the area was created on the basis of a standard land use map (1:25.000, Figure 5.4). The polygons of the land use map were 'cut' from the land use map and reclassified. Each map unit was removed from the initial map and moved to a separate file and classified according to the HGMU method. Soil maps and hydrological maps were used to assign the correct HGMUs to the polygons from the land use map. The local manager provided information on the different present management regimes and these were digitised manually.

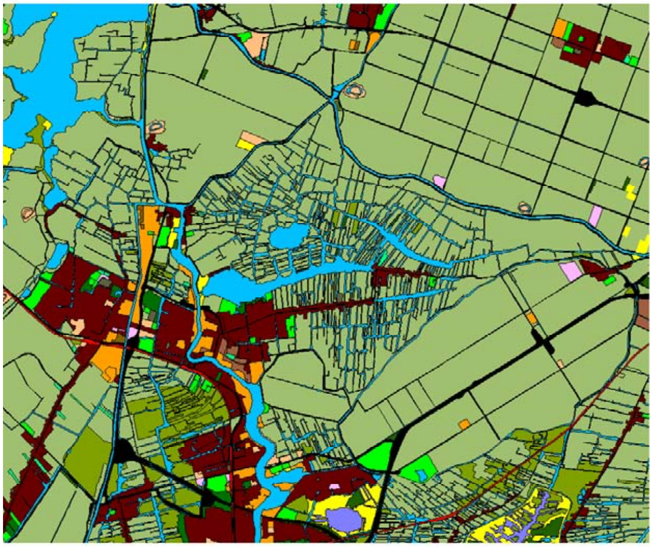


Figure 5.4 Land use map of the study area, used as the basis for deriving the HGMU map.

Small areas such as reed banks and small quaking fens are difficult to map. These HGMUs occur on the fringes of parcels (polygons). The land use map on which the HGMU map is based is not sufficiently detailed to show these small HGMUs. In fact it would require very detailed mapping (1:1000) and gathering the information and processing such a detailed map is very time consuming. Although small, the reed lands and quaking fens are important features in the landscape and for the wetland evaluation it is essential to incorporate them. To solve this issue the reed lands and quaking fens were expressed as a fixed percentage of a polygon. The advantage of this is that even very small HGMUs can be included in the calculations. The disadvantage is that the areas are not visible on a map. In other words: the small units can be included in the calculations but they cannot be made spatially explicit. A further complication arose when the location of a HGMU was considered important for the performance of the wetland. This is the case for example, for patches of woodlands. Predator birds are often present in these patches and as a result little breeding meadow birds can be found in the vicinity of forested polygons (pers. com. H. van der Geldt). This is a typical spatial effect, and in order to express these effects such fragments need to be expressed as separate polygons. The woodland patches were digitised in ArcView

3.3 from a hand-made map obtained from the local manager. Figure 5.5 shows a close up from the HGMU map indicating the approach.

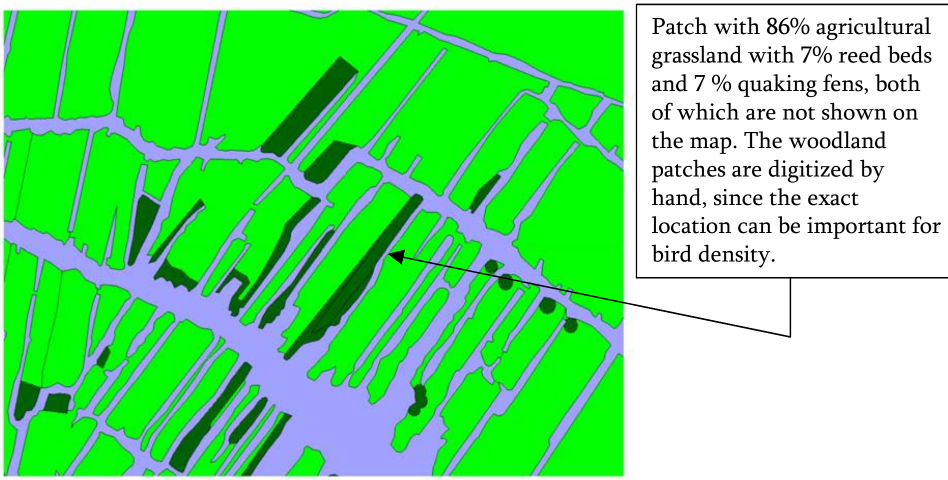
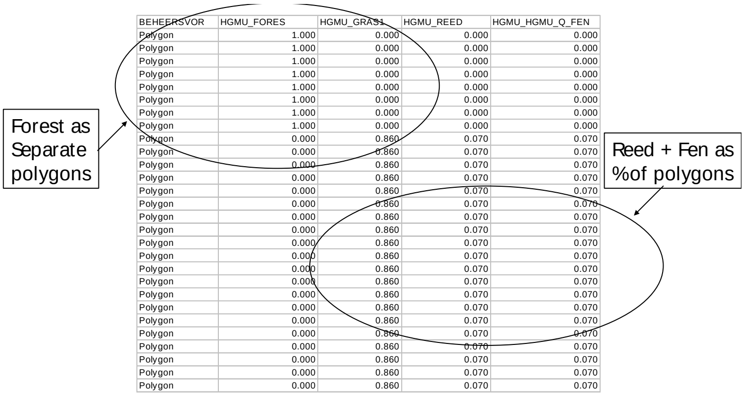


Figure 5.5. A Close-up from the HGMU map. Small fringes of the patches are not shown as their exact location is not essential. For woodlands the exact location is considered to be important, hence they have been digitised.

The percentages of reed land and quaking fens can be changed for each polygon individually (Figure 5.6). The areas of the different HGMUs relative to each other will change. For instance, in the dynamic mire alternative reed beds will be more abundant than in the current situation and fen-meadows in agricultural use will mainly disappear due to the incompatibility with high water levels.



BEHEERSVOR	HGMU_FORES	HGMU_GRAS1	HGMU_REED	HGMU_HGMU_Q_FEN
Polygon	1.000	0.000	0.000	0.000
Polygon	1.000	0.000	0.000	0.000
Polygon	1.000	0.000	0.000	0.000
Polygon	1.000	0.000	0.000	0.000
Polygon	1.000	0.000	0.000	0.000
Polygon	1.000	0.000	0.000	0.000
Polygon	1.000	0.000	0.000	0.000
Polygon	1.000	0.000	0.000	0.000
Polygon	0.000	0.860	0.070	0.070
Polygon	0.000	0.860	0.070	0.070
Polygon	0.000	0.860	0.070	0.070
Polygon	0.000	0.860	0.070	0.070
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Polygon	0.000	0.860	0.070	0.070
Polygon	0.000	0.860	0.070	0.070
Polygon	0.000	0.860	0.070	0.070
Polygon	0.000	0.860	0.070	0.070
Polygon	0.000	0.860	0.070	0.070
Polygon	0.000	0.860	0.070	0.070

Figure 5.6 The feature table shows how each feature consists of percentages of hydrogeomorphologcal units.

Each land unit (HGMU) provides different goods and services and evaluation criteria are used to express the performance of each HGMU. These evaluation criteria should be comprehensive and represent all goods and services that are relevant to the decision making. In successive projects funded by the EU, an interdisciplinary consortium of universities and research institutes has collaborated with the objective to produce the FAEWE approach, a system for the Functional Analysis of European Wetland Ecosystems (Maltby et al., 1994; Maltby et al., 1996). These activities have resulted in a procedure for the assessment of a comprehensive set of hydrological, biogeochemical and ecological wetland functions. These functions, how they relate to policy objectives and how they are made operational in a number of evaluation criteria are presented in Table 5.1. This list was used as a starting point. Users can make a selection of relevant criteria to be incorporated in the final assessment.

Table 5.1 List of criteria categories (based on EU policy relevant to wetland management), wetland functions (which produce goods and services) and evaluation criteria (which express changes in the overall provision of goods and services) that are identified in Maltby et al. (1994 and 1996).

Criteria categories	Wetland functions	Evaluation criteria
Water quality (Water Framework Directive)	Nutrient retention and export	Nitrogen removal Phosphorus removal
Water quantity (Water Framework Directive)	(Flood)water retention	Water retention Peak storage Flood storage
Climate Change (Kyoto Protocol)	Greenhouse gas storage and emission	Net greenhouse gas storage
Biodiversity (habitat directive, bird directive, Ramsar treaty)	Ecosystem maintenance	National Flora diversity International Flora diversity National fauna diversity International fauna diversity
Socio-economic	Direct human use	Cultural historic value Agricultural production Recreational opportunities

The performances of all evaluation criteria are estimated for each homogeneous unit or HGMU. The performances were estimated on the basis of knowledge from the literature, and complemented by expert knowledge. Experts checked all performances scores, but the users can easily alter the scores and sensitivity and uncertainty analysis can be performed.

The performances of evaluation criteria have been standardised and expressed in scores between 0 and 1. This standardisation procedure is required for the multi-criteria assessment (Janssen et al., 2001). In standardization it is important to carefully choose a reference. The reference level for a wetland function is in this case study defined as the maximum performance of a wetland function regarded possible in fen meadow areas in the Netherlands. This means that for instance for the ‘biodiversity’ criterion, the reference score of 1 is assigned to the HGMU where all species occur that are considered to be typical for this specific type of habitat.

5.5 Results of three management alternatives

This section briefly describes the procedures and performances of the different HGMUs on the evaluation criteria. A more detailed description of all estimations and their procedures can be found in the technical background report (Goosen et al., 2004b). The figures 5.7-5.10 are presented at the end of this section.

Water quality improvement: nitrogen and phosphorus removal

To estimate the performance of individual HGMU’s on nitrogen and phosphorus removal, a ‘functional analysis approach’ was used (Maltby et al., 1994; Maltby et al., 1996; Janssen et al., 2004). This approach uses standard procedures that have been developed to provide a tool for assessing hydrological, biogeochemical and ecological functions of wetlands based on underlying processes. The functional assessment procedures contain expert knowledge and have been developed to indicate wetland functioning without having to do measurements in the field. This method showed that especially reed lands and woodlands contribute to water quality improvement through nitrogen and phosphorus cycling. The outcome of functional assessment procedures showed a capacity to remove nitrogen from the system of 279 kgN ha^{-1} yr^{-1} and 95 kgN ha^{-1} yr^{-1} respectively for reed marshes and wetland woodland. A recent study on denitrification in wetland floodplains (Olde Venterink et al., 2006) indicates rates of 236 kgN ha^{-1} yr^{-1} for wetland reed beds and 90 kgN ha^{-1} yr^{-1} for woodland which are comparable to our rates. Such rates are common for Dutch fen meadow areas (Verhoeven et al., 1993). The rates for phosphorus removal estimated with the functional assessment procedures were considerably lower than the ones found by Olde Venterink et al. (2006).

HGMUs in agricultural use generally have high nutrient inputs (because of fertilization) which results in high availability of nutrients for export and retention processes. However, because of the high input rates, high export and retention rates do not automatically lead to purification of the water. High export rates can in this case not be considered as a net positive effect. HGMUs with a direct (agricultural) nutrient input are even more likely to pollute water with nutrients than to purify water from nutrients. Therefore a correction on the scores was necessary for the HGMUs in agricultural use (the grassland HGMUs) and no net export or retention of nutrients occurs in these HGMUs. The results of the functional assessment procedures for all HGMU's are given in Table 5.2.

Table 5.2 The performance of the HGMU's on the evaluation criteria N and P removal. Results were estimated using the 'functional assessment procedures' (Maltby et al., 1994; Maltby et al., 1996; Janssen et al., 2004).

HGMU	Removal of N (kgN/ha/yr)	Removal of Phosphorus (kgP/ha/yr)
fen-meadows in agricultural use	0	0
fen-meadows under nature management	0	0
multi-functional fen-meadows	0	0
reed beds	279	13
quaking fens	58	6
Open water	45	0
woodland	95	9
reclaimed lake (polders)	0	0

The functional assessment procedures used to indicate nutrient removal rates are not meant to predict changes in wetland functions under different management alternatives. However, because the functional assessment procedures provide information on the basis of HGMU's and the alternatives have been defined as sets of different HGMU's, it has been possible to use the procedures for the purpose of evaluation of management alternatives. The functional assessment outcomes have been incorporated in the GIS, demonstrating the performance of the three alternatives on the criteria of nitrogen and phosphorus retention (Figure 5.7, top).

It can be seen that the dynamic alternative performs best on both criteria. As a result of the management of the dynamic alternative, the area of reed lands and woodlands, which contribute most to the removal of nutrients, will be higher than in the other two alternatives.

Water quantity

The Wormer and Jisperveld could be used for either temporary storage of surplus water, or for flood storage during extreme events, or for seasonal retention (storage in winter and a source of water in summer (IWACO, 2000). The capacity of the system to contribute to flood storage (incidental, only in cases of urgent flood danger), peak storage (after heavy rainfall) and seasonal retention (structural measure) have been indicated in a study of the hydrology of the area (IWACO, 2000). The storage capacity indicated in the IWACO study have been standardized and presented in the maps of Figure 5.7. As the area is relatively flat, there is little difference in the performance of the various HGMU's and the performance of the hydrological functions is therefore rather homogeneous, as can be seen in Figure 5.7 (bottom).

Sequestration of greenhouse gasses

Wetlands are potential sinks for carbon. In Dutch fen meadows a net emission of carbon is taking place because of the oxidation of organic soils (Schothorst, 1974; Van den Born et al., 2002). Raised water levels may reduce this rate of oxidation and could even result in a net positive effect. Van den Born et al. (2002) performed a literature study and estimated the net flux of greenhouse gasses in Dutch fen meadows. Such estimates are rather uncertain since a range of estimates is found in the literature and therefore the results can only be used as a proxy for this potential function of wetlands. Van den Born compiled estimates made for fen meadows as a whole. Here we are interested in the estimates per HGMU. Assuming that net emission occurs in the grasslands only (peat drainage occurs only in these grasslands) and that net storage occurs in reed lands, woodlands and quaking fens we can translate these data to individual HGMU's. Table 5.3 shows the expected emissions per HGMU.

Table 5.3 Estimated net greenhouse gas emissions per HGMU in the 3 management alternatives (positive values indicate emission; negative values indicate net storage). Based on Van den Born (2002).

HGMU	(tCO_2-eq/ha/yr) Modern alternative	(tCO_2-eq/ha/yr) Historic alternative	(tCO_2-eq/ha/jr) Dynamic alternative
Grass agriculture	7	0	-1
Grass buffer	7	0	-1
Grass nature	7	0	-1
Reed/quaking fen/woodland	-11	-11	-11
Open water	0	0	0
Reclaimed lake	0	0	0

Maps of the alternatives show that the dynamic alternative has the highest potential for achieving a net storage of greenhouse gasses, because it has the highest cover of reed lands, quaking fens and woodland which are all estimated to be net sinks (Figure 5.8, top).

Biodiversity

In order to indicate potential changes in species composition resulting from changes in water management, the HGMUs have been matched with so called 'nature target habitats' (Bal et al., 1995; Bal et al., 2002). These nature target habitats are used in Dutch nature policy as a standard typology for describing different habitat type. For these target habitats lists of target species have been developed. Target species are species that potentially occur in the habitats and are regarded rare or endangered, nationally, internationally or both. These lists of target species have been used as an indicator of national and international biodiversity. The indicators used here are limited to only bird and plant species. As an indicator for international importance of habitats, we simply scored the number of target species potentially occurring in the target habitats that are listed on the IUCN red list of threatened species and/or on the list of the habitat and bird directive. In this simple approach the potential occurrence of species is used as an indicator of biodiversity value. Whether the target species will actually occur will remain unknown. Hence, the method estimates a score for biodiversity based on the potential occurrence of species in HGMU's.

The maps (Figure 5.8, bottom) indicate the potential occurrence of target species in the different management alternatives. With regard to plant species the historic alternative performs best. Also the potential number of bird species of national importance is highest in the historic alternative. The modern alternative has the highest potential number of bird species of international importance.

Socio-economic functions

The most important economic function of the area is agriculture, although farming in the area is of low-intensity because of the less-favorable soil type (peat) and the low-accessibility of farm parcels (some can only be reached by boat). There is some recreation, but this is also restricted by the low accessibility and the absence of recreational facilities. The landscape and cultural heritage values are high and because of the low intensity use, the area is quiet and relatively unspoiled. Estimating recreational, landscape and cultural heritage values is difficult as hardly any data exists on the number of visitors and their appreciation. Therefore only qualitative statements from interviews with local managers were here and they only serve as an indication.

Agricultural production is included and is based on the study of Van der Ploeg et al. (2001) who investigated impacts of raised water levels on agricultural production, based on field studies on an experimental farm (Zegveld, The Netherlands). Van der Ploeg et al. investigated changes in water levels similar to the management alternatives considered in this case study. However, the dynamic alternative as such was not incorporated. It is assumed that under this dynamic mire alternative there will be no opportunities for commercial farming as water levels will be too high in the growing season. The study by Van der Ploeg et al. (2001) shows that:

- An average farm income outside the fen meadow areas[3] amounts to 1095 euro per hectare per year;
- An average farm income under the current water management regime (modern alternative) of 916 euro per hectare per year;
- An average farm income under the historic alternative of 641 per hectare per year.

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[3] It is assumed that the conditions for farming in the reclaimed lakes or polders are similar to these outside the fen meadows.

A distinction is made between two types of impacts on agricultural production: the impact of water level changes and the impact of nature management done by the farmers to protect meadow birds. Farmers receive subsidies for nature management to compensate for their loss of income, but strictly speaking it is a loss of production and therefore production of the grasslands in the nature and buffer areas is lowered. It is assumed that these subsidies compensate for the costs associated with the nature friendly way of farming. The subsidies for nature friendly farming depend on the length of a ‘period of no-activity’, e.g. no mowing and harvesting. The subsidies range from 316 euro per hectare (mowing after May 1) to 595 euro per hectare (mowing after June 1) to 1113 euro per hectare for complete inundation (www.lnvloket.nl).

Based on the study by Van der Ploeg et al. (2001) and tables with subsidies for nature management (www.lnvloket.nl) average agricultural productivity of the different HGMU’s was estimated. The subsidies received by the farmers are a compensation for a loss of production. Agricultural production is lower in subsidized areas, but the average income of the farmers is compensated. The height of the compensation can be used as a proxy for production loss, and average productivity (in euro per hectare) minus the compensation received (in euros per hectare) has been used as a proxy for production loss due to higher groundwater levels. It was assumed that an average farmer in the buffer area (mixed agricultural and nature use) will have a short period of no activity (mowing after 1 May) and he will receive the subsidy of 316 euro per hectare to compensate for a loss of production. It was also assumed that in the nature areas, the mowing regime after 1 June (corresponding to the 595 euro subsidy) is being applied. Table 5.4 summarizes the farm production (farm income in euro per hectare per year minus subsidies which are to compensate for a loss of production). Figure 5.9 shows the spatial pattern in the three alternatives.

Table 5.4. Agricultural production in the three management alternatives.

	Modern (net farm income in €/ha/yr)	Historic (net farm income in €/ha/yr)	Dynamic (net farm income in €/ha/yr)
Grass agriculture	916	641	0
Grass buffer	600	325	0
Grass nature	321	46	0
Reclaimed lake	1095	746	0

In the dynamic alternative there seems no more future for commercial agriculture, and grasslands with nature management depend fully on subsidies from the government. Although subsidies for nature management are available, there could still be some opportunities for farmers to continue their business. However, having to rely fully on government subsidies is not attractive for farmers nor is it sustainable in the long term. shows the spatial differences between the alternatives.

5.6 Comparison of alternatives using multi-criteria analysis

The estimation of the performances of evaluation criteria as described in the previous section provides maps for each evaluation criterion for each alternative. This resulted in a total of 39 maps (13 criteria x 3 alternatives) to be used for comparison of the alternatives. Understanding all these maps is a complicated task and it cannot be seen easily which of the alternatives performs best or should be preferred. In order to be able to make a decision on a preferred alternative, Van Herwijnen (1999) shows three possible paths to aggregate the available information to reach a final ranking of alternatives.

The first path is the most common approach: the decision maker is offered all maps and it is left to the decision maker to process the information in most cases without additional support. This approach can easily lead to misinterpretations when over-complex information is offered to the decision makers (Uran, 2002).

A second path is to first reduce the number of maps to be compared by making (weighted) overlays of maps. For example, a fauna map and a flora map are combined to a biodiversity map, and the water quality and quantity maps are combined to form a hydrology map. These aggregated maps can again be combined (weighted overlay) to a total performance map. This has been done in Figure 5.10 that shows the performance of the alternatives on five main categories of evaluation criteria: water quality, water quantity, biodiversity, climate change and socio economic. This figure also shows the overall total performance of the alternatives, on the basis of a set of weights. The weights were based on information from the interviews with local managers and policy makers. Policy priorities were discussed in order to define a weight set that would better represent current priorities. Weights add up to 1 and different approaches can be used to establish a set of weights (for instance pair-wise comparison). Setting the weights, however, is highly subjective and arbitrary. Users can easily change the different weights themselves (before producing the maps users are asked if they want to change the weights), making it easy to do experiments with different weight sets.

In determining the weights the following aspects have been taken into account. The absolute importance of the area for contributing to the net storage of greenhouse gasses is considered very small (the area itself is small but also the relative size of the HGMU's contributing to storage of greenhouse gasses is small), and in the context of land use planning this issue was not considered to be highly relevant and therefore the criterion was given a low weight (0.1). Since it proved to be difficult to distinguish between the relative importance of biodiversity, socio-economic and the hydrological functions, the remaining weights were equally distributed (0.3 each). Both water quality and water quantity criteria add up to a weight of 0.3 but since at the moment of writing the policy priority of the water quantity issues was higher, this received a weight of 0.2 and water quality 0.1. Obviously, setting the weights is tricky and will influence the ranking of alternatives.

Figure 5.10 shows that (given this set of weights) the dynamic alternative performs best for water quality and quantity and climate change. The historic alternative is preferred from the perspective of biodiversity conservation and the modern alternative the best for socio-economic objective. The modern alternative performs worst on the criteria of water quality, water quantity and climate change. However, the modern alternative is slightly better than the dynamic alternative for socio-economic objectives and better in the central area for biodiversity but worse at the edges. The overall comparison shows the dynamic alternative as slightly better than the historic alternative, the modern alternative performs worst. The differences are very small and much of the spatial pattern is lost in the aggregation steps. This illustrates the importance of presenting both the aggregated maps for overview and the original maps for explanation. This also shows that making a decision based on this set of maps is still very difficult.

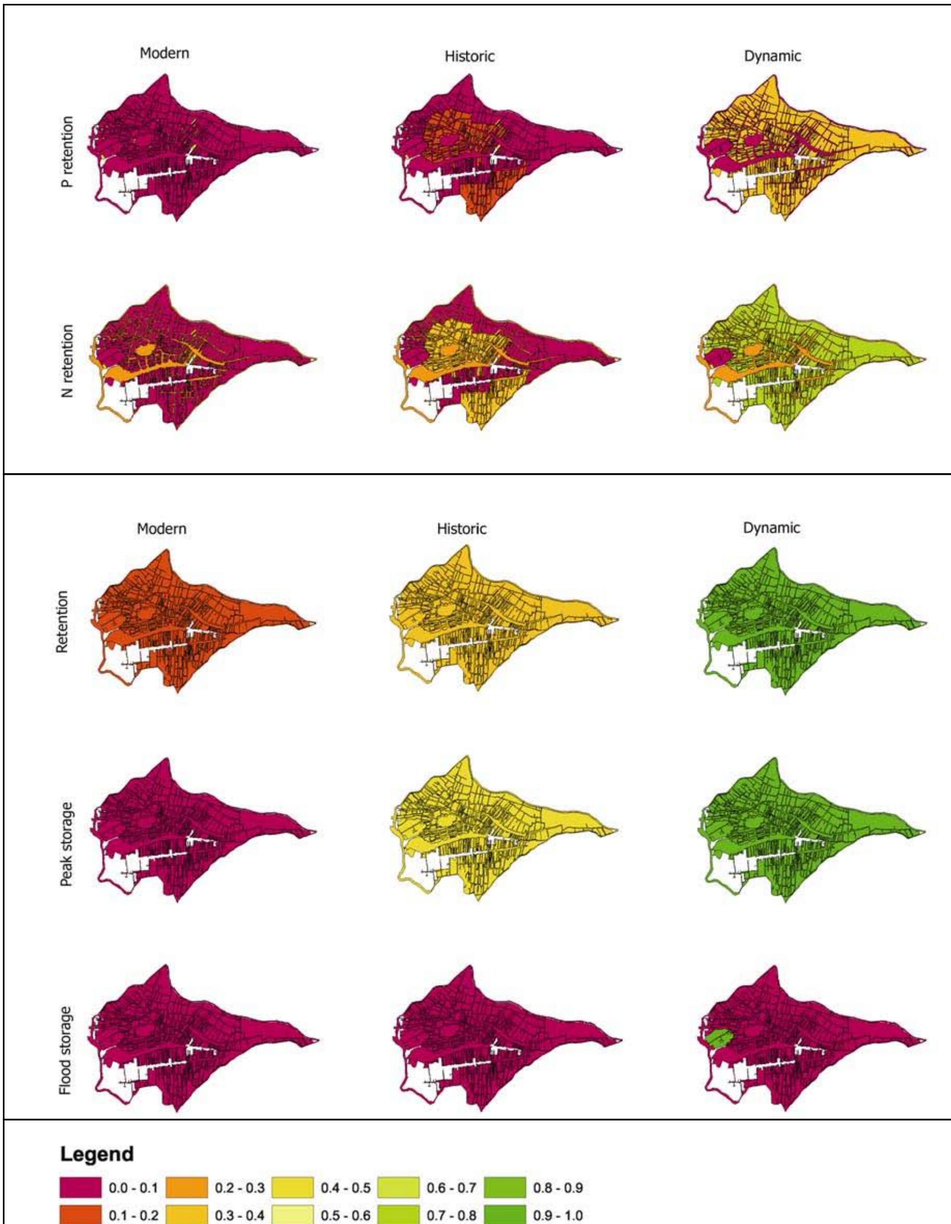

Figure 5.7 Spatial representation of the performance of the three alternatives (defined in section 5.3) on N and P retention (top) and on water quantity criteria (bottom). Performance is scaled between 0 and 1.

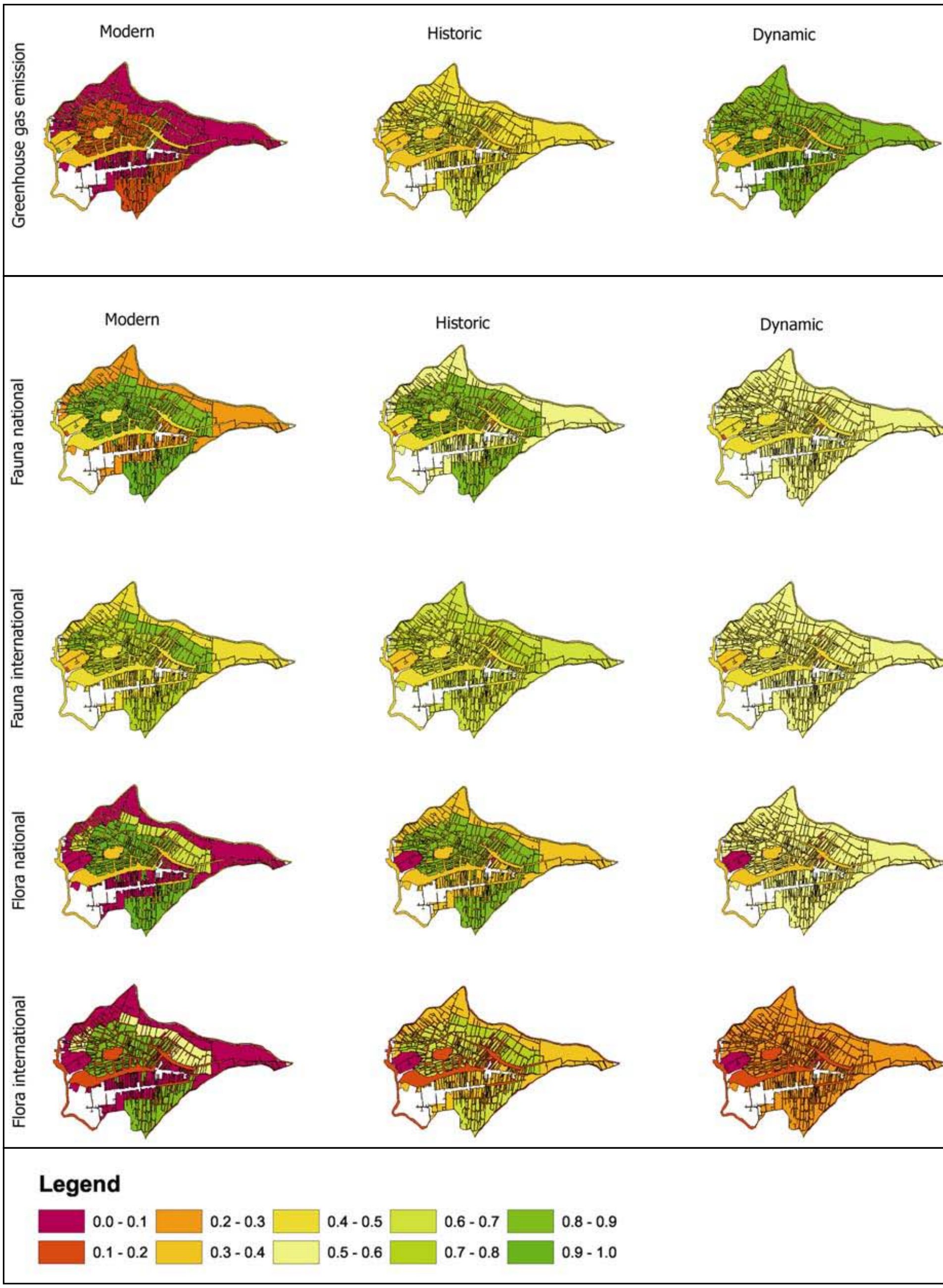

Figure 5.8 Performance of the alternatives on the criterion of storage of greenhouse gasses (top) and on the four criteria for biodiversity (bottom).

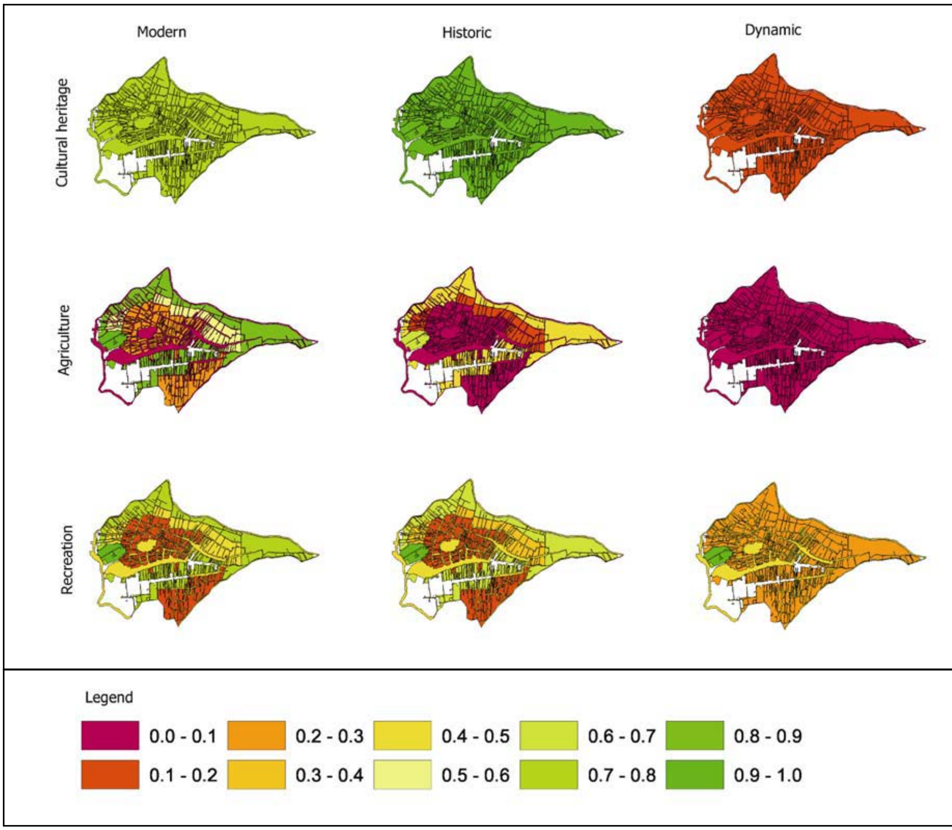

Figure 5.9 Performance of the three management alternatives on socio-economic criteria. Cultural heritage and recreation are based on qualitative statements of local managers. Ranges were scaled between 0 and 1.

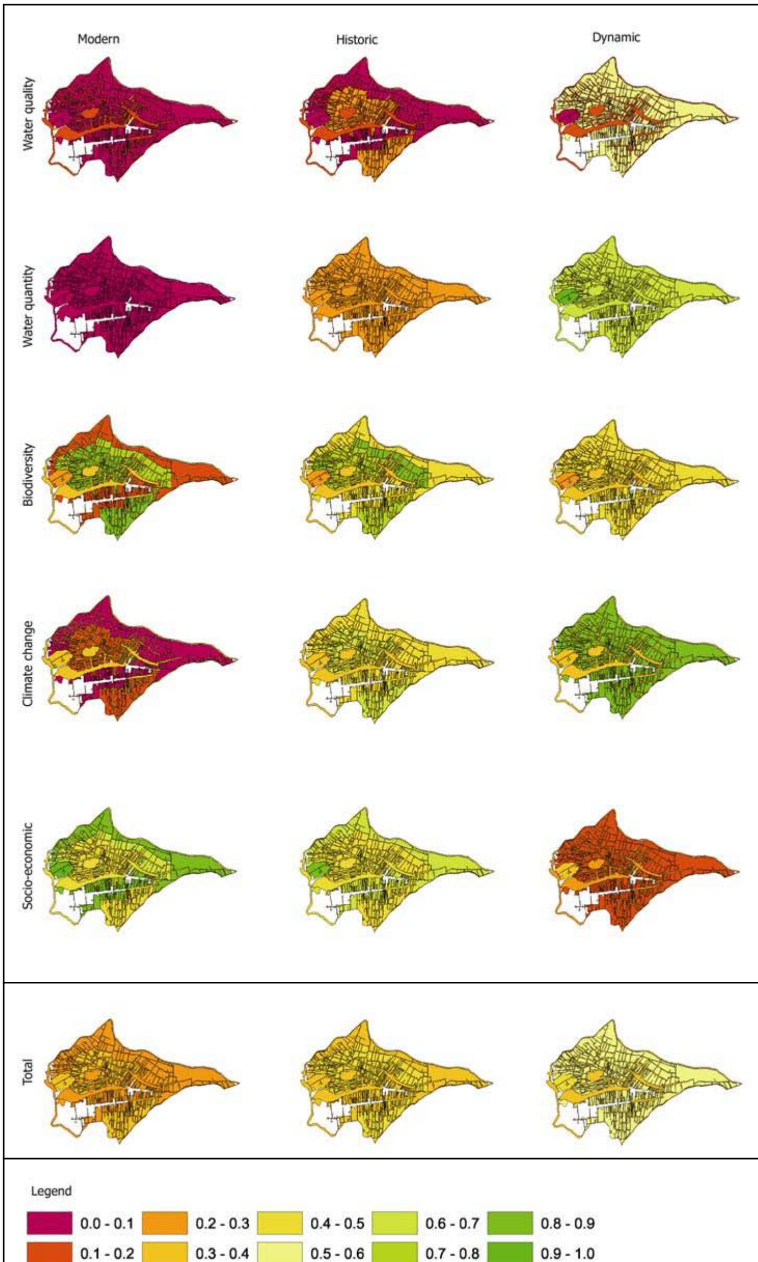

Figure 5.10 Total performance of the alternatives for all the main categories of criteria and the total score under a set of weights obtained from interviews with local managers. Ranges have been scaled between 0 and 1.

A third way to aggregate the information is to do a weighted summation followed by multi-criteria analysis. For each polygon on the maps, the evaluation scores are standardized between the worst (0) and the best possible score (1). These standardized scores are multiplied by their weights and aggregated. For example, from the agriculture map the average production score is weighted by area size, then aggregated and standardized using total area size. This generates an evaluation table such as the one presented in Table 5.5. An evaluation score of 0 results if all areas have the worst possible score. Examples are the scores for peak and flood storage of the modern alternative. An evaluation score of 1 is reached if all areas have the maximum possible score. Scores of 1 are found for water retention and peak storage of the dynamic alternative only.

Table 5.5 Evaluation table with standardized scores of the performance of the three alternatives on the evaluation criteria.

	Modern	Historic	Dynamic
Water quality			
P retention	0.02	0.06	0.25
N retention	0.11	0.19	0.56
Water quantity			
Water retention	0.19	0.33	1.00
Peak storage	0.00	0.50	1.00
Flood storage	0.00	0.00	0.03
Biodiversity			
Fauna national	0.52	0.60	0.48
Flora national	0.43	0.53	0.47
Fauna international	0.56	0.62	0.51
Flora international	0.34	0.41	0.20
Climate change			
Net greenhouse gas storage	0.18	0.48	0.71
Socio- economic			
Cultural heritage	0.80	1.00	0.20
Agriculture	0.41	0.17	0.00
Recreation	0.54	0.46	0.37

To obtain a final ranking of the alternatives, weighted summation is used to (Janssen, 1991; Janssen et al., 2001). The upper row of Figure 5.11 suggests that given the set of weights described above, the historic alternative ranks best, very closely followed by the dynamic alternative. Figure 5.11 also shows that there is a clear trade off between socio-economic functions and the other functions. This also became clear from looking at the maps in figure 5.10. The scores on the biodiversity criterion are rather indifferent. This is because not necessarily the total number of species will change, but rather the species composition. Using a Monte Carlo analysis, the robustness of these outcomes was checked under different uncertainties in the scores. If it is assumed that there is an error of plus or minus 25% in the scores, there is an eighty percent chance that the historic alternative ranks higher than the dynamic alternative. There is a 99% chance that the historic alternative ranks better than the modern alternative. This shows that the ranking of the alternatives seems not very sensitive to possible errors in the scores that were estimated. The ranking does seem to be sensitive to changes in weights assigned to socio-economic criteria. A lowering of the weight of socio-economic criteria from 0.3 to 0.27 already changes the ranking and puts the dynamic alternative in first place when scores are summarized.

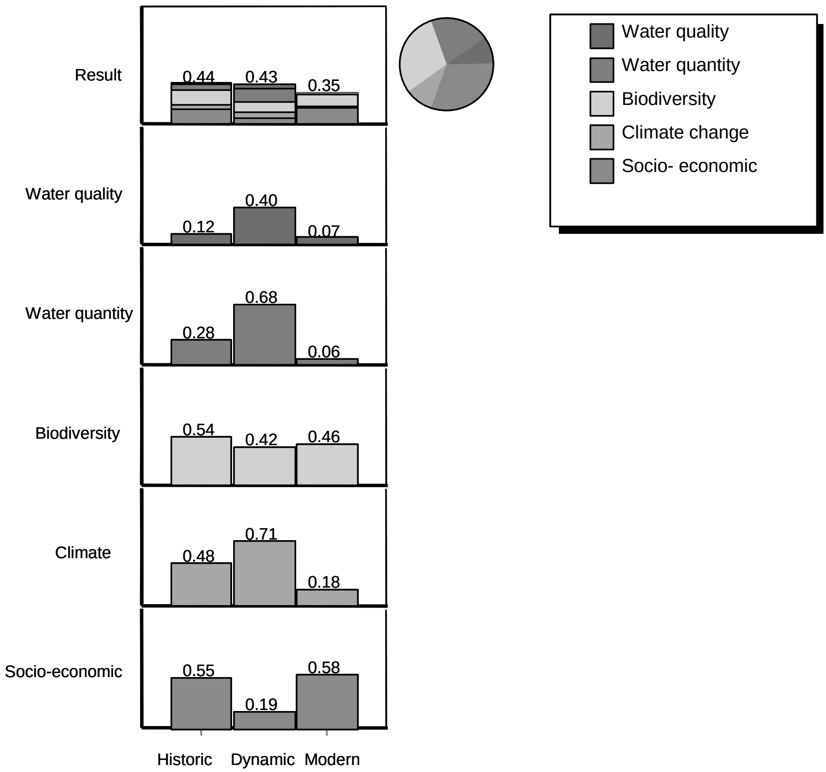

Figure 5.11 Overall performance of the three management alternatives. The top bar shows the aggregated result, the other bars represent the performance per alternative (alt.1, 3 and 3) in a standardized score, weighted by policy priority obtained form interviews with local managers.

Figure 5.12 shows what happens if weights are varied and priority is given to the various objectives. In each row priority is given to one objective: in the first row a weight of 0.5 is given to water quality, the second row to water quality etc. This figure is useful to demonstrate the relation between political priority and preferred choice. In this example the dynamic alternative ranks first if priority is given to water quality, water quantity, climate and biodiversity. However, this alternative ranks last if priority is given to socio-economic. The modern alternative ranks last for all weights.

Figure 5.12 also indicates that the ranking of the alternatives is not sensitive to changes of the weights between the four environmental objectives. In all four cases the dynamic alternative clearly ranks first.

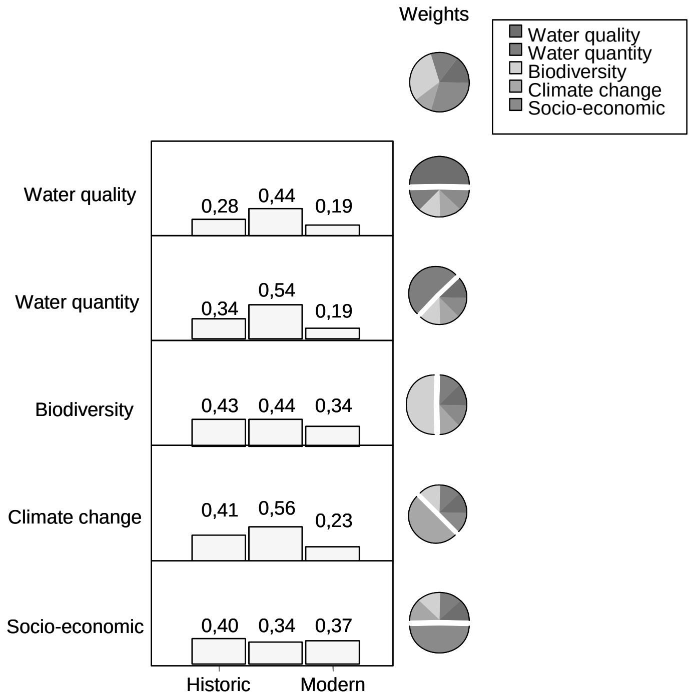

Figure 5.12 Performance of alternatives when different weight sets are applied. Each main criterion category (representing a policy priority area) is given half the total weight.

Although the figure above is relatively complicated it should be kept in mind that it is a summary of 39 maps made for the purpose of linking political priorities to ranking of the alternatives. The aggregated information provides overview but it should be possible to return to the detailed level. The procedure presented offers this possibility both graphically and in tabulated form.

5.7 Evaluation of the tool

In order to gain feedback on the approach, three meetings were held with stakeholders and policy makers in the Wormer and Jisperveld area. Representatives of the local water authority and the nature conservation agency were enthusiastic about the potential value of the tool in early stages of decision making. However, a problem that we experienced was that there was much political sensitivity. At the start of the project there were heavy conflicts between some of the parties. Farmers were angry and because of the slow and long lasting decision making process the parties lost trust in the Province. Stakeholders are on their guard and reluctant to provide cooperation to the project because of political sensitivities. A much heard concern was 'What is going to happen with the information I give to you?' Because of the sensitivities most parties were afraid of wrong quotations and misinterpretation of the provided information.

Some stakeholders did experience the offered approach as too complicated. Civil representatives of the provincial government (formally responsible for coordinating the planning process in the area) commented that the tools too much emphasized political sensitivities. Trade-offs are presented as black and white choices, leaving little room to manoeuvre. Issues were to be solved through political rather than through technical discussions. The province was afraid that the decision support tools would lead to a further polarization of the discussions. The tool was seen as a 'problem solver', whereas it was the deliberate aim to prevent a focus on solutions by incorporating flexibility in scores and weights of criteria.

Lessons from our development of the decision support system reinforce the findings of chapter 4. The developed tools do offer support for comparing alternative management options for peat land management. The parties involved trusted the outcomes and were able to understand the information offered. On the other hand, they stressed that the tool might further emphasize political sensitivities and polarize discussions. A second point made was that the system is not flexible with regard to adding and changing alternatives. Only existing alternatives could be compared. Table 5.6 below summarizes some of the problems that occurred.

Table 5.6 Pitfalls for decision support development encountered in the Wormer- and Jisperveld case study.

Potential pitfall	Encountered in the Wormer- and Jisperveld case
User-friendliness/ presentation of results	Not encountered as a problem.
Simplicity/ over-complexity/transparency	To some extent encountered as a problem. Some end-users found the tools too complicated and technical.
Assumption of rationality	The tools generate a 'preferred alternative', based on a set of weights. The leading party in the decision making process wanted to avoid a technical discussion about winners and losers, and rather preferred political debate.
Practical value and urgency	Because of political sensitivities, parties were reluctant to apply the tools. Issues were to be solved through political rather than through technical discussions.
Lack of solid data and analysis	No problem. Users had confidence in the data that was used and in the credibility of the information offered.
Matching the original requirements and user-needs and timing them right	The original requirements stated by the water authority were met. The water authority was interested in applying the tools, but did not have the financial means and capacity. The province formally coordinated the decision making process and according to them, the tools were too technical and contained too little flexibility for designing new alternatives.
Flexibility	To some extent: the data and weights can be changed interactively, but the tools cannot support a design process, which later in the process became more important
Reliability and confidence	No problem.
Political and institutional barriers	Decision makers felt threatened or limited/bounded by the DSS.

5.8 Conclusions

Water policy implementation in the Wormer- and Jisperveld can be considered as a moderately structured problem. Knowledge is generally available, but complicated trade-offs have to be made with regard to the interests of nature, agriculture, flood safety and water quality, landscape values and recreation. Typical policy making activities in such a context are consensus building and gaining support for proposed management alternatives.

The tools described in this chapter increase insight in the functions performed by the fen meadow wetlands in a comprehensive way, including estimations on how these may change under the influence of different management alternatives. Application and use of the developed tools requires little investment in terms of time and resources. Especially in early rounds of discussion, design sessions and other preparatory activities the tool may play a useful role. In early stages of decision making, the development of advanced assessment- or evaluation tools is often unfeasible as well as unwanted. Advanced and sophisticated tools are not readily available and their development requires time and resources. The use of such advanced and more sophisticated tools may also decrease creativity and it might scare off participants who feel they have no influence on the decision making. Moreover, there is a risk that the discussions shift from the problem towards the tool and its shortcomings.

The outcomes are presented in a simple standardized way, accessible to users with little knowledge and expertise of wetlands. Participants can choose relevant decision criteria and discuss the relative importance of these criteria that can be translated into weights. The ranking of alternatives can then be evaluated under different weight sets. The generic nature of the procedures that are used to make the estimations makes the outcomes relatively 'soft' and the criterion scores should be considered as approximate indications. This has implications for the reach and applicability of the tool. Because of the system's flexibility and simplicity, it can be adapted to the specific wishes of the user quite easily. Input data comes from the functional assessment procedures, but all input data can be changed through a simple pop-up window. Users can decide to leave out criteria and to change their weights. The developed tools thus seem capable of offering the intended type of support.

However, the tools have to date not been used in the actual decision making process. Representatives of the provincial government responsible for coordinating the planning process in the area commented that the tools put too much emphasis on the difficulty of the trade-offs to be made. The situation in the Wormer- and Jisperveld is much like a zero-sum game, where the benefits of one party go directly at the costs of the other party or parties. The province was afraid that the decision support tools would lead to a further polarization of the discussions. The tool was still seen as a 'problem solver', although it was the deliberate aim to prevent this by incorporating flexibility in scores and weights of criteria. This example shows that developers and end-users can have a different perception on the functionality and purpose of a tool. During the evaluation meeting it was recommended to develop less-quantitative and more flexible 'design' tools. Another recommendation was to focus on opportunities rather than on difficult trade-offs.

The first trial of developing decision support for spatial water policy has yielded some valuable lessons. Supporting early phases of planning and decision making requires flexibility. Evaluation tools such as the one presented in this chapter can be extended with a design-functionality to increase their flexibility. A design tool can emphasize the search for mutual benefits and creating values. The next chapter will describe a decision support effort better suited to address the earliest phases in spatial water policy implementation.

6. Collaborative planning using a tool for interactive design of alternatives: the case of the Vechtstreek[4]

6.1 Introduction

This chapter describes a second attempt at developing suitable tools specifically for supporting spatial water policy implementation. The tool described here has been developed for the Vecht area. Based on the most important lessons from the previous decision support experiences (described in chapter 5), the main aim was to develop a more interactive tool for the design of alternatives. The tool should clarify goals and objectives and stimulate value-focused thinking of the parties involved. Application of tools to support participatory processes is not new (see chapter 4), and it is important for tools to be compatible with needs and capabilities of users, available information, the institutional context in which decisions are made and the technologies and skills available to the developers.

The tool developed for the Vecht area case study focuses on design rather than on ranking existing alternatives. Such interactive design tools can aid the decision making by improving the communication between stakeholders and policy makers. This approach follows the recommendations formulated in chapter 4 for the design of tools in this particular type of decision making context. The choice of a selection of tools is motivated in section 6.2 and section 6.3 gives a description of the study area. The remainder of this chapter presents how the tools were developed. Application and testing of the tools is described in chapter 7.

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4 Based on: Janssen., M.A., H. Goosen, N. Omtzigt (2006). A simple mediation and negotiation support tool for water management in the Netherlands. Landscape and Urban Planning.

6.2 Selecting tools for decision support

The dilemma of selecting the right tools for the right purposes was discussed in chapter 4. In this case study we again seem to deal with a semi-structured problem, where scientific knowledge is generally available, but stakeholders and policy makers have often conflicting and sometimes also unclear interests. According to Table 4.4, tools to support such problems should focus on facilitating an interactive process where the main policy activities are to gain support and to work towards consensus. Tools may serve as mediators in this process.

Water in the Vecht area provides different functions for various actors, such as the provision of drinking water, waste treatment, nature conservation and recreation. Furthermore, the quantity of water can be too high (flooding) or too low (droughts). In fact, water is a heterogeneous resource (Steins and Edwards, 1999; Kaijser, 2002), and its management requires co-ordination of its use and cooperation among its users. Since such a resource is characterized by high substractability and difficulty of excluding other users, water resources can be viewed as common-pool resources (chapter 3). Earlier (in chapter 3) we pointed at the concept of platforms for collaborative planning as a promising way to implement spatial water management at the local level. In such platforms, resource management issues are considered from a multiple-use perspective and stakeholders work jointly towards adaptive resource management through:

(i) Fostering understanding about the resource base;

(ii) Minimisation of social dilemmas associated with collective resource use; and

(iii) Implementation and fine-tuning of action strategies with respect to perceived problems (Steins et al., 2000).

The interactive design tool was developed to support stakeholders in the process of implementation and fine-tuning of action strategies (or management alternatives). A three-day workshop programme has been developed in which the design tool has been applied. Each day focuses on one of the goals of platform decision making listed above. Section 6.4 gives a technical description of the tools that are used and the workshop set-up is described in section 6.5.

6.3 Description of the Vecht area

The study area is located in the centre of the Netherlands between the cities of Amsterdam and Utrecht (Figure 6.1). The area consists of roughly 8x20 km of (mainly agricultural) fen meadows and wetlands and includes many natural and artificial lakes, reedlands and marches, and fen meadowland. The Vecht area has a high nature conservation value in both national and international contexts (Barendrecht et al., 1993; Gilbert et al., 2004). Agricultural activities are concentrated in fen meadow areas and in deeper polders (reclaimed lakes).

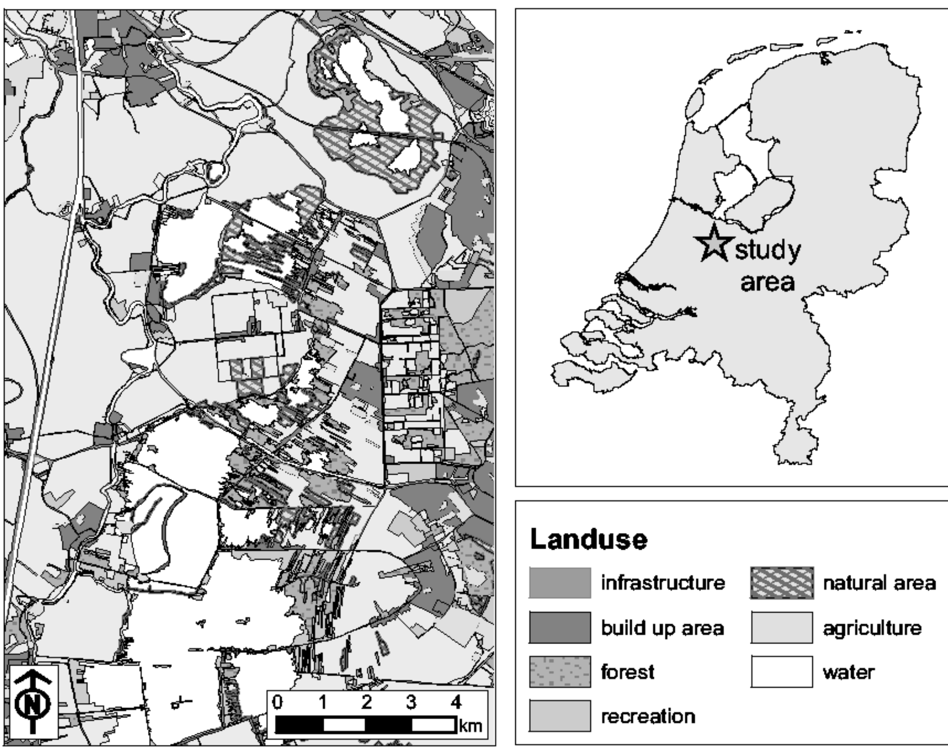

Figure 6.1 The location of the Vecht area.

Drainage and lowering of water levels are required to facilitate agriculture. Consequently, water tables are lower in the agricultural areas as compared to the surrounding wetland areas (Figure 6.2). This causes a water-loss from the wetland areas through seepage to the surrounding agricultural areas, resulting in the degradation of the wetlands and hence the disappearance of typical wetland biota.

Figure 6.2 A small dam illustrating how different water levels can be regulated and fine-tuned between nature areas and agricultural areas.

Future developments of the Vecht area are under pressure of increased demand for recreation activities, urbanisation, and land for water storage in times of extreme rainfall. The management of groundwater levels largely determines the opportunities for different types of land use. The often-conflicting objectives of various stakeholders in the Vecht area lead to a complex decision problem.

6.4 Technical description of the decision support tool

The interactive design tool is grid-based, and ArcView 3 with the Spatial Analyst extension is required. A land use map and a map of groundwater levels form the basis of the interactive design tool. The tool enables users to change land use and/or change groundwater levels in the study area. A manual containing a more detailed technical description can be found in Omtzigt (2005).

The tool distinguishes five types of land use (woodland, wetlands, open water, agriculture and recreation) and four types of water regimes. The type of water regime determines, to a large extent, the suitability for certain land use types. For instance, agriculture in the area is more productive on land with low water tables, and the lower the water table, the higher the productivity. The water regimes distinguished here are:

1. Deep groundwater levels ('low'): groundwater levels are kept low in areas outside the nature reserves in order to suit agriculture. Groundwater levels fluctuate between 60 to 40 cm below soil surface.
2. Intermediate water levels ('middle'): groundwater levels are raised (40 to 20 cm below soil surface) which is unfavourable for agriculture but better suited for nature conservation and decreases the rates at which land subsidence occurs.
3. Dynamic water management ('high'): groundwater levels fluctuate with rainfall and river discharges (between 40 cm above and 20 cm below soil surface). This decreases the water loss from wetlands therewith improving water quality in nature areas. It also reduces the need for pumping and drainage capacity (a more self-sufficient water system).
4. Surface water. Lakes, rivers, streams and areas that are permanently inundated.

The main components of the tool are matrices containing value scores of stakeholders, and a grid map with the current land use and water management situation. Each stakeholder provides values for each combination of land use and water management in the matrix, according to their stakeholder perspective. Users themselves assign values (between 0 and 1) to combinations of land-use and water levels in the area. Different stakeholder groups can use the tool. If there are three groups using the tool, three value matrices have to be completed. The tool projects these values on the grid map of the current situation to create three valuation grid maps (one value map of each stakeholder group) and a total score (also for each stakeholder) as an indicator for how the area currently is being valued by each of the three groups.

The next step is the development of plans for the study area. These plans are designed by each of the stakeholder groups individually and digitised on screen. Under the 'valuation' menu, users can select 'change land-use'; 'change water management' or 'change land-use and water management'. After selecting one of the options, the cursor can be moved to a location on the map and the area to be changed can be selected by clicking on the map. After finishing an area a pop-up menu asks the user to define the new land-use and new water management regime in the selected area. Next, a new area can be selected to be added to the plan or the menu can be closed to complete a plan. This plan is evaluated with the same value matrix.

The two-step evaluation, schematised in Figure 6.3, results in two sets of three value maps, a table and a diagram of summarised values of the current situation compared to the new plan for the three stakeholders. These maps, tables and diagrams can be compared to check whether the new plan is an improvement for the stakeholder groups. The second step can be iterated towards an optimal plan that will have the support of all three stakeholder groups. To take more parameters into account, the results can be analysed further in a multi-criteria analyses tool, as in chapter 5.

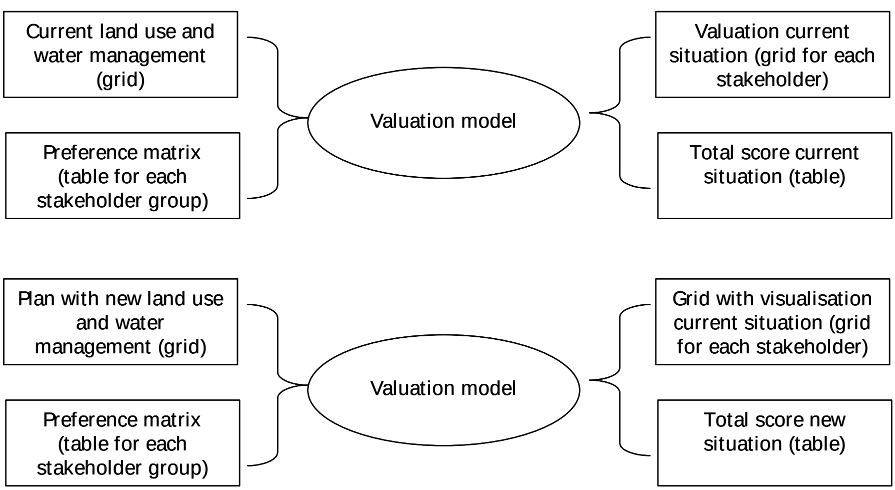

Figure 6.3 The 2-step evaluation procedure to compare newly developed plans with the current situation. The output is a valuation map and a total value score of the plans.

The input data for a calculation session is a table (value matrix) and a grid map of land use and water management. The grid contains the current combination of land use and water management in the area, or of the new plan. To each cell in the grid, the tool assigns the value from the matrix for the combination of land use and water management found in that cell. The result is a grid with basic values, between 0 and 1. Next, for each cell the averaged value of its neighbouring cells is calculated. For example, a single cell with good agricultural qualities has a lower value when situated in the middle of a nature area with high groundwater levels, and the same cell will receive a higher value for agriculture when it is part of an agricultural area. So the surrounding of a cell determines the value assigned to that cell. The mean value of the neighbouring cells is stored in a grid with mean surrounding values. The basic value grid and the surrounding values grid are combined to a final grid. This grid shows the value of each cell as a non-standardised score. The cell values of this grid are summarised, and written to the values table. In this table, the values are also stored standardised, so the results of the different stakeholders or different plans can be compared with each other.

Basic components

When the tool's project file is opened in ArcView, the interface should look familiar. Beside the common ArcView tools and menus, there is one extra menu (Figure 6.4). This menu, “Calculate Value”, contains the different steps of the tool. First, a start value for the current situation can be calculated. Then a plan is designed, and the new situation evaluated in the same way as the current situation.

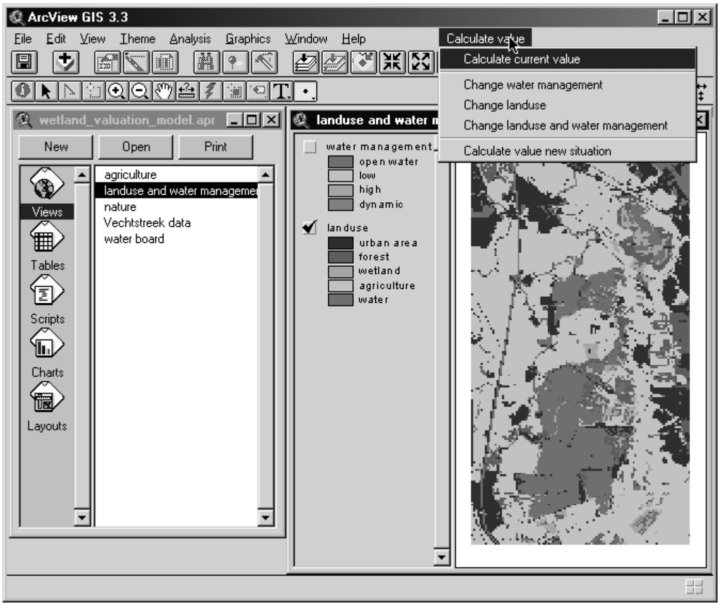

Figure 6.4 The user interface of the interactive design tool.

The basic view, called “Land use and water management”, is open. It shows two themes, one with the land use in the study area, and one with the water management. The land use types are simplified and aggregated in 5 classes: agriculture, wetland, woodland, water and urban areas. The water management types are low, high, dynamic, and open water. Both themes are based on the same grid, this is the basic grid used for the calculations of the current situation.

In the Project Window, the user can manage the different ArcView objects of the tool. There are Views, Tables and charts defined. The valuation grids are visible in the three stakeholder Views: “agriculture”, “nature” and “water board”. This facilitates the comparison between old and new situation, as well as among the three stakeholders. There is one View, called “Vechtstreek data” with extra data for the study area (soil map, digital elevation model, detailed land use map and topography); this can be useful when designing a new plan. The View with land use and water management information is open when the Project file is opened, and needed for the calculation of current and new values, and the digitising of new plans.

There are four tables in the Project: three matrices, and a 'Values' table. The matrices contain the value scores (value tables) of the three stakeholder groups. Stakeholders must edit the values in these matrices, so that they correspond with their own view on the area. Values in the matrix range from 0 to 1, and can have one decimal place. The values in the matrix do not have to be unique. Also, the sum of the values does not have to match 1. The matrices have to be edited before starting the calculations from the menu. The first calculation after editing the matrices is always the calculation of the current value.

After the calculations, the table Values contains the summarised values for the current situation, and the new situation. The scores are also standardised, to be able to compare the results for the different stakeholders, and the current and new situation. In this standardisation, the start values are set to 100.

The functions found in the tool menu are:

- Calculate current value
- Change water management
- Change land use
- Change land use and water management
- Calculate value new situation

Calculating the current value creates three value grids in the 'Results' directory. These grids contain the value of the current situation according to the preference tables.

A plan can be composed in three ways: changing only land use, changing only the water management regime, or changing both the land use and the water regime. In this step, the tool needs input from the user. First, it asks for the name of the new plan. This name will appear in data set names. Depending on the type of plan, the user will be asked to digitise one or more areas, and to select the land use type and / or the water management type (Figure 6.5) for these areas.

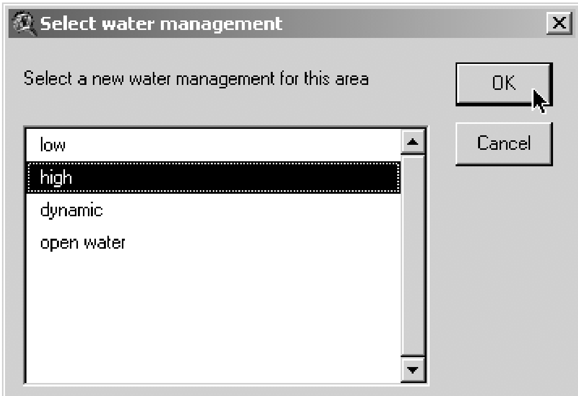

Figure 6.5 Pop-up window asking the user to make select a type of water management regime in the selected area.

After adding an area to the plan, the tool will ask (via a pop-up window) whether the user wishes to add another area. When the user adds another area, the questions for land use, water management and adding a new area will repeat. When the user has finished the input for the new plan, the tool creates a grid with the land use and water management in the new situation in the View "Land use and water management".

Clicking on the item 'Calculate value new situation' will run the 2-step calculation on the grid with the new land use and water management (Figure 6.3). The weighted results are returned as a chart that appears on the screen. The valuation maps for both the current and new situation can be found in the three Stakeholder Views. Per View, they have a standardised legend, so the old and new situation can be compared with each other. All the output is written to one directory. This makes it easy to save results, so that they are not overwritten by later calculations.

The tool is a very much a simplification of the real-life situation. A shortcoming is that the design tool evaluates the study area with a certain combination of land use and water management. Aspects such as accessibility, aesthetics or costs are not taken into account. However, in combination with the use of multi-criteria analysis these other aspects can be evaluated, but to date only a limited number of criteria are incorporated (see Figure 6.6). The tool also does not check whether a proposed change of land use and water management is realistically feasible. It is, for example, possible to flood a town and make it a lake. This item could partly, but not totally, be solved by building extra checks into the tool.

6.5 Workshop set-up

The main task to be completed during the workshop is to jointly develop a plan for implementation of spatial water management in the Vecht area. The boundary conditions are specified by a higher government, in this case the provincial government (a role played by the course leaders). Participants are divided into stakeholder groups and with the use of the support tools they are given the assignment to develop the spatial plan for the Vecht. This plan has to solve a number of issues in the Vecht and is bounded to a number of conditions, defined by the province (course leaders) which are described below. The workshop imitates a platform decision making process, in which stakeholders jointly attempt to develop solutions to a given problem. The workshop contains three steps:

- Identification (includes problem definition and identification of preferences);
- Design and evaluation (includes the development of sectoral plans and a first screening of the impacts of these plans)
- Negotiation and choice.

In the first step participants are asked to study the problem. The province defines the problem and sets the boundary conditions for the final plan. The participants of the workshop will first identify their position and preferences as a stakeholder in the area: what is important for your position in the area? Which types of land use and which water levels are preferable from your own point of few? In the second step, the individual groups develop plans for the area, from their own perspectives. These plans will obviously aim to benefit individual stakeholder interests. However, the groups will realise that claiming too much, will probably not be supported by the other groups. Creating a plan that has great negative impacts on another stakeholder will not foster the relationship, whilst claiming too little might leave a group empty-handed in the end. The groups need to think about a negotiation strategy before developing a plan.

In the third and final step, the groups negotiate with the other groups in order to reach a compromise. It is clearly stated in the assignment that the groups do not necessarily have to reach a compromise, however if no compromise is reached, the Province will force it's own plan upon the stakeholders in the area. This plan might not take full notice of every group's interests. The goals of the province are given in the assignment:

The province will grant projects that help to solve issues in the Vecht area. The province wants to solve the following issues:

- Land must be allocated for horizontal storage of water. The discharge capacity of rivers and canals and pumping stations is not sufficient to cope with excessive water in wet periods.
- The quality of wetlands must be improved. The Vecht area is very important for many bird and plant species and at the moment the water quality in nature areas is increasingly becoming a problem. The seepage flow of (clean) water from the wetlands to adjacent polders must be minimized.
- Agriculture is important for the region's economy and landscape. However, agriculture is in some areas responsible for some of the issues with water quality and quantity. There are funds available for moving farms to other locations.

Stakeholder groups

The participants are divided into three groups of stakeholder representatives: Agriculture (farmers representatives), Nature (representatives of nature conservation groups) and Water management (representing the local water authority). Each group has it's own view on how land and water should be managed (Table 6.1).

Table 6.1 The three stakeholder groups identified in the workshops and their interests.

Agriculture
During the last century agriculture has been the main economic activity in the Vecht area. In terms of land use this still holds true, although the best opportunities for agriculture are concentrated in the north-western and southern parts of the area. In the central parts of the plain, where nature predominates, the number of full-time working farmers is small, and their future is under threat. Agriculture requires relatively low water levels. If the pastures are too wet at the start of the growing season (spring) machines (or cattle) cannot access the land. Also the location (concentration of agricultural areas is better then isolated pastures) and size of farms is important (small farms have lesser opportunities).
Nature
Roughly there are three types of landscapes in the Vecht. There are valuable wetlands and lakes (like lake Naardermeer) that are important for birdlife and many plant species. Polders, lower lying areas mainly in agricultural use, often surround these lakes. These polders offer under certain circumstances habitats for meadow birds. This requires a somewhat higher water level and extra efforts by the farmers such as mowing around the nests of birds. Thirdly, in the Eastern parts of the area lies the ice-pushed ridge, which is largely forested and has a sandy soil. Water naturally flows from the hill-ridge to the lower lying areas and is filtered by the sand and therefore of good quality.
Water management
The main goals of the water management authority are to guarantee safety against floods, to minimize damage from floods or draughts, to minimize land subsidence (lowering of the surface due to peat shrinking) and to improve water quality. Possible solutions for a number of the problems in the area are to assign areas for storage of water. These areas have the capacity to absorb water in times of flood danger and they can also serve as sources of water in times of draught.

Step 1: "Identification"

To familiarise with the area and to foster understanding about the issues a fieldtrip is organised and maps and background information are discussed and discuss within the groups. The groups identify relevant aspects of land use and water that are important for their stakeholder group. The results of the group discussion are being summarised in a value table. This table expresses values assigned to combinations of land use and water levels by each of the groups. This value table is used in the interactive design

GIS tool. The values of the groups are fed into the GIS to produce value-maps of each of the groups. The values assigned in the matrix are linked to grid-cells in the GIS map of the area. For instance, a group prefers woodlands with a high water level. The group assigns a value of 0.9 to a combination of land use 'Woodland' and water management 'High'. The GIS reads the value matrix and assigns a score of 0.9 to grid-cells consisting of 'Woodland' and water management 'High'. By doing this for each grid-cell in the map, the value maps are constructed. Next, the GIS screens all neighbouring cells of a grid-cell and increases the value of a cell when the neighbour cell has a high value. In this way, areas that are large and connected receive a higher value.

There are four predefined water level regimes, which of course is a simplification. A low water table suggests water levels that are permanently more then –70 cm below surface level. A high water table suggests water levels rising to -20 cm; a dynamic water level suggests levels to follow the seasonal fluctuation (wet in winter, dry in summer) and surface waters are areas permanently inundated.

The groups begin by assigning the best possible combination with a value '1', next they determine the worst possible combination and give the this a value of '0'. Values of the other combinations are discussed in the groups. An example of a value table is given in Table 6.2.

Table 6.2 Example of a value table of a stakeholder group with value-scores assigned to combinations of water regime and land use. The alternatives (low, high and dynamic) only apply to groundwater and not to surface water. Surface water therefore receives a separate score.

	Low water table	High water table	Dynamic water levels	Surface water
Wetlands	0.2	0.2	0.2	-
Woodland	0.2	0.0	0.0	-
Surface water	-	-	-	0.2
Agriculture	1.0	0.6	0.2	-

Step 2: Design and investigation of conflicts and compromises

In this phase stakeholders will try to translate objectives into management alternatives. In the process of defining possible solutions the stakeholder will take into account the possible impacts on the other parties. The design of a plan is a strategic exercise and usually is a cyclic activity. After designing a plan it can be evaluated. Based on this evaluation one might want to make a better plan. The goal is to support such a cyclic process by offering different sources of information and tools to assist in making a better plan.

First the value maps containing the values of all the groups are studied. Plans are being developed by changing land-use and/or water levels. In making the plan, the groups take notice of the value maps of the other groups. Groups may consider claiming only areas that are less important to the other groups.

Next, the groups perform a (relatively simple) impact assessment of plans using an excel spreadsheet. This sheet has been prepared to make quick calculations of impacts of plan alternatives. The spreadsheet calculates 1) the changes in the total value of the area for the different groups, 2) the changes in agricultural production, 3) the expected changes in biodiversity and 4) the contribution to water storage. From the GIS the students have to obtain information on the number of grids with any combination of land-use and water regime. The number of grids in each category has to be filled in an input sheet (Figure 6.6). Changes in agricultural production are calculated based on production data on different soil types with various water regimes (Van der Ploeg et al., 2001). Changes in species diversity are based on standard lists of numbers of target species (Bal et al., 2002). Water storage capacity is calculated simply by assuming an average height of the water table over a given area. Costs for land acquisition are calculated on the basis of average prices of agricultural land in the area in 2004 (www.cbs.nl). After completion of the input sheet (Figure 6.6) the results of the assessment are presented in an impact table (Table 6.3). This impact table gives the users a first indication of the pro's and con's of the developed alternatives.

The assessment of impacts is obviously simplified and not very precise. However, for the purpose of the workshop exercises it is believed to provide sufficient insight. The output gives the groups a quick indication of how the other groups might respond to developed plans.

Agricultural production		
current situation		
	low water	high water
grids on clay soils	0	0
grids on peat soils	0	0
plan team 1		
	low water	high water
grids on clay soils	0	0
grids on peat soils	0	0
plan team 2		
	low water	high water
grids on clay soils	0	0
grids on peat soils	0	0
plan team 3		
	low water	high water
grids on clay soils	0	0
grids on peat soils	0	0

Species diversity				
current situation				
	low water	high water	dynamic	surface water
agriculture	0	0	0	
wetlands	0	0	0	
forest	0	0	0	
surface water				0
plan team 1				
	low water	high water	dynamic	surface water
agriculture	0	0	0	
wetlands	0	0	0	
forest	0	0	0	
surface water				0
plan team 2				
	low water	high water	dynamic	surface water
agriculture	0	0	0	
wetlands	0	0	0	
forest	0	0	0	
surface water				0
plan team 3				
	low water	high water	dynamic	surface water
agriculture	0	0	0	
wetlands	0	0	0	
forest	0	0	0	
surface water				0

Water storage				
	current situation	*plan team 1*	*plan team 2*	*plan team 3*
area dynamic water	0	0	0	0
area high water level	0	0	0	0
area surface water	0	0	0	0

Land acquisition				
	current situation	*plan team 1*	*plan team 2*	*plan team 3*
# gridcells changed	0	0	0	0

Figure 6.6 The input sheet used to calculate impacts of plans on agricultural production, species diversity, water storage capacity and costs of land acquisition. Users need to fill in the shaded cells (number of grids on different soil types, number of grids in different land use and water categories, the total area dynamic, high and surface water and the total number of grids that have changed in the alternatives). This information is obtained in ArcView.

The results of the impact assessment may give rise to an alteration of preliminary plans. After a number of iterations, the groups develop a final plan.

Table 6.3 The impact table presenting the impacts of alternatives after completion of the input table.

	C/B	Unit	Current	Agriculture plan	Nature plan	Water plan
Preference score agriculture	B	index				
Agricultural production	B	€/ha/yr				
Preference score nature	B	index				
Vegetation species diversity	B	index				
Bird species diversity	B	index				
Preference score water	B	index				
Total water storage capacity	B	cubic metres				
Costs of land acquisition	C	€/ha				

Step 3: “Negotiation and choice”

On the final day of the workshop each group gives a presentation of its plan to the other groups. In this presentation the groups try to convince the other stakeholder groups of the benefits of their plan.

After the presentations the groups start the negotiations. Elements of the different plans can be combined and each of the parties tries to satisfy as many of their own goals, at the same time attempting to solve the water issues in the Vecht area. The final compromise plan (if one is reached) is presented to the Province official (a role played by one of the course leaders) for approval.

Box 6.1: The SIRO-MED approach

An interesting example of a similar support effort with a similar purpose is the SIRO-MED approach for land allocation developed at the division of Wildlife and Ecology in Australia's Commonwealth Scientific and Industrial Research Organization (CSIRO) (Cocks et al., 1995; Cocks and Ive, 1996). In this approach stakeholders provide allocation guidelines, which are essentially statements about which land uses should be allocated to various classes of mapping units. There are different types of guidelines. Commitment(/exclusion) guidelines state that the final plan must always (/never) include some particular allocation, for example always exclude logging activities from very steep land. Preference (/avoidance) guidelines would like to see certain activities allocated/(not be allocated), but it might not be fully possible due to conflicting interests with other stakeholders. The land use, which is selected in the allocation plan, is the one with the highest suitability score. This land use best satisfies the most important guidelines. The stakeholders express the weighting of guidelines. A land-value map for a stakeholder group shows the relative value that it places upon each mapping unit in the area when it is used for their preferred use. Given the land-value maps, a conflict indicator map can be constructed by mapping the numerical difference between land values of two stakeholders for each cell where the preferred use differs. Even the SIRO-MED method, which was aimed to be simple and easy to use, has proven to be very time-consuming and expensive. Application of the method in a real-time spatial planning process will take at least a year and several million dollars (Cocks and Ive, 1996). The number of derived stakeholder guidelines (up to 250 different rules) and maps (2500) illustrate how these methods tend to become complex. A relatively successful application of the SIRO-MED approach is described in Abel et al. (2002) who applied the approach during a 5 year project for the rangelands of New South Wales in Australia.

6.6 Discussion

The tools described in this chapter have explicitly been developed to support a process of interactive design with a focus on creating values and identifying objectives and preferences, following the lessons from chapter 5. The support tools have been designed to contribute to three platform activities as outlined by Steins et al. (2000); 1) fostering understanding about the resource base; 2) minimisation of social dilemmas associated with collective resource use; and 3) implementation and fine-tuning of action strategies with respect to perceived problems. The tools are highly interactive, user-friendly and simple (only a short explanation and a small manual of the tool is required), transparent and flexible (all values are assigned by the users themselves, plans can be developed and changed interactively and evaluation of the performance of plans occurs instantly). Supporting spatial water policy requires a move from traditionally top-down analytical approaches towards more bottom-up interactive participatory approaches. Such interactive decision support tools applied at the local level involving local stakeholders should pay special attention to being user-friendly, transparant, simple and flexible (Bacon et al., 2002). Moreover, the application of the spatial multi-criteria approach for the Wormer- and Jisperveld (chapter 5) reinforced this importance of user-friendliness, transparency, simplicity and flexibility.

7. Application and testing of the support tool for local spatial water policy implementation

7.1 Introduction

The approach developed in chapter 6 has been applied and tested in a number of workshops with student groups (groups of 15 to 45 students) and post-graduates working in different areas (government, water authorities, consultants). A total of six workshops with different audiences were held in the period 2002-2005 (Table 7.1). Two workshops were held in the context of the Master programme Environmental Resource Management and four within the post-doctoral UNIGIS educational programme. The workshops have been used to test and improve the tools and to obtain some indication of their potential benefits (Goosen et al., 2006). The response from the participants and the outcomes of the workshops (in terms of the sophistication of the final plan) provide some indication of the tool's benefits.

During the workshops the participants worked in groups representing different stakeholder interests. With the use of the support tools they were given the assignment to develop solutions for the water problems in the Vecht area. In the workshops organised thus far the number of stakeholder groups have been limited to three, however this can be extended to include a larger number of stakeholders. Workshops went through three stages: 1) identification; 2) development and analysis of plan alternatives; 3) negotiation and choice.

7.2 Summary of the workshop results

Although the workshops are different every time, some general findings can be abstracted. On average each group contained 5 to 6 students, but in the larger workshop (with sometimes 46 students) the groups ran parallel sessions.

Table 7.1 Workshops held in which the approach of chapter 6 was applied.

Workshop	Number of participants	Type of audience
2002 UNIGIS	11	Post-graduates*
2003 UNIGIS	7	Post-graduates*
2003 ERM	46	Students Master of Environmental Management
2004 UNIGIS	10	Post-graduates*
2004 ERM	41	Students Master of Environmental Management
2005 UNIGIS	21	Post-graduates*

* = mostly employees of governmental agencies

Step 1: Identification

On the first day of each workshop the participants visit the study area and are informed about the different functions and how they are performed in the area. After the field trip and studying the background material, the groups develop a value map representing their perspectives on the area. To provide some initial guidance, a small number of interviews with stakeholders in the area were conducted to identify the most important objectives and preferences. Scores were assigned to combinations of land use and water levels, from the perspectives of the three stakeholder groups. For instance, farmers were asked to assign a score (between 0 and 1) for combinations of land use type ‘agricultural grassland’ and ‘periodical flooding’, ‘grassland’ and ‘no flooding’ and so on. Representatives of the nature and recreation groups were asked to do the same. These values were incorporated in the GIS tools as default values. Students discussed these default values and stated their preferences regarding land use and the preferred water regime from their perspective as representing the stakeholder group, and the default values were changed accordingly. The value matrices of the student groups of the most recent UNIGIS 2005 workshop are presented in Table 7.2.

Table 7.2: Preferred land use and water regime of the three stakeholder groups in the UNIGIS 2005 session. A value of 0 refers to the least preferred land use, and a value of 1 refers to a most preferred land use.

Agriculture group	Low water table	High water table	Dynamic water table	Surface water
woodland	0.2	0.0	0.1	0.0
wetland	0.2	0.0	0.2	0.0
water	0.0	0.0	0.0	0.1
agriculture	1.0	0.3	0.4	0.0
Water group				
woodland	0.3	0.5	0.6	0.0
wetland	0.3	0.9	1.0	0.0
water	0.0	0.0	0.0	0.8
agriculture	0.0	0.5	0.6	0.0
Nature group				
woodland	0.4	0.8	0.7	0.0
wetland	0.0	1.0	0.5	0.0
water	0.0	0.0	0.0	1.0
agriculture	0.0	0.8	0.8	0.0

Table 7.2 shows only one example of a value matrix. When comparing the tables of the different sessions, there are of course many differences, but in general the agricultural groups are more critical to combinations of land use and water tables. The nature groups generally assign high values to wetlands, woodlands as well as surface water, whereas the farmer groups tend to only assign high values to agricultural grassland with a low water table.

The scores assigned by the stakeholder groups are used to develop *value maps*, displaying how the groups value the present situation. Value maps are created for each individual stakeholder group and an example is shown in Figure 7.1. The value map of a stakeholder group expresses the degree to which the preferences of the stakeholder are met. The map is constructed by evaluating a set of rules with the following general structure for each grid cell:

IF land use x AND conditions y THEN value z

The spatially explicit information can be aggregated into a stakeholder score for the whole region. This is done by adding up the values of all grid cells, and weighing all grid cells equally. This aggregated value enables a comparison of the consequences of plan alternatives from the perspective of the different stakeholder groups.

To calculate value maps, the preference values from the matrices above have been assigned to the grid map of the current situation (the grid map consisted of a land use map combined with a map containing information on water levels). The GIS corrects these values by screening the neighbourhood cells. If the cells in the neighbourhood of a grid cell have a high value on the same land use type, its value is increased. In this way a connected area will have a higher value than an isolated one of the same size. This better expressed the view of the stakeholders who preferred large interconnected areas rather than small scattered areas, as became clear during the preparatory research and interviews. Each group produces these value maps to demonstrate the importance of certain areas within the Vecht region, from its own perspectives (Figure 7.1).

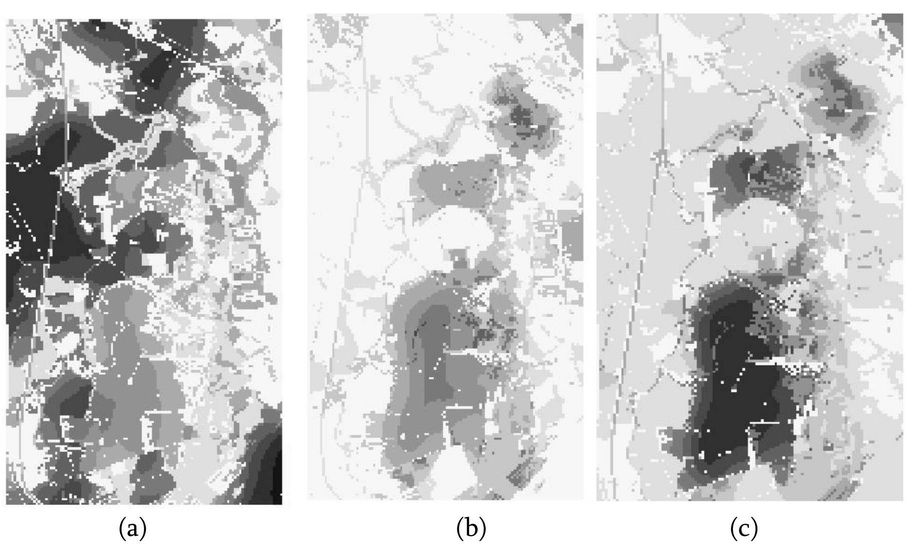

Figure 7.1 Value maps of the agriculture (a), the nature (b) and the water (c) groups, which are a spatial representation of the value matrices of table 7.1. The darker the shading, the higher the value of the area according to the stakeholder group.

In each of the workshops, the participants have translated their values with regard to combinations of land use and preferred ground water regimes into standardized scores between 0 and 1. As a final check, the value maps were inspected whether preferences match the spatial patterns shown in the maps. In some cases, the values were changed to represent the importance of certain areas better.

Step 2: Development of alternative land use plans

Next, the groups develop plans for the area from their own perspective. While drawing up these plans, value maps of the other groups (representing other stakeholder preferences) are used to check how others are potentially affected by the intended land use changes. By taking account of the expressed values of other stakeholders, it is expected that the level of conflict be reduced. The groups generally show very strategic behaviour. In the workshops held so far, the agriculture groups usually adopt a defensive strategy. Agriculture owns most of the land and is threatened by claims of land for nature, water and urbanization. Their strategy generally is to try to protect areas suitable for agriculture. The nature groups are generally more aggressive and claim areas suitable for nature development. An example of plans developed by the students, and the impacts they have on value maps is given in Figure 7.2. The figure shows where the increase in values concentrates for each of the stakeholder groups.

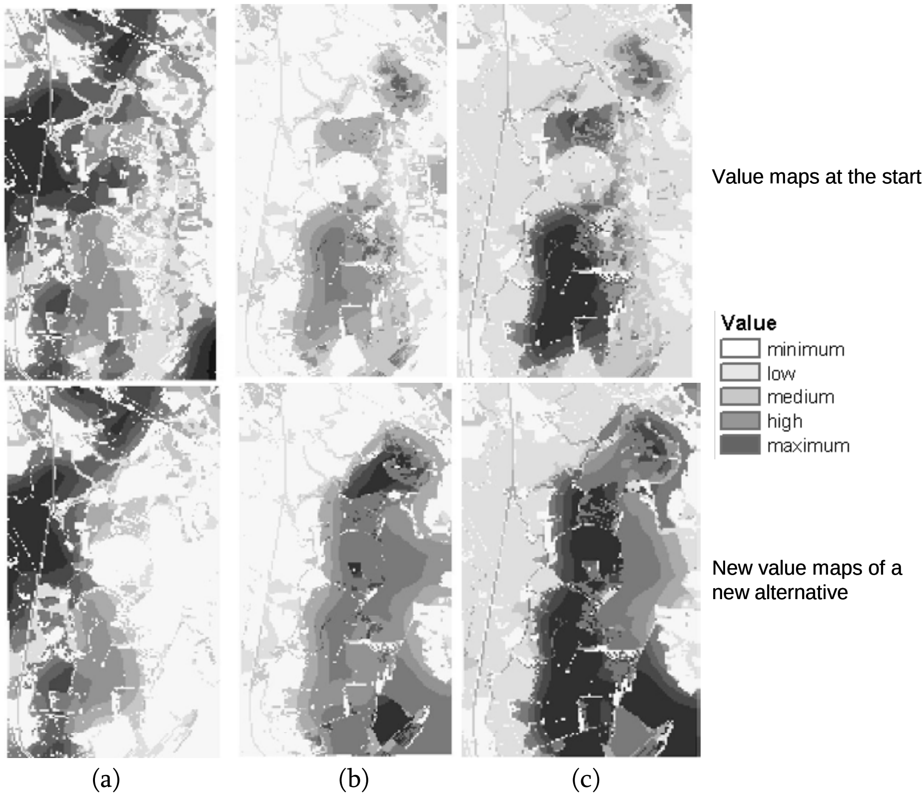

Figure 7.2 Value maps of three stakeholder groups, a) agriculture; b) nature; and c) water management before (top) and after (bottom) implementation of an alternative.

The changes in values are aggregated over the whole area and presented in a diagram (Figure 7.3). So for each new plan that is developed, the GIS tool generates new value maps that show where the changes occur, and aggregates the changes in values to a new score. The original and new values are presented in a diagram.

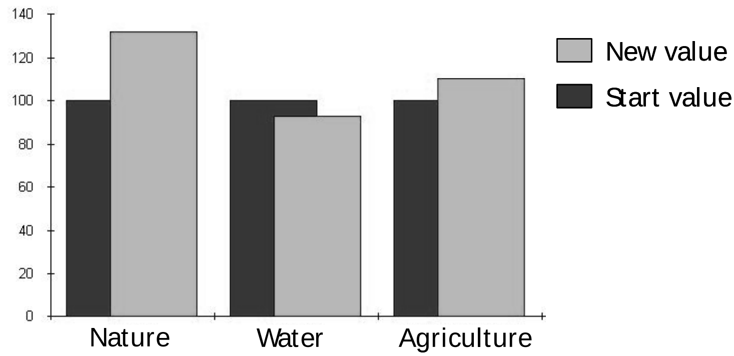

Figure 7.3 Diagram showing the relative changes in values for all groups. Start values are set at 100% and the green bars show the total value of a plan compared to the total value of the situation before that plan. The diagram clearly shows the winners and losers.

The impact table contains information on the impacts of an alternative. Impacts are calculated using a predefined calculation spreadsheet (Figure 6.6). In the example below, three different plans have been evaluated, developed by each of the individual stakeholder groups. Scores are calculated on the basis of fixed standard values.

Table 7.3 Impact table of three alternatives developed by the individual stakeholder groups.

	Unit	Current situation	farmplan1	natureplan1	waterplan1
Value score agriculture	Index	1519120	1652778	1117624	1318549
Agricultural production	Million €	96932	98179	68193	73467
Value score nature	Index	735026	723512	1217447	1123092
Vegetation species diversity	Index	274535	253334	396163	408213
Bird species diversity	Index	866227	876829	1144431	1153462
Value score water	Index	990824	956571	1490066	1394322
Total water storage capacity	M^3	4520500	4142000	7712500	6694000
Costs of land acquisition	Million €	40	53	150	125

A ranking of the performance of alternatives is difficult to obtain from such an impact table. Therefore the impact table is analysed using multi-criteria analysis software (DEFINITE software) (Janssen et al., 2001). The participants can study the multi-criteria analysis outputs and experiment with different weighing sets.

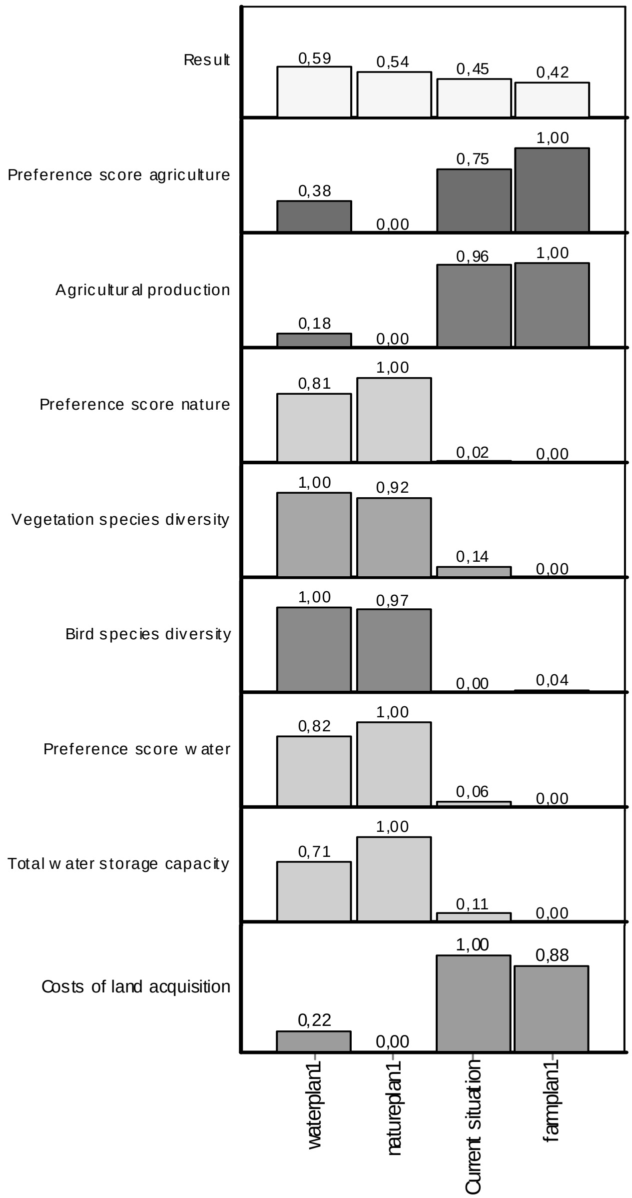

Figure 7.4 Output of the multi-criteria analysis of three alternatives. This output was generated using equal weights for all criteria.

For each group a map is constructed demonstrating the location and magnitude of the gains and losses (conflict maps). These maps represent the differences in value between the value map of the current situation (the situation without any change) and the value map of a new land use alternative (Figure 7.5). To demonstrate the potential severity of the conflict, the maps are combined in such a way that they highlight the areas where high potential losses for one group overlaps with the high benefits of the other. In these 'hotspot' areas there is a high stake or interest for changing the conditions whilst other groups are threatened by these changes.

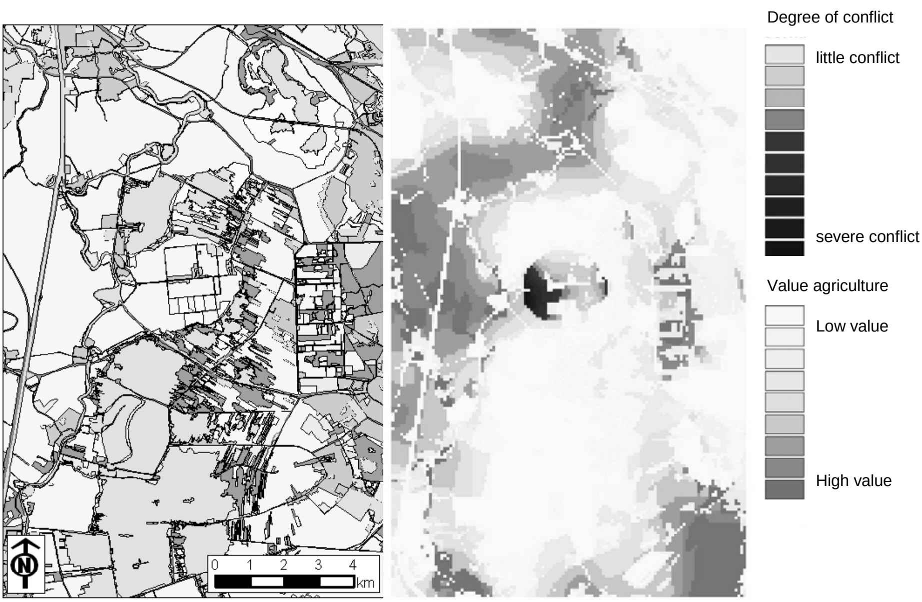

Figure 7.5 Example of a conflict map showing the degree of conflict in certain areas where changes are planned. The map on the left shows the topography of the area, the map on the right combines the value map of the stakeholder and the level of conflict with another stakeholder.

The conflict map shows that, for a particular plan (in this case a nature group's plan), a high level of conflict can be expected in the areas bordering existing valuable agricultural land. It also shows that some parts of the plan area are likely to cause heavy conflicts while other parts might be up for negotiation, as the drop in value for, in this case, agriculture is not extremely severe. Groups use the conflict maps to stress the severity of the potential losses and use them in their claims of other areas or to try and persuade others to change their plans. In this way the conflict maps provide a useful tool in negotiations.

Potential conflicts and compromises can thus be analysed using different sources of information, notably the value maps (Figure 7.2), the impact table (Table 7.3), the multi-criteria analysis results (Figure 7.4) or the conflict maps Figure 7.5).

Step 4: Negotiation of possible compromises

In this final step, the groups discuss each other's plans and attempt to reach a consensus on a compromise plan. In each of the workshops held so far, the groups succeeded in finding a compromise alternative that combined aspects of the individual plans formulated in step 2 when the individual groups develop 'single-perspective' plans.

7.3 Evaluation and discussion of the support tool

A question remaining is whether the use of the tool helped the students to reach consensus, and whether they would have reached consensus if the tool had not been used. An obvious limitation is the use of students as subjects for the analysis of the tools. However, since the stakes are high for the actual stakeholders, experimentation with a new tool might have unintended consequences in real world situations. It was therefore decided to apply the tools with less emotionally involved participants to test the procedures, and the technical and organizational aspects of the tools. Based on these experiments we can draw some conclusions on the potential usefulness of the tools, but not on the actual effectiveness in practice. To measure the effectiveness of the approach is methodologically difficult and we would have to separate the impact of the tools applied from the impact of the workshop itself (see also section 4.3 for a discussion on testing effectiveness of decision support tools). Evaluation of the impact of the tools would require multiple experiments with control groups not using the tool.

The approach described here has been applied in experimental settings with students and in 2004 a survey was undertaken to ask the participants of the workshop about the different tools and methods they had been exposed to. After each day of the three-day workshop the students were asked to fill in a questionnaire form. The response rates were 89% on day 1, 57% on both day 2 and day 3. The students were asked what sources of information influenced the development of their plans (on a five point scale). From Figure 7.6 it can be seen that especially on the first day, the students relied on the information provided by the workshop leaders. The other sources of information were considered less useful on the first day. On the second day of the workshop during the design and evaluation of plans, the students mainly used the value maps, impact tables and information from the course leaders. Note that discussion between the different groups was limited and that the multi-criteria output was considered less important than the value maps and the information from the course leaders. On the final day, during negotiations, discussions with the other teams were of main importance. Value maps were also used in the negotiations, and only few students found the impact tables and value matrices useful.

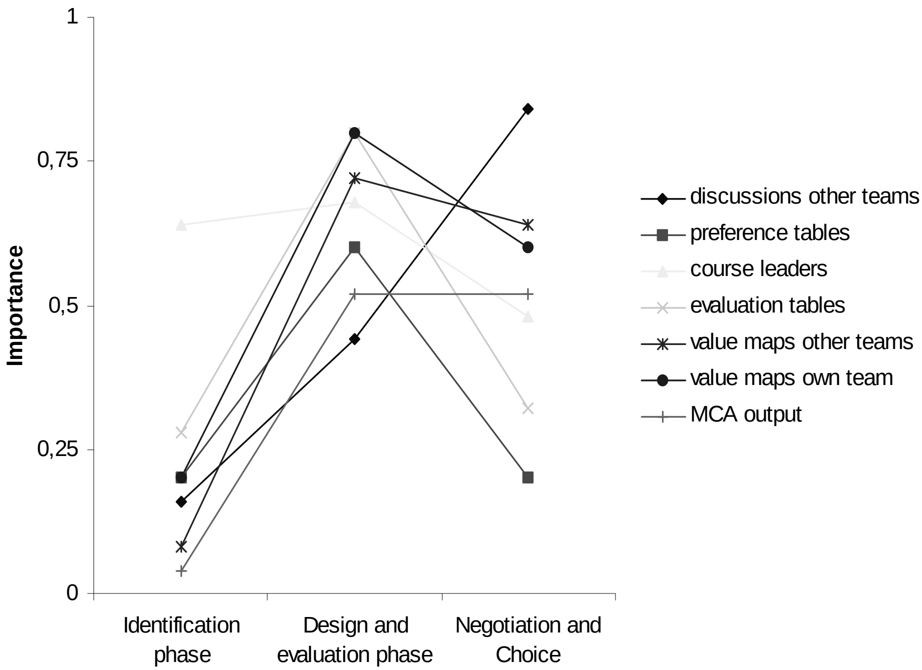

Figure 7.6 The importance of different sources of information according to the students during the three days of the workshop (identification, day 1 (n=41); design and evaluation, day 2(n=26); negotiation and choice, day 3 (n=26)). Scores were given on a 5 point scale and the figure shows the average score of all respondents.

Different sources of information were used in different phases of the exercise. Interaction with other groups increased as the workshop progressed. More quantitative sources of information became relevant during the design and evaluation phase, but were not regarded to be very important in the final negotiation phase. When asked about the overall usefulness of the tools offered, the value maps were most frequently judged as being very useful (Figure 7.7).

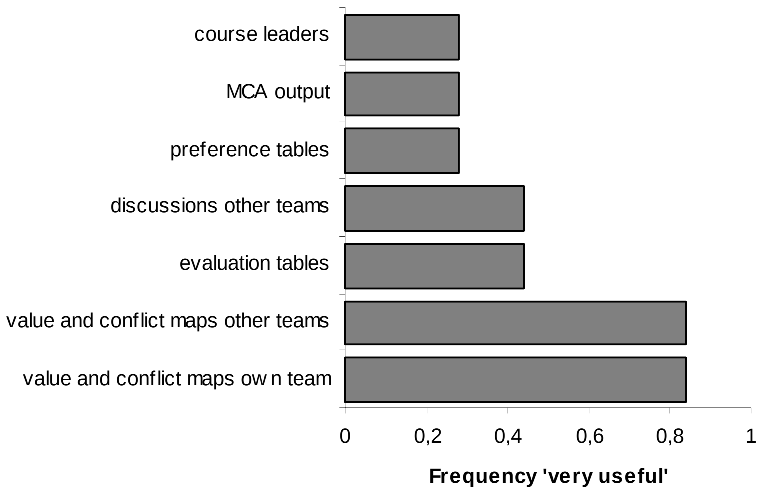

Figure 7.7 Overall usefulness of the different sources of information according to the students after completing the workshop (n=26).

A possible explanation for the difference in usefulness is that the output of the multi-criteria is more difficult to understand. The students found the value maps easier to understand than the multi-criteria analysis results (Table 7.4).

Table 7.4 Response of the students on the question of whether they understood the value maps and the multi-criteria analysis results.

Easy to understand?	The value maps	The multi-criteria analysis output
Yes	69 %	48 %
No	15 %	28 %
Don't know	16 %	24 %

Whether or not the students had understood the value maps and the multi-criteria analysis results was not only asked, but also checked. About 70% of the students that had stated to understand the value maps gave the right answer to a small exercise with a value map. Only 42 % of the students that had stated to understand the multi-criteria results gave the right answer to an exercise on multi-criteria analysis.

After the first and second day the students were asked with which of the other groups they anticipated to reach agreement and with which groups they expected to run into conflict. Figure 7.8 shows the weighted frequency of the answers of the students. The figure shows that each group was expected to encounter conflicts, but that almost every student expected heavy conflicts with the agricultural team. After the second day of the workshop, this expected level of conflict was considerably lower.

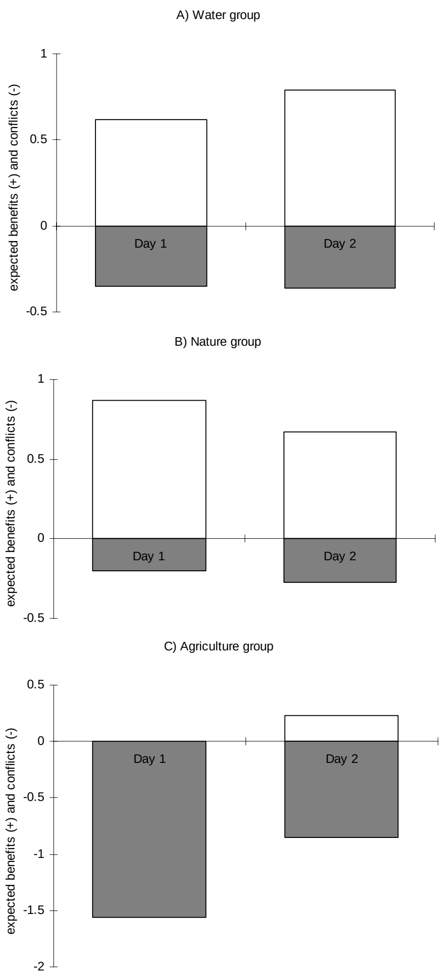

Figure 7.8 Expected conflicts and compromises after day 1 and day 2 of the workshop. Possible answers were severe conflict (-2), some conflict (-1), indifferent (0), some mutual benefits (+1) and many mutual benefits (+2). The figure shows the weighted frequency of the answers.

Students were also asked if they were satisfied with the compromise and whether the plan met their expectations before the workshop (Table 7.5). The table shows that especially the nature and water groups got more than they expected. The farmers group was less satisfied.

Table 7.5 Expectation and satisfaction over the outcome of the workshops as indicated by the students after the final day of the workshop.

		Is your team satisfied with the outcome?	
	not quite	as expected	more than expected
nature		4	5
water		3	4
agriculture	2	6	1

The feedback from the students after completing the workshops suggests that they regarded the tools as being useful, especially the use of the conflict maps and value maps as means to communicate their goals and preferences. On the other hand they felt the tool lacked sufficient detail and there was a need for more quantitative data on other aspects of the plans. The tool seems to contribute to the understanding of the problem and supports discussion and interaction in designing preliminary plans. The tool stimulates a cooperative attitude, but this can also result in 'middle-of-the-road' solutions as extremes are being avoided. This is probably not so much a shortcoming of the tool but the consequence of interactive design by stakeholder groups. Another interesting outcome of the workshops was that the outcome showed many similarities with actual plans recently developed for the area. With only limited prior knowledge of the area and a simple tool as the one we used, we did not expect the outcomes to reach such a high level of sophistication. Still, this cannot simply be attributed to the use of the tool alone.

On one occasion (the workshop of 2003), some technical difficulties occurred with the computers, and the tool could not be used. The discussions were chaotic and the compromise that was reached was not very sophisticated and detailed. The students could not use the tool to analyze gains and losses and so were not aware of where their dissatisfaction lay. This incident offers anecdotal evidence of the role of the tool in offering a way to structure to the discussions.

Only few of the pitfalls for decision support development (see section 4.3, pg 78) were encountered during the experiments with the tools (Table 7.6). Although this again is no proof that the approach will work in real-life situations, it does strengthen our belief that simple tools such as the one presented here can offer support to platform-like decision making.

Table 7.6 Summary the pitfalls encountered in application of the support tools in the six workshops.

Potential pitfall	Encountered in the Vecht workshops
User-friendliness/ presentation of results	Tools are easy to use and results can easily be interpretated.
Simplicity/ over-complexity/transparency	To some extent. Some users found the tools too simplified. Some users found the MCA results difficult to understand.
Assumption of rationality	No, the tool uses preference scores expressed by the stakeholders themselves and the tool does not pretend to be objective and rational.
Practical value and urgency	
Lack of solid data and analysis	Some users identified a need for more quantitative data and analysis after completing the workshop.
Matching the original requirements and user-needs and timing them right	The tools can be useful in early phases of planning and decision making.
Flexibility	The tools are flexible. New alternatives can be developed and scores can easily be changed.
Reliability and confidence	The qualitative and simplified nature of the tool limits its reliability in real world situations.
Political and institutional barriers	

7.4 Conclusions

Application of tools to support participatory processes is not new, but various authors have reported disappointing experiences with the use of such tools (see section 4.3).

Here, we have applied a simple, flexible, easy to use and transparent tool for interactive design of alternatives. The tool is used in an interactive workshop setting, to simulate a platform approach to collaborative planning aimed towards generating potential compromise to a given problem. In the development process of the tool we used the lessons learned from the literature and from a first attempt, which has been described in chapter 5.

The interactive design tool has been used in combination with multi-criteria analysis, aimed at stimulating discussion and interactive planning design as an extension to more traditional decision support approaches often aimed at a ranking existing alternatives. Confidence that the approach is promising is based on the results of six workshops where the tools have been applied and tested. The tool improves insight in preferences of the parties involved and forces stakeholders to think in terms of seeking consensus and opportunities rather than being defensive and uncooperative. The illustrative maps that were derived during the workshops show interesting spatial patterns of compromises and conflicts, and provide insights for possible win-win solutions with a high level of sophistication. Only in one of the workshops did the participants not reach a compromise but this could have various reasons. The tools did not work properly due to some computer problems, and the workshop set-up was different due to the large number of participants. The results of a questionnaire undertaken in 2004 show that especially the value maps and conflict maps were considered useful tools in the planning exercise.

Besides the tool's benefits, the users brought forward a number of shortcomings. The tool is simplified and uses the input from the users themselves (value statements). After completing the workshop participants felt a need for more quantitative information on the performance of developed alternatives. The general feeling was that in a follow-up, alternatives should be further specified and there was a need for more insight into the costs and benefits. Application of the tool should therefore only aim at early phases in the decision making process where the tool may help to improve the communication and cooperation among stakeholders.

In a real life situation it is likely that there are stronger winners and losers, which would give rise to heavier conflicts. But the platform-like setting and the use of flexible mediation and negotiation tools could help overcome a situation of deadlock.

The concept of regional water platforms supported by simple mediation and negotiation tools therefore seems promising. This was postulated from literature in chapter 4, and now received empirical support from realistic exercises with the tool developed.

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8. Conclusions

Implementation of spatial water policy requires both technical and political knowledge and skills. Given the threats of climate change and a continuing economic development, spatial water policy implementation appears as one of the major challenges in the coming decades for the Netherlands. Critical constraints or bottlenecks for a successful implementation of spatial water policy have been identified leading to an overview of interrelated and often context-specific conditions for successful implementation. A good institutional organisation stands out as the prime factor. Stakeholder involvement ranks second and is almost always mentioned as a negative condition if not implemented properly. A sense of urgency is the third important condition. The various conditions can be grouped into process-related conditions (institutional organisation and communication and stakeholder involvement), content-related conditions (shared knowledge and a sense of urgency), and financial-legal conditions (legal framework and finances). Ideally, each of the conditions is to be met, but in practice this will hardly ever be the case.

Focusing on process-related conditions (which stands out as being of prime importance), spatial water policy requires both good *control* (top-down elements) as well as room for *participation* (bottom-up elements). From the literature on common-pool management, successful examples of sustainable management of common-pool resources through bottom-up self-organisation have been reported. However, because of 1) the heterogeneity of water resources; 2) the supra-local nature of water management issues, which offers a potential scale mismatch and 3) the variety of users, it is questioned whether a process of pure self-organisation can lead to sustainable management. For sustainable management of heterogeneous, cross-scale and multiply used common pool resources, some sort of facilitating organizational form appears useful. Platforms have been proposed for such resource use negotiations. Applied to spatial water policy, the platform concept combines elements of top-down control and bottom-up input of local knowledge and objectives. In a platform, multiple stakeholders are given the opportunity to jointly develop local solutions to supra-local problems. The platform has to be politically legitimised and acknowledged and an independent party should facilitate the platform to safeguard trust, objectivity and continuity. An analysis of 20 case studies in the Netherlands offers support for such a mixed top-down/bottom-up approach. Implementation was significantly more successful when such an approach was applied to the planning process.

An important aspect of organising participation is the provision of information in the participatory process to inform the stakeholders involved. Over the past years a great number of decision support systems have been developed, but generally these efforts have led to unfulfilled expectations. The impact of decision support on decision making processes has been rather unsatisfying from a developer's point of view. Support tools for spatial water policy should move away from their traditional technical focus to fully inform and legitimise top-down decisions, and move towards facilitating the exchange of bottom-up ideas, to stimulate dialogue for reaching common ground. The latter group of tools should pay special attention to being user-friendly, transparent, simple and flexible. Tools should also by their nature be integrative, interactive and spatial. Such tools have a role primarily as mediators in interactive processes but the requirements of the decision support tools need specification in each individual case. The framework presented in table 4.4 offers guidance, but it should be stressed that decision support development should be a demand-driven process.

In two case studies decision support tools have been developed and applied. For the first case study, multi-criteria analysis tools have been combined with GIS, to be used in a participatory process. This is a more traditional approach in the sense that it presents a ranking of alternatives. The outcomes are presented in a simple standardized way, accessible to users with little knowledge and expertise of the area. Users can select relevant decision criteria and discuss the relative importance of these criteria that can be translated into weights. The ranking of alternatives can then be evaluated under different weight sets. The tool can be used for rapid assessment and screening of the strengths and weaknesses of predefined alternatives. However, the tool cannot support the design and evaluation of new alternative.

In a second case study, a second tool has been developed. This tool supports interactive design and evaluation and can be used in platform-like planning and decision making processes. The interactive design tool has been applied in six three-day workshops.

The tools have proven to be interactive, user-friendly and simple (only a short explanation and a small manual of the tool is required), as well as transparent and flexible (all values are assigned by the users themselves, plans can be developed and changed interactively and evaluation of the performance of plans occurs instantly). Confidence that the approach is promising is based on the results of six workshops where the tools have been applied and tested. The tool improves insight in preferences of the parties involved and forces stakeholders to think in terms of seeking consensus and opportunities rather than being defensive and uncooperative. The illustrative maps that were derived during the six workshops show interesting spatial patterns of compromises and conflicts, and provide insights for possible win-win solutions with a high level of sophistication.

Tools for interactive design combined with tools for integrated spatial evaluation offer good opportunities to support participatory planning and decision making. The implementation of spatial water policy can benefit from the development and application of such tools.

Based on 1) the analysis of water management projects, 2) a review of empirical based theory of groups governing common pool resources, 3) a review of decision support literature, 4) application and testing of two decision support efforts in six workshops, this thesis concludes that regional multi-stakeholder water platforms supported by interactive, flexible and user-friendly tools, may contribute to meeting the challenge of implementing spatial water policy in helping to prevent a situation of deadlock. The approach strikes a balance between control over supra-local and long-term objectives on the one hand, and room for stakeholders in creating values and meeting local objectives. Interactive design tools combined with spatial multi-criteria analysis tools, such as presented in the final chapters of this thesis, could offer necessary support in such a complicated planning process and may well enhance implementation of spatial water policy that is presently considered to be slow.

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Summary

Introduction

The Netherlands is a highly populated and economically developed country where space has become a scarce commodity. Recent flood events and the increasing risk of flood occurrence due to climate change require a rethinking or reconsideration of flood protection and water management. After many decades of focus on 'vertical' water defence relying on dikes and pumps it is increasingly clear that 'horizontal' buffering of water has to play a more important role. Land is considered for the storage of water and for controlled flooding. To explore the implementation aspects of horizontal water management at the local level, the term 'spatial water management' is introduced. As the spatial component is becoming more important, water policy involves decisions that affect agriculture, infrastructure, safety, urbanisation, landscape and nature quality. Consequently water policy implementation affects and involves many new stakeholders as well as various governmental agencies that were not involved in flood protection and water management before. In this sense water policy has become politically complex, apart from the technical complexity of introducing a new way to deal with water.

Conditions for successful policy implementation

Implementation of national water policy goals at the local level appears to be a major struggle. In attempt to identify the critical conditions, an analysis of case studies has been performed. An inventory of water management projects resulted in a list of 100 projects, of which 20 have been analysed in more detail in attempt to highlight the critical conditions related to the local implementation of spatial water management policy. The twenty projects range from relatively simple and clear-cut problems to complex situations where both the political setting and the problem itself are complex.

The analysis shows that many recently started projects are in a situation of deadlock. So although the Dutch are advanced in their skills and knowledge of how to manage water, the implementation of spatial water policy projects appears to be wearisome. Organizational complexity and involvement of stakeholders are the most important

constraints, and at the same time the most important conditions for success when successfully dealt with. Technological problems and a lack of knowledge are less often mentioned as crucial factors in implementation of spatial water policy.

Decision processes

The key to local implementation of spatial water policy is to find a balance between top-down control and bottom-up collaborative planning. In situations without a mechanism of control or power and where different parties with opposing interests are involved, projects could run into a situation of deadlock. Stakeholders with conflicting interests may well be uncooperative and unwilling to participate. On the other hand, when control is too strong, stakeholders may attempt to block the decision making process and use their power to delay or hinder the process ('hindermacht'). Because of 1) the heterogeneity of water resources; 2) the supra-local nature of water management issues and 3) the variety of users, the style of decision making should be somewhere between good control and leaving room for active participation and co-production. Lessons from sustainable management of heterogeneous, cross-scale and multiply used common pool resources show that some sort of facilitating, separate organizational form is required. Platforms for resource use negotiations are proposed. Within top-down formulated boundary rules, the participants of the platform jointly develop initiatives and plan alternatives for the implementation of spatial water policy. Confidence that such an approach will work is based on indications from the literature on common-pool resource management and is supported by our analysis of the water management projects.

Decision support

The issues that the local platforms need to deal with are complex, because of the diversity of the subject and because of the number of different stakeholders and parties involved. Meaningful participation requires effective two-way communication between experts and laypeople that often find it difficult to understand each other. Decision support tools can contribute to efficient exchange of information between experts, stakeholders, decision makers and laypeople. It is then important for decision support systems to be accessible, transparent and credible to people who may be unfamiliar with computer technology. If properly developed, decision support systems have a great potential in the increasingly complex setting of water policy. However, the achievements of decision support systems are repeatedly being reported as modest.

Support tools for spatial water policy should take a less a technology-oriented focus and move towards facilitating the exchange of bottom-up ideas. Special attention should be paid to being user-friendly, transparent, simple and flexible. Tools should also by their nature be integrative, interactive and spatial. Such tools have a role primarily as mediators in interactive processes but the requirements of the decision support tools need specification in each individual case. A framework has been developed in chapter 4 to offer some guidance, but it should be stressed that decision support development should always be a demand-driven process.

Two different decision support tools to support spatial water policy have been developed and are elaborated in two case studies. The first tool, developed for the Wormer- and Jisperveld area, uses spatial multi-criteria analysis in a participatory context. The second tool, developed for the Vecht area focuses on interactive design and land use negotiation.

A tool for spatial multi-criteria analysis

A spatial multi-criteria approach is used to evaluate alternative management strategies for wetlands. Impacts of these alternatives are assessed on a number of criteria. Spatial evaluation techniques in combination with multi-criteria methods are used to support and communicate the evaluation results. The tools are flexible and suitable for use in an interactive setting. The developed tools seem capable of offering the intended type of support. Yet, the tools have to date not been used in the actual decision making process. The tools emphasize the trade-offs to be made and clearly show whom the winners and losers are. This might polarize the decision making process. Policy makers involved in the decision making process identified a need for less quantitative and more flexible 'design' tools.

A tool for interactive design

A second decision support tool that was developed for spatial water policy focused on interactive design and has been applied in the second case study. The tool for interactive design and land use negotiation aims to support an interactive design process among stakeholders in the Vecht region, a mixed wetland-agricultural area with high recreational values. The tool consists of maps of the land-use and groundwater levels in the area. The users express their preferences and the tool uses these to determine value maps. The tool enables users to change land use and/or change groundwater levels in the study area. The tool distinguishes 5 types of land use and three classes of groundwater regimes. In this study area the water regime determines to a large extent the suitability for certain land use types. The power of the tool seems to be its simplicity and the way in which it encourages discussion and interaction. The tool improves insight in preferences of the parties involved and forces stakeholders to think in terms of seeking consensus and opportunities rather than being defensive and uncooperative.

Testing of the support tool

The interactive design tool has been applied in six participatory workshops. The workshops were designed to meet the characteristics and typical tasks of platforms for collaborative planning. The tool is interactive, user-friendly and simple (only a short explanation and a small manual of the tool is required), transparent and flexible (all values are assigned by the users themselves, plans can be developed and changed interactively and evaluation of the performance of plans occurs instantly). The tool improves insight in preferences of other parties and forces stakeholders to think in terms of seeking consensus and opportunities rather than being defensive and uncooperative. The illustrative maps that were derived during the six workshops show interesting spatial patterns of compromises and conflicts, and provide insights for possible win-win solutions with a high level of sophistication.

Conclusions

An approach in which regional water platforms are established, supported by interactive, flexible and user-friendly mediation and negotiation tools, seems promising in meeting the challenge of creating a sustainable water system through local implementation of the principles of spatial water policy. The approach strikes a balance between control over supra-local and long-term objectives on the one hand, and leaving room for local stakeholders in creating values and meeting local objectives. The approach could help overcome a situation of deadlock. This conclusion is based on a review of empirical based theory of groups governing common pool resources, of which regional water management can be an example, but also based on our experiences with student exercises on complex water management and land use planning. Application of these tools should focus on preparatory phases of decision making. Focusing on preliminary phases prior to actual negotiations was observed to increase the chance of successful use of the tool. In the preliminary phase much can be gained from avoiding unnecessary conflicts and investigating potential compromises. As soon as the actual discussions and negotiations start, it is too late for that..

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Samenvatting

Introductie

Het waterbeheer in Nederland staat voor een belangrijke uitdaging. Watersystemen zijn in de loop der jaren steeds verder vastgelegd waardoor het zelfregulerend vermogen is afgenomen. Open ruimte is verder bebouwd waardoor grote gebieden kwetsbaarder zijn geworden voor veranderingen zoals zeespiegelstijging, veranderende neerslagpatronen en sterker wisselende rivierafvoer. Tegelijkertijd daalt de bodem. Het waterbeleid speelt op deze bedreigingen in door meer ruimte te scheppen voor het water. Dat is echter geen sinecure in ons dicht bevolkte en intensief gebruikte land waar ruimte schaars is.

Hoewel traditionele ingrepen de veiligheid ook in de volgende eeuw kunnen waarborgen, bijvoorbeeld door verdere dijkverhoging en vergroting van de maalcapaciteit, is het besef inmiddels toegenomen dat deze traditionele ‘verticale’ benadering op termijn geen aantrekkelijke noch duurzame weg is. Meer ruimte geven aan water en versterking van zelfregulerende systemen lijken dat wel. Deze nieuwe manier van waterbeheer waarbij de horizontale dimensie centraal staat en waarbij andere ruimtegebruikfuncties meegenomen dienen te worden in de planvorming wordt in dit proefschrift aangeduid met de term ‘ruimtelijk waterbeheer’.

Succes- en faalfactoren

Implementatie van het ruimtelijk waterbeheer op lokaal niveau verloopt moeizaam. Een inventarisatie van de praktijk van het waterbeheer heeft geleid tot een lijst van bijna 100 projecten. Uit de lijst zijn er twintig geselecteerd en nader bestudeerd om inzicht te krijgen in belangrijke succes- en faalfactoren die een rol kunnen spelen bij de praktische uitvoering van waterbeheerprojecten. Uit die analyse blijkt dat problemen ontstaan door gebrekkige organisatie, door het onvoldoende of niet op de juiste manier betrekken van actoren bij de planvorming, door een gebrek aan urgentie, door verkokerde financieringsstructuren en soms door ontoereikende technische kennis of een tekort schietend juridisch kader. Vooral de procesmatige aspecten worden van belang geacht, de technisch inhoudelijke kant wordt minder vaak genoemd als oorzaak van stroeve implementatie.

Sturing en organisatie van planprocessen

Om ruimte voor water gestalte te geven zou gekozen kunnen worden voor verschillende sturingsstijlen. Omdat: 1) water een zeer heterogene natuurlijke hulpbron is, 2) het karakter van waterproblemen het lokale niveau overstijgen (beleid wordt geformuleerd op het niveau van stroomgebieden, en 3) waterbeleid moet inspelen op de lange termijn, moet gezocht worden naar manieren om enerzijds betrokkenheid van lokale partijen te benutten, en anderzijds sturing te geven op bovenlokale en langetermijn doelstellingen. In de literatuur is gezocht naar manieren om een balans te vinden tussen participatie en sturing, waarbij 'the best of both' benut worden. Regionale waterplatforms worden geïntroduceerd als een manier om deze balans vorm te geven. In deze platforms zijn alle relevante belangengroeperingen vertegenwoordigd. Zelf moeten zij tot oplossingen komen voor problemen die het lokale niveau overstijgen. De hogere overheden kunnen weliswaar condities stellen, maar draaien verder niet actief mee in het overleg. Een statistische analyse van de eerder genoemde twintig waterprojecten laat zien dat projecten waarbij deze balans tussen top-down en bottom-up is gevonden, als succesvoller worden beoordeeld dan projecten die òf bottom-up òf top-down zijn benaderd.

Beslissingsondersteunende systemen

Beslissingsondersteunende systemen kunnen bijdragen aan kennisuitwisseling tussen wetenschappers, belanghebbenden, beleidsmakers en leken. We moeten echter pessimistisch zijn over het effect dat veel beslissingsondersteunende systemen hebben gehad op de uiteindelijke planvorming. Vooral in een context van participatieve planvorming is het van belang dat deze systemen toegankelijk, transparant, flexibel en geloofwaardig zijn voor mensen die niet zondermeer gewend zijn met dergelijke technologieën te werken. Grote, complexe, technisch-analytische geïntegreerde systemen werken vaak niet. Daarom is het de moeite waard om te experimenteren met simpele, lichte en flexibele toepassingen. In de hoofdstukken 5, 6 en 7 worden twee casussen beschreven waarin twee verschillende ondersteunende systemen zijn ontwikkeld.

Een instrument voor ruimtelijke multicriteria analyse

Het eerste instrument dat is ontwikkeld betreft een ruimtelijk multicriteria analyse systeem voor het Wormer en Jisperveld. Het instrument is gericht op het ontrafelen en in kaart brengen van de vele aspecten die een rol spelen bij het beheer van een veenweidegebied. Het instrument biedt inzicht in de effecten van beheersalternatieven op een reeks vaan beoordelingscriteria. Deze effecten worden bestudeerd aan de hand van kaarten en staafdiagrammen door gebruik te maken van multicriteria analyse. Doordat het instrument flexibel is kan het relatief eenvoudig worden aangepast aan de wensen van de gebruiker. Zo zijn de invoergegevens eenvoudig aan te passen en heeft de gebruiker de mogelijkheid om relevante criteria uit te lichten en niet relevante zaken weg te laten. Het instrument kan in een eerste onderhandelingsproces goed gebruikt worden om basisinzicht te krijgen in de afwegingen die later in het proces moeten worden gemaakt. Een potentiële eindgebruiker gaf echter aan vooral behoefte te hebben aan minder kwantitatieve instrumenten waar het accent meer ligt op interactief ontwerp dan op evaluatie van bestaande alternatieven.

Een instrument voor interactief ontwerpen

De tweede opzet speelt daarop in: een systeem voor interactief ontwerp, toegepast op de Vechtstreek. Het systeem maakt gebruik van een Geografisch Informatie Systeem dat is uitgebreid met een interactieve ontwerpfunctionaliteit. Gebruikers (stakeholders) bepalen hun waardering voor verschillend landgebruik in combinatie met het grondwater regime kunnen invoeren in het systeem. Van die waarderingen worden kaarten gemaakt die zichtbaar maken welke gebieden in welke mate worden gewaardeerd door de betreffende partij. Op plekken die hoog worden gewaardeerd door de ene partij maar waar ook veel winst valt te behalen voor een andere partij worden conflicten verwacht. Hoe groter deze verschillen, hoe groter het potentiële conflict. De kracht van het systeem ligt in de eenvoud: het is gemakkelijk te gebruiken en het is voor de gebruikers duidelijk wat het instrument doet.

Test en evaluatie van de ontwikkelde instrumenten

Het instrument bevordert inzicht in de preferenties van de verschillende partijen en het stimuleert een consensusgerichte benadering. Het instrument is tot op heden toegepast en getest in zes workshops met wisselende populaties doctoraal en postdoctoraal studenten. Uit een enquête onder workshop deelnemers blijkt dat vooral de waarderings- en conflictkaarten worden gebruikt en een handig hulpmiddel zijn bij het proces van gezamenlijk ontwerpen.

Conclusies

Het onderzoek concludeert dat een platformbenadering kansrijk is voor de implementatie van ruimtelijk waterbeleid. De platformbenadering vormt een balans tussen enerzijds controle over de bovenlokale en langetermijnbelangen en anderzijds de ruimte voor kennis, creativiteit en wensen van lokale partijen. Kennis wordt in deze platforms ingebracht en onderling uitgewisseld via relatief eenvoudige, flexibele en gebruiksvriendelijke instrumenten, waarvan voorbeelden zijn ontwikkeld en beschreven in dit proefschrift. Sterk kwantitatieve benaderingen en zware beslissingsondersteunende systemen hebben hier waarschijnlijk weinig te bieden.

10. Appendix I: List of water projects

Aakvlaai

- Zuid-Holland, omgeving Dordrecht
- Polder (150 ha) wordt uiterwaarden van de Maas door dijken door te steken en door kreken e.d. te graven. Het gebied wordt ingericht als natuurrecreatiegebied en zal waarschijnlijk 1 keer per jaar meestromen al onderdeel van het rivierbed. De dijken zijn medio 2001 doorgestoken en er wordt nu nog verder aan de inrichting van het gebied gewerkt. Het natte gedeelte wordt ingericht voor watersporters.
- Afronding praktische uitvoering
- Betrokkenen: LNV, SBB, Dienst Landelijk gebied, Rijkswaterstaat, Vereniging watersporters en gemeente Werkendam.
- Parels van vernieuwd waterbeheer

Afsluitdijk

- Plan fase (overleg met partijen)
- Combinatie van veiligheid (water buffering), visserij, natuur en recreatie
- Bron: Het Blauwe Goud verzilveren (Rathenau Instituut, 2000)

Amfibisch wonen

- Mogelijke concepten van amfibisch wonen, nog geen plannen om het werkelijk toe te gaan passen.
- http://www.amfibischwonen.nl/index2.html

Bakenhof

- Arnhem
- dijkverlegging, 200 m landinwaarts en natuurontwikkeling. Eerste echte project dat voortkomt uit “ruimte voor de rivieren” .
- Planfase, in 2002 wordt het uitgevoerd
- Betrokkenen: gemeenten Arnhem en Huissen, polderdistrict Betuwe en Rijkswaterstaat.
- http://www.polder-betuwe.nl/waterb2.htm

Beerse overlaat

- Den Bosch

- Herstel van de loop van de oude rivier. Boeren maken plaats voor natuurontwikkeling. Het gebied wordt ook zo ingericht dat het de oude functie van overstromingsvlakte weer terug krijgt. Kan bij nood geïnundeerd worden.
- Planfase.

Bethune polder

- Maarssen
- Plannen tot herinrichting van de polder (500 ha) tot een recreatie/natuurgebied. Natuurmonumenten gaat het beheren. De 15 boerenbedrijven moeten uit het gebied, de 50 bewoners mogen er blijven wonen. Het waterbedrijf mag kwelwater winnen, maar moet als tegenprestatie meebetalen aan de herinrichting. Begin 2002 moeten de plannen worden goedgekeurd en kan er begonnen worden met de uitvoering.
- Planfase
- http://bewonersmaarssen.tripod.com/uitdepers/un991208_1.html

Blauwe kamer

- Wageningen
- Uiterwaarden vaker laten overstromen door het graven van nevengeulen en het doorsteken van de zomerdijk. Het gebied kan voor waterberging gebruikt worden en er is natuurontwikkeling i.p.v. landbouw. Het gebied is 120 ha groot en was een pilotproject.
- Afgerond (1992)
- Betrokkenen: Rijk, provincies Utrecht en Gelderland, gemeente Wageningen en Rhenen en het WNF
- http://www.bartimeus.nl/ecoproject/html/i_blauw.html

Blauwe stad

- Oldambt
- Polder omvormen tot meer van 800 ha met eilanden. Op de eilanden komen woningen (1800) en natuurontwikkeling (350 ha). De plas gaat voor een verbinding zorgen voor de recreatievaart.
- Plan is goedgekeurd en wordt begonnen met aanbestedingen, nog planfase
- Betrokkenen: gemeentes Scheemda en Winschoten, provincie Groningen, LNV, VROM, waterschap Hunze en Aa’s.
- http://www.deblauwestad.nl
- http://odin.let.rug.nl/~kastud/CAS/projecten/blauw/blauw2.html

- http://www.volkskrant.nl/nieuws/nederland/1010646672407.html

Bossche broek

- Den Bosch
- Retentiepolder van 525 hectare die eens in de 150 jaar gebruikt moet worden. Kan open gezet worden door betonnen stuwen te verwijderen. Wordt voor landbouw gebruikt.
- Afgerond
- Parels van vernieuwd waterbeheer

Breda

- De oude haven en stadsgracht van Breda worden hersteld. In de jaren '60 zijn ze gedempt. Door ze te herstellen wordt het kwalitatief en kwantitatieve waterbeheer in de stad verbeterd. De gracht komt in verbinding met de Mark en deAa.
- Planfase, begin uitvoering 2002
- http://www.sev.nl/ipsv/project/stir99/99pro/genom/99418.htm?55,61

Breevenen

- Drente, Hunze dal
- Herstellen kwel en grondwaterstand, daarbij schraalland ontwikkelen en dankzij agrarisch medegebruik broed en voedselplaatsen voor weidevogels. Het gebied wordt eveneens geschikt voor recreatie. Het overschot aan grondwater wordt deels gewonnen voor drinkwater.
- Overgang plan naar uitvoering
- Initiator: stichting het Drentse landschap
- http://www.noorderbreedte.nl/artikel/99-4-5.htm (hier zijn meerdere artikelen)
- *http://www.pvda.nl/~aahunze/actualit/gebiedsgericht99.htm#3*

Bruisend Water

- Visie op waterbeheer en ruimtelijke ordening van de provincie Zuid Holland en de waterschappen in die provincie
- Overkoepelend kader waarbinnen projecten uitgevoerd worden
- http://www.pzh.nl/

De Rug

- Roosteren

- Natuurgebied van 180 ha dat ontwikkeld wordt met opbrengsten van waterwinning in het gebied Het gebied is eigendom van de waterleidingmaatschappij Limburg. Het vormt ook een verbinding tussen de Maas en het Maasplassen gebied.
- Afgerond
- http://www.arknature.nl/ark-gebied/noord-limburg/de-rug/index.asp

De Wieden

- Meppel
- Volgens het plan wordt een verbinding gegraven tussen het Meppelerdiep en een ander groot water. Deze verbinding moet voor doorstroming gaan zorgen bij hoge neerslag hoeveelheden, de waterkwaliteit moet verbeteren en de flora en fauna moet zich gaan ontwikkelen.
- Planfase.

Dinkel

- Oost Twente
- Beek krijgt oorspronkelijke vorm terug en zal weer vaker overstromen. Langs de rivier zal natuurontwikkeling en landbouw plaatsvinden. Het hele stroomgebied wordt aangepakt, dit houdt in dat Duitsland ook meewerkt. Om extreme waterhoeveelheden op te vangen wordt er een retentiegebied van 50 ha ingericht. Voor de landbouwers is er een compensatiesysteem opgezet voor waterschade. Boven Dinkel en Woolderbinnenbeek zijn onderliggende projectdelen.
- Praktische uitvoering
- inrichtings- en beheersvisie voor het Dinkeldal in het kader van het provinciaal programma met de naam Gebiedsgericht Beleid Noord-Oost Twente (GGB-NOT).
- Betrokkenen: waterschap Regge en Dinkel, gemeenten Losser en Denekamp, Tauw, SBB en LNV
- http://www.rioned.org/1999/zonder99.htm
- http://www.landwerk.nl/Artikelen/artikel-Dinkel.htm
- Waterschap Regge en Dinkel (2000). *Inundatieproblematiek Boven Dinkel*.

Dommel en Aa

- Zuiden van 's Hertogenbosch
- Natuurontwikkeling, grondwaterherstel en retentie in het stroomgebied van de Dommel en de Aa.
- Het streefbeeld voor het gebied is ontleend aan de plannen voor Groene Woud(Brabants landschap e.a., 2000), waarvan het oostelijk deel overeenkomt met

"Dommel en Aa", en de visie "Ruimte voor boeren, burgers en buitenlui" (Bureau Coördinaat, 2000).
- http://www.google.com/search?q=cache:KixLNwQPzP4:www.maaswerken.nl/upload/documenten/Samenvatting_text.pdf+%22Dommel+en+Aa%22+%2Bwater&hl=nl&lr=lang_nl

Drentse Aa

- Drente, ten zuidoosten van Assen
- Combinatie van een ROM en WCL project. Deze overlapten elkaar, besloten is ze beiden in een project te stoppen.
- Praktische uitvoering
- Betrokkenen: VROM, LNV, Provincie, gemeenten Vries, Anloo, Assen, Rolde Westerbork, Beilen, Waterschappen Meppelerdiep, Hunze en Aa, Zuiveringsschap Drenthe en SBB. De algemene coördinatie ligt bij de Provincie.
- Regionaal

Duursche Waarden

- Olst en Wijhe (Overijssel)
- Rivier verbreden en uitgraven zijarm en zomerdijk om oude rivier natuur te ontwikkelen. Dit was een pilot project van SBB om rivieren natuurlijker te maken. Oppervlak ca 112 ha. Afwisseling Ooibos en grasland.
- Afgerond (1989)
- Initiator: SBB
- http://www.waterland.net/overijssel/aw6.htm

Eiland van Dordt

- Zuid Holland
- Strategisch Groen project in combinatie met ruimte voor de rivier vergroting afvoercapaciteit Nieuwe Merwede
- Planfase
- nadere info Edith van Dam

Eschmarke

- Enschede
- Wadi’s in een woonwijk; afkoppelen en vasthouden regenwater
- Afgerond
- Initiator: Gemeente Enschede

Geestmerambachtplas

- Alkmaar
- Berging van water in en rond de stad samen met flexibel peilbeheer en natuurontwikkeling. Plan voortgekomen uit "spannend water"
- Planfase

Gelderse Poort

- Natuurontwikkeling in de uiterwaarden in combinatie met delfstoffenwinning, in Gelderland en deels in Duitsland.
- Deels uitgevoerd (Ooijpolder) en deels nog in uitvoering
- Initiatiefnemer: ministerie van LNV, uitgevoerd door de Provincie Gelderland.

Grensmaas

- Limburg, van Maastricht tot Roosteren (45km)
- Projecten die naast het verminderen van de hoogwateroverlast ook streven naar grootschalige natuurontwikkeling in combinatie met grindwinning en rivierverbreding.
- Planvorming/Uitvoerend
- Betrokkenen: LNV, Rijkswaterstaat en de Provincie Limburg
- http://www.demaaswerken.nl/

Grift

- Apeldoorn,
- Stadsbeek, herstel verbinding Grift en Koningsbeek, o.a. om hogere kwelafvoer van Veluwe op te vangen. 3.5 km gedempte beek herstellen in de stad. Tevens ontwikkeling natte ecologische verbindingszone en cultuurhistorische waarden. Verbeteren belevingswaarde stad en recreatief medegebruik.
- Praktische uitvoering
- Betrokkenen: gemeente Apeldoorn, Provincie Gelderland, Waterschap Veluwe
- Contactpersoon: Ir H. Rossingh (gemeente Apeldoorn)
- Bron: J.A. Klein en C. Kwakernaak of Alterra (2000), *Bekenland in beweging;handreiking voor een kwaliteitsimpuls*, Bennekom, Modern
- http://www.apeldoorn.nl/webmag/wk40_2001/03.htm

Groenblauwe Slinger

- Grote groenzone gericht op water, natuur en recreatie; regionaal plan

- Status: in streekplannen opgenomen, uitvoering blijkt lastig (geen geld, geen regie)
- MRG speelt rond Driemanspolder en Oude Leede
- Info: provincie ZH; hoogheemraadschap van Delfland (Marja Hilders)
- Info boeken Provincie Zuid-Holland

Groote Wielen

- ’s Hertogenbosch
- Een wijk van 335 ha aanleggen met gesloten watersysteem en een waterplas van 40 ha die geschikt is voor opvang extra water/
- Planvorming afgerond, begin uitvoering 2002
- Betrokkenen: gemeente Den Bosch, Rosmalen, waterschap Maaskant
- Initiator: Den Bosch
- http://www.grootewielen.nl/index2.htm

Hedwige polder

- Zeeland
- Polder langs Westerschelde die ontpolderd zou worden om verdieping Schelde te compenseren voor natuurontwikkeling en om hoogwaters op te vangen. Door grote tegenstand uit de gemeenschap is het plan in de ijskast gezet. Agrariërs en bewoners waren erg tegen. Relatie landbouw en bevolking enerzijds en overheid en natuurorganisaties anderzijds zijn ernstig bekoeld. Was een bottom-up benadering, alleen de keuzevrijheid was beperkt, het besluit was al genomen alleen de plaats kon nog bepaald worden. Voorbeeld van gebrek aan voorlichting en waarschijnlijk verkeerde manier van aanpak qua bevoegdheden burgers.
- Plan, in de ijskast
- Initiator: Rijkswaterstaat/Verkeer en waterstaat
- http://www.eur.nl/fsw/studenten/actor/1996nov/matmis.html

Heeswijkse Kampen

- Cuijk
- Woonwijk met ruimte voor water, staat in open verbinding met de Maas. Het opgezogen zand is als grondstof verkocht aan de industrie.
- Praktische uitvoering.
- Betrokkenen zijn gemeente Cuijk (initiator) en Ballast Nedam.
- http://www.wonenincuijk.nl/heeswijksekampen/heeswijksekampen.html

IJsselzone

- Gebied langs de IJssel van Wijhe tot Kampen
- Er wordt een samenhangende en breed gedragen regionale gebiedsvisie ontwikkeld, waarbij wordt gezocht naar vernieuwende concepten van meervoudig ruimtegebruik uitgaande van het behoud van de kwaliteiten van dit gebied en tevens het versterken daarvan. Dit heeft betrekking op recreatie, landbouw, water, vervoer, wonen en werken. Deze functies moeten ook gecombineerd worden.
- Planvorming
- Betrokkenen: ANWB, Habiforum, provincie Overijssel en Rabobank Zwolle
- http://www.zwolle.nl/cms/cms.nsf/V_LUSCW/aefb61426087e15941256a8f004bcbde!OpenDocument&TableRow=1.0#1.
- Dhr. drs. M.J. Kerstens , 038-4983315, e-mail: IJsselzone@Zwolle.nl

Integrale verkenning Benedenrivieren

- Verkennend onderzoek naar de opties voor herstel van natuurlijke dynamiek in rivieruiterwaarden in de benedenrivieren Lek, Merwede, Maas en Waal. Er is een kosten-baten analyse uitgevoerd naar de ecologische, sociaal maatschappelijke en economische effecten van verschillende alternatieven.
- Initiatiefnemer: Rijkswaterstaat

Kaliwaal

- Plan om stort van baggerspecie te combineren met afgraven van uiterwaarden en natuurontwikkeling.
- Wereld Natuur Fonds en de provincie Gelderland
- Er is veel verzet tegen dit plan: zie o.a: http://kaliwaal.novi.net/kaliwaalhtml/startpagina.htm

Landstad Deventer

- Deventer
- Ruimtelijke en sociaal economische integrale toekomstvisie (2020) voor Deventer en omgeving. Onderdelen van deze visie zijn de projecten Nieuwe netwerken en Zandwetering.
- http://www.prv-overijssel.nl/asp/index.asp?contents=http://www.prv-overijssel.nl/omgeving/landstad_deventer.html

Lateraalkanaal

- Limburg (nabij Roermond)

- Retentie, grondwaterherstel en natuurontwikkeling langs zijkanaal van de Maas, dit alles moet gefinancierd worden door grindwinning.
- Planfase/uitvoerend
- Betrokkenen: Provincie Limburg, gemeenten, Panheel groep.
- Initiator: Panheel groep
- www.demaaswerken.nl

Lent

- Nijmegen
- Onderdeel van de Waalsprong. Opvang kwel- en regenwater in 3 plassen rond nieuwe woonwijk. Dit water wordt gebruikt voor een grijswater systeem.
- http://www.sev.nl/ipsv/project/stir99/99pro/genom/99411.htm?54,42

Levende berging

- Plan/Visie met verzameling ideeën
- Ideeën om natuur, recreatie, wonen, drinkwater, delfstoffenwinning te combineren met meer ruimte voor waterberging in Noord Holland.
- Initiatiefnemer: Wereld Natuur Fonds; Hoogheemraadschap van Uitwaterende sluizen.
- Heeft aanleiding gegeven tot het project Waterberging en meervoudig ruimtegebruik in Noord Holland

Levende Rivieren

- Plan/Visie met verzameling ideeën
- Ideeën om natuur, recreatie, wonen, drinkwater, delfstoffenwinning te combineren met meer ruimte voor rivieren.
- Initiatiefnemer: Wereld Natuur Fonds
- Aantal voorbeeldprojecten is uitgevoerd: (Gelderse Poort, blauwe kamer)

Living with Floods

- Studie naar overstromingen in het rivierengebied
- Initiatiefnemer/uitvoerder: RIZA

Meegroeien met de Zee

- Plan/Visie met verzameling ideeën uit 1996
- Ideeën om natuur, recreatie, wonen, drinkwater, delfstoffenwinning te combineren met meer ruimte voor water.

- Initiatiefnemer: Wereld Natuur Fonds
- Aantal voorbeeldprojecten is uitgevoerd, maar met name voor het rivieren gebied

Meerstad
- Groningen (tussen dorpen Middelbert, Engelbert, Euvelgunne en Roodehaan)
- stad in een meer van 650 ha die als noodberging voor de Eemskanaal-Dollard boezem kan dienen en heeft ook een recreatieve functie.
- Planfase
- Initiator: stad Groningen
- http://www.archined.nl/news/0103/meerstad.html
- http://www.prvgron.nl/beleid/voordr/2001/vdr2001_012.htm

Meervoudig ruimtegebruik en waterberging in Noord Holland

- Onderzoeksproject met pilotprojecten: Bovenkerkerpolder, Zwaansbroek en de Geestmerambachtplas/Alkmaar-Noord (spannend water: waterberging en recreatie en stad); Saendelft (water en stad); Polder Zeevang en De Beemster (landbouw en water); Wieringerrandmeer, Wormer/Ilperveld en Bergermeer (natuur en waterberging).
- Landbouw; recreatie; natuur en stedelijke ontwikkeling en waterberging
- www.habiforum.nl

Meliepark
- Heusden
- Wonen en waterberging, ingegeven door actieve houding waterschap in de richting van gemeenten, deze haalden het waterschap vroeg bij plannen voor nieuwe woonwijken. Meeste projecten zijn afgerond, aantal lopen nog.
- Afgerond
- http://www.maaskant.nl/projecten_stedelijkwaterbeheer.htm

Moerasbos Hapert

- Nieuw moerasbos (11ha) in stroomgebied van de Beerze
- Aanpassing van de zuiveringsinstallatie in combinatie met aanleg van een zuiveringsmoeras, waterbuffering en recreatie
- Waterschap de Dommel
- Plan
- http://www.gtd.nl/actueel/moerasbos_hapert.htm

Nieuw Rotterdams Peil

- Visie op het mondingsgebied van de Rijn en de Maas, uitwerking van Meegroeien met de Zee voor dit estuarium. Uitgevoerde voorbeeldprojecten zijn: het Eiland van Brienenoord, de Landtong Rozenburg, Klein Profijt (Albrandswaard), het Kuipersveer (Puttershoek) en het Ruigeplaatbos bij Hoogvliet. De hoofdfunctie in deze projecten is natuur maar er is daarbij gezocht naar bondgenoten bij waterbeheerders, recreatie en delfstoffenwinning (bijvoorbeeld kleiwinning in uiterwaarden voor rivierverbreding en stadsvernieuwing bij Hoogvliet).
- http://www.wnf.nl/speer/nwnatuur/nrprap.htm

Nijeveense polder

- Omgeving Meppel
- Nieuwbouwwijk met waterberging in de wijk en in een meer in de polder.Daarnaast natuurontwikkeling en herstel van beken.Er is ook plaats voor landbouw in de polder.
- Planfase, onderdeel visie 2030
- Initiator: Meppel
- http://www.meppel.nl/info/structuurv/natuur.htm

Noordwaard

- Zuid Holland
- Natuurontwikkelingsproject (ontpoldering), dat op termijn in open verbinding komt met Nieuwe Merwede en zo voor waterstandsverlaging gaat zorgen.
- Praktische uitvoering
- nadere info Henk Jagt

Ooijpolder

- Nijmegen
- Landinrichting langs de Waal, agrariërs worden vervangen door natuur en water,
- afgerond

Oostburg

- Zeeland
- Gebieds- en uitvoeringsprogramma is opgesteld voor de inrichting van west Zeeuws Vlaanderen (2000-2001).
- Planfase
- http://www.pzc.nl/CDA/regioportal/1,2078,1612__540993_0,00.html

- http://www.duumpje.nl/gga/gga01pri.htm

Oude Leede

- Delft
- Pilotproject Groen blauwe slinger, herinrichting gebied met aandacht voor natuur, recreatie en duurzaam waterbeheer.
- 3 subprojecten in uitvoering, 5 in de planfase en 13 in de ideevormingsfase.
- Provincie Zuid-Holland (1999), *Bijlage Stad en land in balans* (p15 e.v.)

Overdiep

- Noord Brabant
- Retentie en landbouw in een polder langs de Bergse Maas.
- Planfase
- Betrokkenen: zlto, Waalwijk
- http://www.zlto.nl/reindex.htm?http://www.zlto.nl/thema's/water/overdiep.htm

Piekenhoef

- Berghem
- Stad en waterberging

Plan Ooievaar

- Hele rivierengebied
- Vernieuwende ideeën op het gebied van rivierbeheer, natuurbescherming en landschapsarchitectuur werden hierin gebundeld tot een krachtig ontwerp. Al snel werd duidelijk dat dit verhaal een enorme impact zou hebben op zowel de inrichting van het rivierengebied als op het denken binnen de Nederlandse natuurbescherming. Hieruit zijn pilotprojecten ontstaan zoals de Blauwe kamer en de Duurse waarden. Ook Maaswerken komen hier uit voort.
- Uitgevoerd
- http://www.arknature.nl/ark-plannen/rivier/rijntakken/ooievaar.asp
- Bruin, de, *et al.* (1987). *Ooievaar; De toekomst van het rivierengebied.* Arnhem, Stichting Gelderse Milieufederatie

Reeshof

- Tilburg
- Bij een te bouwen woonwijk (3000 woningen) wordt het stroomgebied van de Donge heringericht. De oude meanders worden hersteld en tevens worden er

overloopgebieden gecreëerd.Hier gaat natuurontwikkeling plaatsvinden en wordt een ecologische verbindingszone gemaakt.

- Praktische uitvoering (1996-2000)
- Betrokkenen: Gemeente Tilburg, het Brabants Landschap, waterschap de Dongestroom en de Tilburgse Waterleidingmaatschappij.
- Bekenland in Beweging (p65)

Regge

- Twente
- Natuurontwikkeling (HES), retentie en landbouw. Een structuurvisie die verder dient te worden ingevuld met concrete projecten.
- Planfase/uitvoerend
- www.waterpact.nl

Rijnstrangen

- Oosten Arnhem/Nijmegen bij Duiven
- Retentiegebied ingericht in oud rivierengebied waar landbouw gedeeltelijk vervangen wordt door natuurontwikkeling.
- Planfase, doorgerekend door het CPB
- Betrokkenen: Rijkswaterstaat,
- http://www.waterland.net/home.page/wd130.pdf

Romeinenweerd

- Venlo
- Herstel oorspronkelijke zandige oever met natuurlijke vegetatie na kleiwinning. In 1996 laatste winning en sindsdien wordt het gebied met rust gelaten.
- Afgerond

Rooseveltsingel

- Wageningen
- Idee voor herstel gedempte beek, is nu een brede weg. De watercirculatie zal verbeteren en de stadsgracht zal weer op natuurlijke wijze gevoed worden en in verbinding staan met retentiegebieden in Born. Het zelfreinigend vermogen van het watersysteem wordt versterkt en de verkeersveiligheid zal toenemen.. Het initiatief is van de bewoners zelf gekomen.
- Planfase. Na een hydrologisch haalbaarheidsonderzoek is het stil komen te liggen.
- http://www.sev.nl/ipsv/project/stir99/99pro/genom/99407.htm

Ruimte voor Rijntakken

- Verkennend onderzoek
- Rijkswaterstaat

Saendelft

- Noord Holland, Zaanstreek
- Berging in stedelijk gebied van Vinex-locatie. Berging, recreatie en natuurontwikkeling in de omliggende polders.
- Praktische uitvoering
- http://www.antenna.nl/kmz/ontwplan.htm

Smalwater

- Boxtel
- hermeandering rivier de Beerze en retentie. Tevens wordt er 45 ha natuur ontwikkeld
- praktische uitvoering
- betrokkenen: Provincie Noord-Brabant, Brabants landschap, Natuurmonumenten, gemeente Boxtel, Werkgroep Natuur- en Landschapsbeheer, waterschap Dommel en Dinst Landelijk Gebied.

Tungelroyse beek

- Limburg, Roermond
- Door de oude loop van de beek over 10 km te herstellen werd er gepoogd water vast te houden. Hiernaast vond ook natuurontwikkeling plaats. Helaas is het hoofddoel, de retentie van water door hermeandering mislukt (zie ook nieuwsbrief 6, herstel watersysteem Tungelrooyse beek), wel is er ruimte gecreëerd om ca 150.000 m^3 water te bergen en is de natuurontwikkeling gestart.
- Betrokkenen: SBB, waterschap en Zuiveringschap Limburg
- Contactpersoon: Mw. J. de Groot (043-3897875)
- Afgerond
- http://www.wpm.nl/2000/2000_01a.htm
- Inhoudelijke werkgroep Tungelroyse beek (2001). *Blauwdruk; een eigentijdse aanpak voor complexe multidisciplinaire projecten*. Drukkerij Schrijen-Lipertz, Voerendaal.

Tussenklappenpolder

- Groningen
- Calamiteitenberging in polder, is een keer voorgekomen toen het water erg hoog stond. Nu wordt er aan een plan gewerkt waarin alles wordt vastgelegd ook met schadevergoedingen.
- Planfase

Viermannekesbrug
- Boxtel
- Een 90 ha groot retentiegebied waarin natuurherstel wordt nagestreefd, dit gebied ligt in de EHS. Van origine landinrichtingsproject maar tijdens uitvoering aangepast voor waterdoelstelling.
- Afgerond (2000)
- Contactpersoon: mw. M. Martens, Dienst Landelijk gebied Noord-Brabant, 013-5950595
- DLG Noord-Brabant (2000), Uitkijken over oud en nieuw water, Ruilverkaveling viermannekesbrug. Ronaveld

Visie Hollandse kust

- Noord en Zuid Holland
- Proberen een integrale visie samen te stellen van de Hollandse kust, lopende tot 2050. In deze visie worden wonen, recreatie, waterwinning, natuur, landbouw, visserij, scheepvaart, industrie, transport energiewinning en kustverdediging.
- Planvorming
- http://www.kustvisie.nl/
- Bureau Bosch Slabbers (2000) Op koers? Analyse van 16 rapporten in relatie tot de nota ‘kust op koers’. Den Haag

Vorstengrafdonk

- Oss
- Een bedrijventerrein (100 ha) nabij Oss waar een wadisysteem wordt aangelegd en hemelwater wordt geïnfiltreerd.
- Planfase
- http://www.maaskant.nl/actueel/persberichten/010911vorstengrafdonk.htm

Waalsprong

- Nijmegen
- Woonwijk ten noorden van de Waal bij Nijmegen, 11.000 woningen. Worden 2 plassen van totaal 90 ha aangelegd waar re recreatie en natuurontwikkeling gaat plaatsvinden. De MER moet over gedaan worden, kan watertoets waarschijnlijk in huidige vorm niet doorstaan. Waarschijnlijk wordt in 2002 een dijk verlegd, waardoor het project weer gecontinueerd kan worden.

Walsen

- Marshoek-Hoonhorst (Zwolle)
- integraal waterproject, 2000 ha, wordt rekening gehouden met behoefte landbouw, waterwinning, bosbouw en natuur (40 ha) waar het gaat om grondwaterstand en grondwaterkwaliteit. In natte perioden wordt hier water vastgehouden om de overlast bij Zwolle te verminderen. Het project wordt mede gefinancierd door IRMA-programma. WMO gaat drinkwater winnen en koopt hier grond voor aan, DLG combineert dit gelijk met ruilverkaveling. Voor compensatie van het ontrokken grondwater wordt er Vechtwater geïnfiltreerd.
- Praktische uitvoering, in 2002 afgerond
- Betrokkenen: Dienst Landelijk Gebied, Waterleiding Maatschappij Overijssel, Waterschap Groot Salland, Provincie Overijssel, inwoners gebied
- Initiator: Waterleiding Maatschappij Overijssel
- http://www.wgs.nl/pagina/projecte/dalfsen/p_1.1.htm
- Dienst Landelijk gebied (2000). Integraal waterproject Dalfsen;Een natuurlijke ontwikkeling. Zwolle, Meindertsma

Waterlandgoed Enschede

- Pilotproject, experiment om de ‘technocratische benadering’ waarop we met water omgaan te overwinnen
- Planfase
- combinatie van wonen, recreatie, natuur en waterwinning
- Waterschap Regge en Dinkel, Waterleiding Maatschappij Overijssel
- http://www.wmo.nl/main_fullarticle.asp?ID=139

Winterswijk

- Landbouw en waterconservering en natuurwaarden Stortelersbeek als waterproject
- Info: Oskar de Kuijer

- Waterschap Rijn en IJssel.

Woolderbinnenbeek

- Hengelo
- Aanleggen retentievijvers naast de stad waar natuurontwikkeling bij plaats moet vinden en waar kan worden gerecreëerd, totaal oppervlak ca 60ha. Voorbeeldproject van de EU. Begonnen in 1993 (?) en de laatste 6 jaar zijn besteed aan het doorlopen van procedures)Inrichtingsplan en bestemmingsplan zijn parallel opgezet, alleen liep het inrichtingsplan anderhalf jaar voor het bestemmingsplan, zodat het I-plan kon worden meegenomen in de besluitvormingsprocedure van het B-plan. (Royal Haskoning (2001), *Bergen en afvoer van water in Fryslan*, Concept rapport)
- Praktische uitvoering
- http://www.wrd.nl/html/aanhetwerk/frame.php3?bekijken=4&id=10&sub=10
- Nieuwsbrief Woolderbinnenbeek, nr.1 oktober 2000

Woudse Polder

- Waterberging (calamiteiten) met verschillende gebiedsfuncties combineren
- Plan in voorbereiding, overleg gestart met partijen
- hoogheemraadschap van Delfland (Marja Hilders)

Water in het Natte Hart

- Onderzoek naar de mogelijkheden voor herstel van natuurlijk waterpeilverloop in het IJsselmeer incl. randmeren.
- Initiatief van Rijkswaterstaat

Woudmeer en Speketerspolder

- Waterberging en natuur
- Noord Holland
- Inmiddels uitgevoerd
- Info via Florrie de Pater (prov. NH)

Waterlandschap van de toekomst

- Prijsvraag
- Een aantal inzendingen richten zich specifiek op meervoudig ruimtegebruik en water, zoals bijvoorbeeld de Zuidplaspolder

- Manifestatie op 23 november

Water voor Ruimte

- Inzending WL/TUD/ICIS en IVM voor de Morgen de Ruimte Prijsvraag (Habiforum e.a.)
- http://www.water4ruimte.myweb.nl/

Zandmaas

- Limburg, van Roermond tot Den Bosch
- Hoogwaterbescherming, natuurontwikkeling en verbeteren scheepvaartroute. De project organisatie Maaswerken verzorgt de planvorming en uitvoering van deelprojecten.
- Betrokkenen: LNV, Rijkswaterstaat en de Provincie Limburg (vormen samen Maaswerken)
- Planfase/Uitvoerend
- http://www.demaaswerken.nl/invision/

Zanen Verstoep

- Natuurontwikkeling en rivierverruiming langs de Lek gecombineerd IRMA project;
- Praktische uitvoering
- Nadere informatie Piter Hiddema
- http://www.nvwk.nl/waardvogels/9901/zhl_actueel.html

Zeevangse Koggen

- Noord-Holland, omgeving Edam
- Multifunctionele berging in het Markermeer. Behoud gebiedseigen water voor inlaat in de zomer en opvang boezemwater uit de Schermerboezem. Nu alleen nog landbouw, maar er is tevens mogelijkheid tot ontwikkeling recreatie gebied.
- Planfase
- http://www.xs4all.nl/~glpurm/de_zeevangse_kogge.htm

11. Appendix II: questionnaire

Question form Workshop participants Day 1.

Student name: ….

Team Name: …..

1) How do you expect the other teams to react to your plan? Indicate in the table below what level of conflict/mutual benefits or agreement your team expects with the other teams. For instance if you are in the Nature team, then cross out one of the boxes under agriculture team and water team to indicate how you think they will respond to your plans. Leave open if you don't know.

	Nature team					Agriculture team					Water team				
Nature team						--	-	0	+	++	--	-	0	+	++
Agriculture team	--	-	0	+	++						--	-	0	+	++
Water team	--	-	0	+	++	--	-	0	+	++					

-- severe conflicts; - some conflict; 0 indifferent; + some agreement; ++ full agreement; leave open if you don't know

Do you think you will be able to reach agreement with the other teams (please tick one or more of the boxes if you think you will reach an agreement):

- ❑ The nature team
- ❑ The agriculture team
- ❑ The water team

How can you characterise your team's attitude (tick one or more of the boxes below):

- ❑ Cooperative
- ❑ Uncooperative
- ❑ Open to other plans
- ❑ Not open to other plans
- ❑ Protecting own interests
- ❑ Trying to combine own interests with those of others

- ❑ Don't know

Can you characterise how you expect the other team's attitude to be (tick one or more of the boxes below):

- ❑ Cooperative
- ❑ Uncooperative
- ❑ Open to other plans
- ❑ Not open to other plans
- ❑ Protecting own interests
- ❑ Trying to combine own interests with those of others
- ❑ Don't know

What kind of strategy will your team choose to follow (tick one of the boxes):

- ❑ Offensive
- ❑ Give and take
- ❑ Wait-and-see
- ❑ Defensive
- ❑ Don't know

Question form Day 2

Student name: ….

Team name: ….

Do you think you understand/comprehend the problem and the positions of the other teams better than you did yesterday?

- ❑ Yes
- ❑ No
- ❑ Don't know

If you indicated 'yes', can you indicate what helped you in better understanding the problem in the table below:

	No influence	Some influence	Substantial influence	Decisive influence	Don't know
Discussion with the other teams					
Preference tables of the other teams					
Discussions with the course leaders					
The evaluation table					
Value and conflict maps of the other teams					
Value and conflict maps of our own team					
DEFINITE results					

Did your team adjust the plan you developed yesterday? If you did, what were the changes and why did you perform them?

Do you think you would have made the same changes without the tools (GIS maps, the DEFINITE output and the evaluation table)?

- ❑ Yes
- ❑ No
- ❑ Don't know

If your team changed yesterdays plan can you indicate what sources of information influenced the changes made?

	No influence	Some influence	Substantial influence	Decisive influence	Don't know
Discussion with the other teams					
Preference tables of the other teams					
Discussions with the course leaders					
The evaluation table					
Value and conflict maps of the other teams					
Value and conflict maps of our own team					
DEFINITE results					

How do you expect the other parties will react to your team's new plan? Indicate in the table below what level of conflict/mutual benefits or agreement your team expects with the other teams.

	Nature team					Agriculture team					Water team				
Nature team						--	-	0	+	++	--	-	0	+	++
Agriculture team	--	-	0	+	++						--	-	0	+	++
Water team	--	-	0	+	++	--	-	0	+	++					

-- severe conflicts; - some conflict; 0 indifferent; + some agreement; ++ full agreement; leave open if you don't know

What kind of strategy will your team choose to follow in the negotiations tomorrow:

- ❑ offensive
- ❑ give-and-take
- ❑ wait-and-see
- ❑ defensive
- ❑ don’t know

Were the preference maps easy to understand?

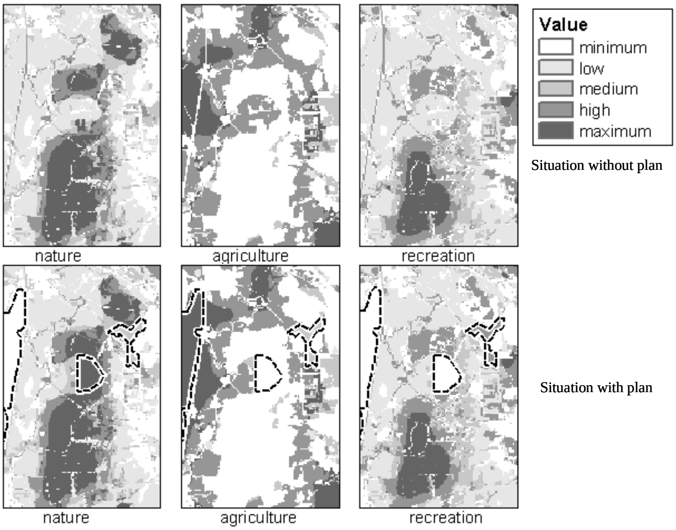
- ❑ Yes
- ❑ No
- ❑ Don’t know

Below are preference maps of three stakeholder teams (teams nature, agriculture and recreation). The maps at the top are for the situation before a plan was introduced, the maps at the bottom represent the new values for a plan.

Can you tell which team benefits most from the plan (the plan is indicated with the dashed lines in the preference maps at the bottom)?

Which team benefits most from the plan?
Nature

- ❑ Agriculture
- ❑ Recreation
- ❑ Don’t know



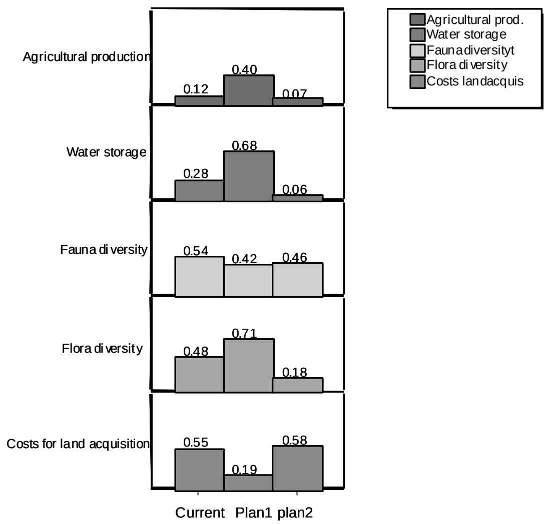
If you were the recreation team, which area would you claim if your aim were to avoid conflicts with the other two teams? Please draw an area in the maps above.

Were the DEFINITE results easy to understand?

- ❑ Yes
- ❑ No
- ❑ Don't know

Based on the figure below, can you indicate which plan is best?

- ❑ Current
- ❑ Plan 1
- ❑ Plan 2
- ❑ Don't know



Please explain your answer:

....

....

....

....

....

Question form day 3

Student name: …..

Team name: ……

How satisfied is your team with the outcome of the negotiations?

- ❑ Not satisfied
- ❑ Not quite what we had hoped for
- ❑ We got what we expected
- ❑ We got more than we expected
- ❑ Don't know

Do you think the people that your team represents will be happy with the outcomes?

- ❑ Yes
- ❑ No
- ❑ Don't know

What sources of information were useful in the negotiations and how did they influence the negotiation process?

	No influence	Some influence	Substantial influence	Decisive influence	Don't know
Discussion with the other teams					
Preference tables of the other teams					
Discussions with the course leaders					
The evaluation table					
Value and conflict maps of the other teams					
Value and conflict maps of our own team					

DEFINITE results					

How useful do you think the different sources of information are in the whole planning process?

	Not useful	Quite useful	Very useful	Don't know
Discussion with the other teams				
Preference tables of the other teams				
Discussions with the course leaders				
The evaluation table				
Value and conflict maps of the other teams				
Value and conflict maps of our own team				
DEFINITE results				

In which parts of the workshop were the different sources of information useful? Please mark in the cells below if you think a type of information was useful in that phase of the workshop.

	Identification (day 1)	Planning and evaluation (day 2)	Negotiation and choice (day 3)	Don't know
Discussion with the other teams				
Preference tables of the other teams				

Discussions with the course leaders				
The evaluation table				
Value and conflict maps of the other teams				
Value and conflict maps of our own team				
DEFINITE results				

What are to your personal opinion the most important benefits and shortcomings of the methods used?

……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………
…………………………………………………………………………

12. Curriculum Vitae

Hasse Goosen studied environmental sciences at the Free University of Amsterdam (MSc, 1995). For the past ten years, he has done research on water management, decision support, and the evaluation of nature at the IVM – the Institute for Environmental Studies. In addition he has served as the Secretary of the European Forum on Integrated Environmental Assessment (EC DG-XII). Goosen received his PhD from the Free University of Amsterdam in 2006 based on Spatial Water Management, which served as his dissertation. Goosen is a member of the board of the Dutch Society for Landscape Ecology Research and continues his work on support tools for participatory planning and decision making at the department for the Environment of the Province of South Holland.