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A simple mediation and negotiation support tool for water management in the Netherlands

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Abstract

When the stakes of stakeholders are not properly incorporated during early phases of a planning process, it may later give rise to severe conflicts. The issue of how to deal with stakeholders in regional water management has been a subject of ongoing debate in the Netherlands. This paper promotes a 'platform' approach where stakeholders collectively attempt to develop plans for regional water management. Ideas for this platform approach are based on a review of research on groups governing common-pool resources. We argue that simple negotiation and mediation support tools can offer useful support and can serve to facilitate platform negotiations. We present a simple mediation and negotiation tool to support the early phases of such a land use planning process. The tool translates stakeholder preferences on the use of the landscape into spatially explicit value maps. Proposed plans can be evaluated and potential conflicts can be identified. The use of such a tool enables stakeholders and mediators to formulate explicitly the problems that need to be addressed in the decision-making process.

Keywords: Regional water management; Mediation and negotiation support; Spatial conflicts; Platforms for collaborative planning; Participatory approaches; GIS; Decision support

1. Introduction

This article presents a GIS tool aimed at supporting interactive mediation processes water management. The main aim of the tool is to facilitate the communication and exchange of stakeholder knowledge and preferences in a complex planning process for water management. Application of GIS tools to support participatory processes is not new (Pahl-Wostl, 2005; Kwaku Kyem, 2004; Cain et al., 2003; Harris and Weiner, 1998; Harris et al., 1995), but various authors have reported disappointing experiences with the use of support tools (Kok and Wind, 2003; Uran and Janssen, 2003; Walker, 2002; Pereira and Quintana, 2002; McCrown, 2002, 2002; Cox, 1996; Lyytinen and

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Hirschheim, 1987). Tools should 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 (Walker, 2002).

Water management problems are no longer predominantly addressed as technical issues; they have become part of a complex policy process in which many different stakeholders and institutions are involved. In a sense, the management of water can be considered a common-pool resource management problem (Ostrom, 1990). The institutional arrangements in Dutch water management have changed over the past decade. There is a tendency towards open and interactive policy making. These changes in the nature of the water management problem require a more process-oriented and less data-driven approach in the development of decision support tools. In the development of a simple tool for the Vecht area we focused on facilitating communication, mediation and negotiation rather than on identifying 'best possible solutions'. Such simple negotiation support tools could improve the decision-making by improving the communication between stakeholders and policy makers, although testing the effectiveness of tools is a challenge. Ideally, one needs to perform a number of experiments with and without the developed tool in order to make statements on statistical significance of the effects. Practically, this is not likely to be possible. Therefore, it is even more important to relate the choices about the architecture of the negotiation tool to empirically based theory of groups governing common-pool resources, such as water management.

2. New developments in Dutch water management

For centuries, building dikes and developing drainage systems has been the main strategy for flood protection in the Netherlands. The hydrological system (rivers, coastal zones, lakes, streams and canals) has become strongly regulated but at the same time is still vulnerable to extreme events. Climate change poses new threats to the Dutch water management system. Together, the predicted increase in discharge of the large rivers, the higher frequency of peak precipitation and sea level rise increase the susceptibility to floods. A growing awareness of the severity of the problem has led to a shift in water management policy distinctly emphasising the lateral, spatial dimension. Water is to be stored 'horizontally', making use of natural processes and a natural capacity to adapt to and absorb extreme events. The focus has turned to natural resilience and adaptation rather than on technical control (Rathenau Institute, 2001; Commission on Water Management for the 21st Century, 2000; Helmer et al., 1996). The urgency of this shift was reinforced by the events of 1993, 1995 and 1998 when water in the large rivers Rhine and Meuse rose to extreme levels. The spatial approach in water management policy imposes larger claims on the land. Traditional measures could be taken in or directly along the rivers itself whereas measures according to the new water policy required more room for rivers and the reservation of retention areas or flood storage areas. The implementation of spatial water policy became no longer mostly a matter of the Ministry for Transport, Public Works and Water Management, but it involved land use decisions that affect agriculture, infrastructure, safety, housing, landscape and nature quality.

2.1. *Changes in institutional arrangements and approach to policy making*

The tragic flood of 1953 confronted the Dutch with the vulnerability of the land, and drastic measures were needed to prevent such a disaster from ever happening again. A very large-scale and ambitious plan, the Delta Plan, was developed which took decades to finalize. At this stage, water management became a very centralized, top-down process. A plan of the magnitude of the Delta Plan could never have been implemented by the local water authorities alone. The dilemma of the role of the central government in water management has been subject of ongoing debate in the Netherlands (Huitema et al., 2003; Wiering and Driessen, 2001; Verbeek and Wind, 2001). On the one hand, society today demands flood safety and the government is expected to take necessary measures. To do so, the government could speed-up decision-making processes through more centralized power. On the other hand, society demands careful integration of different priorities and local stakeholders want to be involved in the decision-making process. Wiering and Driessen (2001) evaluated how these divergent claims are honoured in dike reinforcement projects and conclude that especially in dike reinforcement projects, there were some interesting examples of integrative and participatory policy making. In these projects, there was a balanced combination of both strict, transparent guidelines (top-down) and room for participation and integrative policy-making. It seems that at the beginning of the 21st century, water management is searching for a balance between consensus building through stakeholder involvement in policy making, and taking effective measures to ensure flood safety and good water quality. The implementation of these space-demanding water measures has proven to be a difficult task (Goosen and Vellinga, 2004). Many stakeholders and institutions with different views and preferences are involved in the decision-making and to achieve a different water management regime in an area has become a very complicated process.

3. Water as a common-pool resource

Even though Dutch water control systems are not, strictly speaking, common-pool resources, the problems faced share quite similar characteristics (Kaijser, 2002). Water provides different functions for various actors, such as drinking water, waste treatment, natural conservation and recreation. Furthermore, the quantity of water can be too high (flooding) or too low (droughts). In fact, water is a heterogeneous resource, 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.

Common-pool resources are widely studied (Dietz et al., 2003; Ostrom, 1990). Traditionally, common-pool resources were linked to the inevitable tragedy of the commons, and recommended solutions were state control, or privatization. The current insight is that under certain conditions, cooperative solutions to the management of resources can be reached without state intervention or privatization (Ostrom, 1990).

Research on single-use common-pool resources provides the insight that communication helps to build up trust relationships and the likelihood for cooperative actions (Ostrom et al., 1994). The management of such resources becomes very complex and cooperative solutions cannot be reached through communication alone. A more formal structure is required to institutionalise the management arrangements. The concept of ‘platforms for resource use negotiation’ has been developed by the Communication and Innovation Studies Group at Wageningen University, The Netherlands (Röling and Wagenmakers, 1998). 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) minimization 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). Various authors have identified the need for an external agent or organization. Examples are an analysis of collective action in watershed management in Haiti (White and Runge, 1995), the study on collective action and the role of water management institutions in the United Kingdom (Hodge and McNally, 2000), and a study on the role of institutions in a number of Dutch case-studies (Huitema et al., 2003). Thus, the nature of the common-pool resource problem suggests that increased communication might be an important element in solving the collective action problems.

In the platform design of Goosen and Janssen (2002), a significant role is proposed for scientific knowledge. Scientific tools, such as the mediation and negotiation tool presented in this paper, can be used to facilitate discussion among stakeholders. The government will only act by authorizing the final plan. Mediation and negotiation tools provide stakeholders insights into the consequences of their own preferences and those of others.

The tool, as discussed in Section 5, is not aimed to optimise the decision problem. In fact, the decision problem is often not very precise, and using a mediation or negotiation support tool in the beginning of a planning process might be useful to set the agenda for the planning process. Many projects and policies may fail despite a favorable cost–benefit ratio, due to opposition and non-cooperation of certain stakeholders (Goosen and Vellinga, 2004; Grimble and Wellard, 1997). The same can be seen happening in policy innovations in governance and natural resource management. The post World War II belief in the efficacy of top-down solutions has often led to policy failures (Ostrom and Janssen, 2004). As a consequence, new ways of governance need to be explored, including the involvement of the relevant stakeholders. Research on common-pool resources shows the importance of repeated interaction, conflict resolution, participation of the various resource users and communication (Dietz et al., 2003). The design of our tool, as discussed in Section 5, incorporates lessons from common-pool resource governance to increase the likelihood of creating cooperative agreements.

4. Tools to facilitate participatory planning and decision-making

sIt seems that the achievements of decision support systems in natural resource management have been rather unsatisfactory (Kok and Wind, 2003; Uran and Janssen, 2003; Walker, 2002; Pereira and Quintana, 2002; McCrown, 2002; Beynon et al., 2002; Cox, 1996; Lyytinen and Hirschheim, 1987). It is therefore important to ensure that the type of tool to be developed fits the demands of the parties involved. As long as the goals, preferences and objectives of the parties involved in or affected by a decision are clearly formalized, decision problems may be suitable for scientific analysis. When the objectives are vague, or differ among the stakeholders, and if technical information is surrounded by uncertainties, problems become part of a political process. During the past 20 years, various approaches have been developed which are aimed to structure the decision process in order to improve decision-making. There are a number of participatory approaches, such as policy delphi, dialectical debate, focus group and participation decision analysis, which focus on the involvement of stakeholders in the decision-making process (van der Kerkhof, 2001). These participatory approaches focus on structuring discussions between stakeholders. Here, we will focus on the involvement of scientific knowledge in the participatory process. Examples of approaches to offer scientific information to participatory approaches are: simulation-gaming, policy exercises, integrated assessment, adaptive management, decision support systems, cost–benefit analysis and multi-criteria analysis. Despite the variety of terminology, all approaches focus on a similar issue: how to design a formal tool or procedure to structure and improve decision-making.

Fig. 1 shows which different tools are suitable for different situations. When goals are clear and unified, and scientific knowledge is unified (knowledge is adequately accepted and available), formal models might be used to find the best solution for the decision problem. The more uncertainties are involved in the problem, the less formalized and exact approaches can be used, and the more dialogue between the different parties needs to be stimulated.

There has been a long history of using GIS for analyzing unified and well-defined problems, such as land use suitability mapping (Malczewski, 2004; Joerin and Musy, 2000). Such approaches generally focus on finding solutions of problems, using multicriteria decision-making techniques or artificial intelligence methods. These methods might help to derive optimal allocations of land use that maximize a set of criteria of a group of stakeholders. Other examples of tools to support evaluation of discrete and predefined alternatives are spatial decision support systems (Uran, 2002; van Herwijnen, 1999) or group decision-making techniques (Jankowski and Nyerges, 2001). In the study that we discuss in Section 5, we deal with limited scientific

		Institutional interests	
		Unified	Fragmented
scientific knowledge	unified	Extrapolation Optimization models	Gaming-simulation Scenario analysis
	fragmented	Analytical Integrated Assessment Models Fuzzy methods	Policy exercise mediation and negotiation support

Fig. 1. Approaches in the context of environmental management (modified after Underwood, 1989).

knowledge, and stakeholders not only have conflicting but also unclear interests. In our case, there are no alternatives, they are being defined and generated interactively. In fact, we envision that our tool helps to define the problems that the stakeholders face in a systematic way. Different stakeholder groups are asked to express their preferences, and mapping them provides insights in potential conflicts and compromises. This enables the stakeholder groups to better define the problem space. The approach can be considered a policy exercise. A policy exercise can be defined as: "A deliberate procedure in which goals and objectives are systematically clarified and strategic alternatives invented and evaluated in terms of the values at stake" (Brewer, 1986). The exercise is a preparatory activity for effective participation in official decision processes; its outcomes are *not* official decisions. A policy exercise can be considered as a combination of structured participation of stakeholders, interaction between science and policy and the use of scenarios to explore future conditions of the system.

The dilemma of model building and the incorporation of local stakeholders is addressed by various scholars in environmental management (Bousquet et al., 2002; Talen, 2000; Harris and Weiner, 1998). In participatory geographic information systems (GIS), for example, GIS is used to express the spatial representation of the local stakeholder groups (Pain and Francis, 2003; Haklay, 2003; Gonzalex, 2002). Participatory GIS focuses on the use of GIS by non-experts and occasional users. This requires that the software is accessible and easy to use. Although we will use our GIS tool with occasional users, our focus is not on the human–computer interaction design component of participatory GIS. We want to be able to express preferences of land use is a simple and transparent manner. But the participants of our framework do not necessary need to use the software themselves. Most participatory GIS is focused on expressing the view of one group into a GIS framework. We are especially interested in confronting different views of multiple groups onto the land use in one area.

4.1. Mediation and negotiation support

An interesting example of a mediation and negotiation support system that has inspired the tool described here, 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 and Ive, 1996; Cocks et al., 1995). 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 (or exclusion) guidelines state that the final plan must always (or never) include some particular allocation, for example always exclude logging activities from very steep land. Preference (or avoidance) guidelines would like to see certain activities allocated (or 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. Within the region the mental models of the stakeholders were influenced by participating in such a process, as was measured through surveys. However, at the larger level, the state, there was no significant influence on the attitude towards the problem.

Although inspired by their approach, our goal is less ambitious compared with Abel et al. (2002). We have developed a simple tool (developed in the GIS software ArcView), which is flexible with regard to further development and can be applied to other case-study areas.

5. A simple tool for the Vecht area

5.1. Description of the Vecht area

The study area Vecht is located in the center of the Netherlands between the cities of Amsterdam and Utrecht (Fig. 2). The area is of roughly 8 km × 20 km and consists of (mainly agricultural) fen meadows, wetlands, natural and artificial lakes, reedlands, marshes and wet pasture lands. The Vecht area has a high nature conservation value in both national and international contexts. Agricultural activities are concentrated in fen meadow areas and in deeper polders (reclaimed lakes). Drainage and lowering of water levels are required to facilitate agriculture. Consequently, the groundwater levels are lower in the agricultural areas as compared with the surrounding wetland areas. This causes a water-loss from the wetland areas to the surrounding agricultural areas, resulting in the degradation of the wetlands and hence the disappearance of typical wetland flora.

5.2. Management problem in the Vecht area

The Vecht area is under pressure from increased demand for recreation activities, housing 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. How to design a spatial plan of the Vecht area in order to meet best the objectives and requirements of stakeholders in the area?

5.3. A negotiation and mediation tool

A simple tool has been developed to support a negotiation process among stakeholders in the Vecht area. The tool is inspired by the SIRO-MED approach as developed by Cocks et al. (1995). However, our tool is much simpler and only includes a limited set of rules to be defined by the stakeholders to express their preferences. This makes the tool potentially more interactive, and suitable for the use of it during the initial stage of a negotiation process which defines the negotiation space. The SIRO-MED approach is much more detailed and provides more detailed information for later steps in the negotiation process. The tool is at the time of writing still only used for educational purposes. The tool has been used in six workshops with student groups

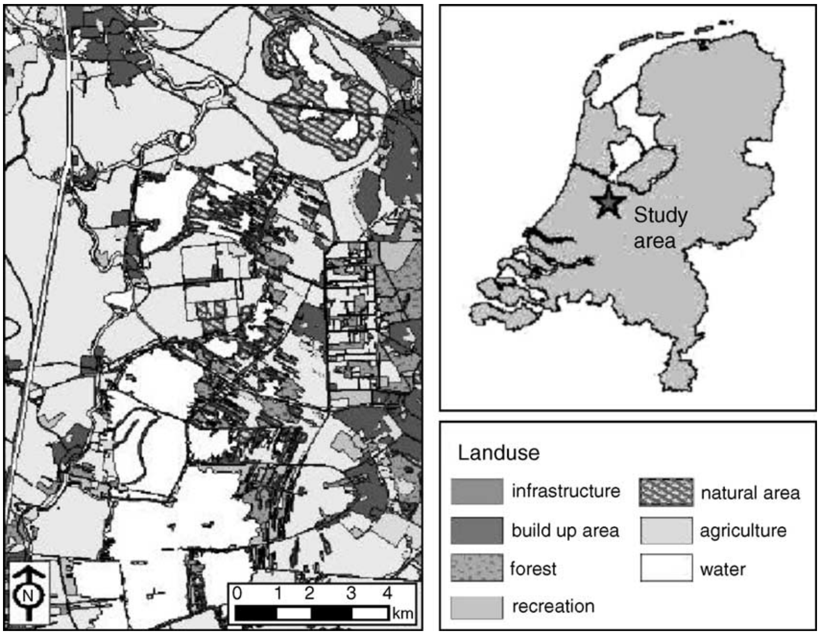

Fig. 2. The Vecht area.

(groups of 15–45 students). Besides educational purposes, the workshops served for testing the tool, and to a limited extent to obtain some indication of its potential benefits. The use of students for predicting its value in ‘real-life’ situations of collaborative planning obviously has limitations. But even in the case of a real-life application of the tool it is difficult, if not impossible, to estimate the added value of using a mediation support tool. Its *potential* value follows from our analysis of tools in a context of common-pool resource management, and its *actual* value will always be difficult to track. However, 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 students were divided into groups representing stakeholder interests and with the use of the simple spatial mediation and negotiation support tool they were given the assignment to develop a spatial plan. In this testing phase, we limited the number of stakeholder groups to only three, but the tool can easily be extended to include a larger number of stakeholders. The three stakeholder groups, farmers, recreation and nature conservation, are found to be the most prominent and influential in the long-lasting debate in the area. On the first day of the workshop, the students visited the case-study area where they became familiar with the area and the management problems.

The tool is programmed in ArcView 3.2 and consists of a land use map and a map of groundwater levels in the area. A design functionality has been programmed to enable users to change land use and/or change groundwater levels in the study area. The model distinguishes five types of land use (forest, wetlands, open water, agriculture and recreation) and three classes of groundwater regimes (low, middle and high water regime). The 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 reflected three basic scenario’s for the area:

- *The current situation (low)*: Groundwater levels are kept low in areas outside the nature reserves in order to suit agriculture. Groundwater levels fluctuate between 60 and 40 cm below soil surface.
- *The historic situation (middle)*: Groundwater levels are raised (40–20 cm below soil surface) which is unfavorable for agriculture but better suited for nature conservation and decreases the rates at which land subsidence occurs.
- *Dynamic water management (high)*: Groundwater levels fluctuate strongly 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 and less effort is required from the water managers (it becomes a more self-sufficient water system).

The model guides the users through four steps: (1) identification of objectives and preferences; (2) development of alternative land use plans; (3) exploration of potential conflicts; (4) negotiation of possible compromises. These steps are discussed below.

Step 1. Identification of objectives and preferences.

A very important first step is to discuss objectives and preferences. During workshops, the students discuss a strategy and determine the potential objectives and preferences of the stakeholders they represent in the exercise. Each group contained 5–6 students (in the larger workshop with 45 students the groups ran parallel sessions). To provide some initial guidance, we have conducted a small number of interviews with stakeholders in the area and gathered policy documents and background information to identify the most important objectives and preferences. Scores have been assigned to combinations of land use and water levels, from the perspectives of the three stakeholder groups. For instance, farmers have been 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 have been incorporated in the model as default values. In the workshops, students discuss these default values and state their preferences regarding land use and the preferred water regime from their perspective as representing the stakeholder group, and the default values are being changed accordingly (Tables 1–3). The preferences of the student groups of the most recent workshop are presented in Tables 1–3.

Table 1
Preferred land use and water regime of the nature stakeholder group

Land use	Water regime		
	Low	Middle	High
Forest	0.4	0.5	0.8
Wetlands	0.6	0.8	1.0
Agriculture	0.1	0.3	0.6
Recreation	0.1	0.2	0.2
Open water	0.6	0.6	0.8

A value of 0 refers to the least preferred land use, and a value of 1 refers to a most preferred land use.

Table 2
Preferred land use and water regime of the agricultural stakeholder group

Land use	Water regime		
	Low	Middle	High
Forest	0.5	0.3	0.1
Wetlands	0.1	0.1	0.0
Agriculture	1.0	0.8	0.1
Recreation	0.4	0.3	0.0
Open water	0.3	0.0	0.0

A value of 0 refers to least preferred land use, and a value of 1 refers to a most preferred land use.

These preferences were used to develop *value maps*, which represents how the present situation is being valued by the groups. Value maps were created for each individual stakeholder group and an example is shown in Fig. 3. 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:

Table 3
Preferred land use and water regime of the recreation stakeholder group

Land use	Water regime		
	Low	Middle	High
Forest	0.9	0.6	0.4
Wetlands	0.8	0.6	0.1
Agriculture	0.2	0.3	0.4
Recreation	1.0	1.0	0.7
Open water	0.8	0.8	0.8

A value of 0 refers to the least preferred land use, and a value of 1 refers to a most preferred land use.

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 can be done by summing the values of all grid cells, and weighing all grid cells equally. This aggregated value enables us to compare the consequences of scenarios for different stakeholders.

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 neighborhood cells. If the cells in the neighborhood 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

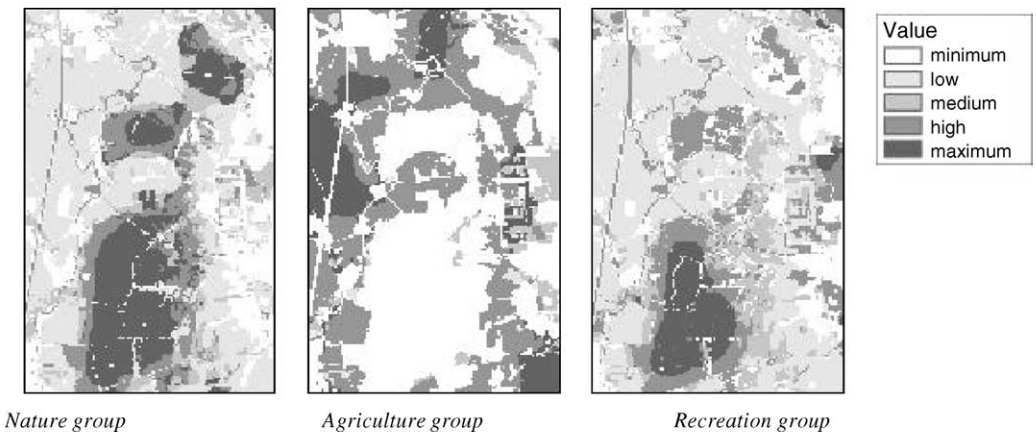

Fig. 3. Value maps of the three stakeholder groups: nature group; agriculture group; recreation group.

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 their own perspectives. The figures below represent the value maps of the individual groups.

In the workshops, the users of the tool are able to translate their preferences with regard to combinations of land use and preferred ground water regimes into standardized scores between 0 and 1. They use the value maps to check whether their 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 is reduced. The groups generally show very strategic behavior. 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 for suitable for nature development. An example of plans developed by the students, and the impacts they have on value maps is given in Fig. 4. The figure shows where the increase in values concentrates for the three stakeholder groups.

Table 4 shows the appreciation of stakeholders for the developed plans. Each of the sectoral plans has a total positive effect: the negative impacts of each

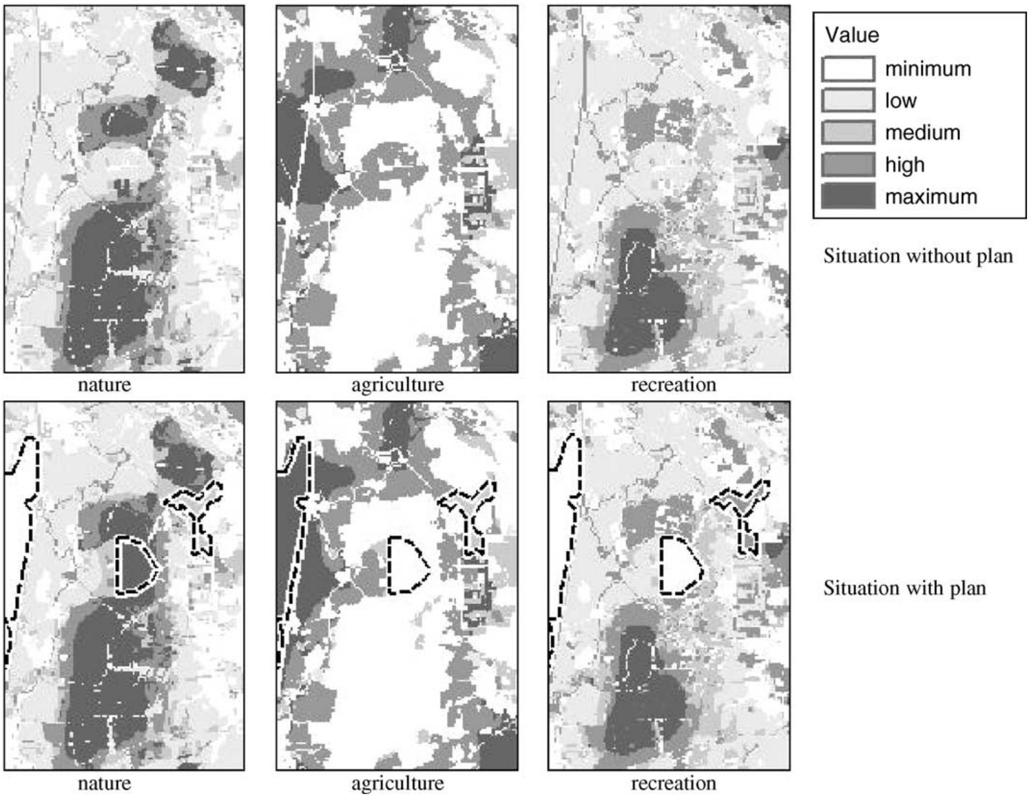

Fig. 4. Stakeholder plans and the new value maps.

Table 4
Values of the different plans

	Start	Plan nature	Plan agriculture	Plan recreation
Recreation	834371	+4789	−20475	+32259
Nature	938481	+29500	−42057	+23198
Agriculture	933949	−27801	+87876	−29052
Total	2706801	+6488	+25344	+26405

The numbers are the sum of the values of each individual cell (from the point of view of the stakeholder group). The last three columns denote the change of value of a plan compared to the current situation.

of the plans are compensated by the positive effect it generates. However, this does not mean that the plans are *acceptable* to the stakeholders. A minor decrease in value for one stakeholder might be totally unacceptable. In the next step, such potential conflicts are analysed.

Step 3. Exploration of potential conflicts.

Potential conflicts can be analysed, based on value maps of the alternative land use plans developed by the individual groups. 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. To demonstrate the potential severity of the conflict, we have combined the maps in such a way that they highlighted 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.

An example of such a conflict map is given in Fig. 5.

The conflict map shows that, for this particular plan (in this case the 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 as weapons to claim other areas or to try and persuade others to change their plans. In this way, the conflict maps provide a useful tool in negotiations.

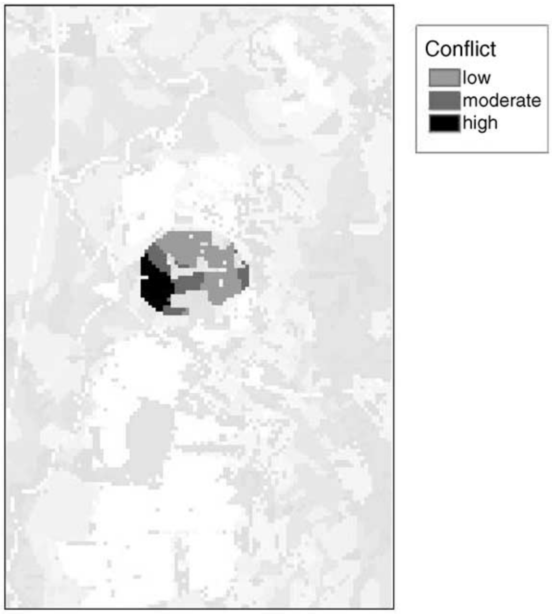

Fig. 5. A map of potential areas of conflict between agriculture and nature. The level of conflict is high in the dark areas, i.e. both the losses for agriculture and the benefits for nature are high.

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.

6. Evaluation and discussion of the use of the mediation and negotiation tool

The question which now remains 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 of our study is the use of students as subjects for the analysis of the tool. Since the stakes are high for the actual stakeholders, experimentation of a new tool might have unintended consequences. We decided therefore to apply the tool with less emotionally involved participants to test the procedures, and the technical and organizational aspects of the tool. Based on these experiments we may provide some conclusions on the *potential usefulness* of the tool, but not on the *actual effectiveness*.

It is very difficult to provide clear evidence of the impact of tools. In our case, a tool is used in a participatory context of designing alternatives. To measure the effectiveness of the approach we would have to separate the impact of the GIS tool from the impact of the workshop itself. Measuring effectiveness of procedures such as conflict mediation or alternative dispute resolution is difficult and rarely reported on. There are very little empirical studies on the effectiveness of conflict mediation in environmental management (Sipe and Stiftel, 1995). The literature in this area has been criticized as biased because professional mediators often report on the successfulness themselves (Todd, 2001; Sipe and Stiftel, 1995). A second problem is that success is difficult to define (Todd, 2001; Moore, 1996). Even if participants are enthusiastic about a decision-making process, the question still remains (a) whether this success can be attributed to the application of conflict mediation techniques (would they have reached consensus without application of the techniques) and (b) whether the compromise is not only good for the individual participants but also for the system as a whole.

To evaluate the impact of the GIS tool requires multiple experiments with control groups not using the tool. Practically, this is difficult to organize. In measuring the effectiveness or usefulness of GIS tools, a similar bias or conflict of interest may exist as in is the case in mediation or alternative dispute resolution literature. Evaluators are usually researches and developers of GIS and decision support methods, or as Walker (2002) puts it: "Investigation of failure in decision support projects is a significant challenge in its own right as failure is rarely reported and analysed". Attempts to empirically 'measure' effectiveness of GIS tools and mediation processes are thus rare, although some studies point at the effectiveness of mediation in environmental disputes (Rose and Suffling, 2001; Sipe and Stiftel, 1995). Also, Kwaku Kyem (2004) highlights strengths and weaknesses of GIS applications in conflict management and demonstrates some of the opportunities of participatory use of GIS, to explore the conflict situation 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 (Cain et al., 2003; Harris and Weiner, 1998; Harris et al., 1995). The choice of developing our GIS tool in a setting of collaborative planning is thus supported by some empirical studies from the mediation literature but is primarily based on our review of empirical based theory of groups governing common-pool resources.

Keeping in mind the methodological difficulties of evaluating the effectiveness and usefulness of our approach, and knowing that the approach has only been applied in experimental settings with students, we can point at some indications that our approach is promising. Feedback from the students after completing the workshops suggests that they regarded the tool 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 maybe not so much a shortcoming of the tool but the consequence of interactive design by stakeholder groups. Another interesting outcome of the three 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. We can report on one workshop where, due to technical difficulties with the computers, 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 might offer some more evidence of the role of the tool in offering a way to structure to the discussions. However, this is only one accidental case and the students might have had the same chaotic discussions had the tool worked properly.

At this moment, a questionnaire is being developed to enable a more structured analysis of the usefulness and impact of the tool at different phases during the workshop. This testing remains difficult since the use of control groups are difficult to establish. The questionnaire can however reveal opinions and changes in opinions over time (see, for example, Rose and Suffling, 2001) and it can be used to determine which sources of information are being used and responsible for certain decisions participants make (Uran, 2002).

7. Conclusions

It is generally recognized that involvement of stakeholders in the planning process will lead to more balanced plans and smoother implementation. However, it is less clear how to get stakeholders involved properly in the planning process. The mediation and negotiation tool presented in this paper is developed to contribute to this. Application of tools to support participatory processes is not new, but various authors have reported disappointing experiences with the use of such tools. We promote the use of simple tools at the very beginning of the planning process that can support interactive processes towards generating potential compromise to a given problem. We developed a simple and interactive tool aimed at stimulating discussion and interactive planning design rather than on comparison of alternatives, which is common in spatial decision support or groups decision support. The tool serves as a mediator and facilitator of the process, and users are not themselves using the tools, which is common in participatory GIS methods. Despite the limitations of using students and the lack of a structured questionnaire and sound experimental set-up, we are confident that the approach helps users in finding compromise solutions. 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 exercise show interesting spatial patterns of compromises and conflicts, and provide insights for possible win–win solutions with a high level of sophistication.

On the other hand, the users brought forward a number of shortcomings. The tool is very simple and only uses input from the users themselves. 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. However, the tool was only aimed to support the earliest phases in the decision-making process and in that sense we may conclude that the tool may help to improve the communication and cooperation among stakeholders, its applicability should be limited to a very early stage of a planning process.

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 conclusion is based on our 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.

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