

# Using a touch table to support interactive land use planning

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## 1. Introduction

Dutch fen meadow areas will face major changes in the near future. With current water management ground levels will continue to drop and the peat layer will slowly oxidize. Agriculture will face increasing difficulties to produce in a cost-effective way. The Gouwe Wiericke area is located in the west of the Netherlands and consists predominantly of fen meadow. This type of landscape has high natural, cultural and historical values. Multiple groundwater levels are present and have been managed for centuries to make them suitable for functions such as agriculture, recreation and nature conservation. At present, several issues are critical in Gouwe Wiericke namely, ground subsidence, the physical preservation of the fen meadow landscape, fragmented water management, water quality below the standards of the Water Framework Directive (EU-WFD), and the changing economical position of dairy farming. These issues suggest that in the area multiple stakeholders with different, and often conflicting, objectives are present. Defining both short- and long-term land use policies for the area is thus a complex task. This paper presents progress on a method to interactively develop land use plans that combine and integrate the objectives of the various stakeholders involved.

## 2. The approach

In recent years, complex decision problems have increasingly been supported by workshop-based decision sessions, often called decision conferences. The same interactive approach (design-assess-evaluate-design) carried out by a team of experts or decision makers is extended to spatial negotiation. For spatial negotiation, plans are assessed in real-time by GIS-based tools and interactive instruments. Results are discussed and fed to design sessions to produce alternative options in real-time. This facilitates appraisal of existing options, and the creative exploration of alternatives. The team set-up ensures participation, but also efficient exploration of the major decision perspectives. Two major objectives are defined for this case study:

- To develop and implement a method for supporting interactive land use planning processes in fen meadow areas
- To integrate and communicate knowledge generated in the process to public and private stakeholders through several workshops, with the help of interactive instruments

Spatial information plays a central role in our approach. Maps are used to communicate and

exchange knowledge among stakeholders. This is done through workshops, where interaction between stakeholders is prompted through the use of printed and digital maps. For the case of digital maps, a device called the ‘touch table’ is used. The touch table is an instrument to visualize and handle spatial information in a multi-user setting. It is used in this study as a tool for stakeholder input via a touch-enabled screen. This device allows multiple users to both input their views simultaneously and to draw map features using different backgrounds, keeping a record of which user has drawn what. It is also an objective of this research to measure the added value of such devices for interactive land use planning processes and its complementary role next to that of printed maps.

### 3. The workshops

Our approach involves six workshops. For Gouwe Wiericke, the sequence of the workshops is indicated in Table 1. The nature of each workshop is defined according to one of the three frames in the framework for map use in policy making (Carton, 2007):

- Analysis                      Map use as science  
    Map as a research model
- Design                              Map use as art  
    Map as a design language
- Negotiation                      Map use as politics  
    Map as a decision agenda

**Table 1.** Plan of workshops for Gouwe Wiericke

	<i>Workshop</i>	<i>Frame</i>
1	Exploratory policy workshop	Design
2	Scientific workshop	Analysis
3	Exploratory stakeholder workshop	Design
4	Scientific workshop	Analysis
5	Stakeholder workshop	Negotiation

The first three workshops were exploratory and focused mostly on the exchange of knowledge. These workshops took place in October, December 2007 and February 2008. The remaining workshops will be more oriented to negotiation and are planned for June, October and December 2008.

#### 3.1 Workshop 1: design

Policy goals of the first workshop were to communicate spatial information, exchange knowledge and explore/develop possible land use alternatives for the area. This workshop was organized for civil servants from province, municipalities involved and the water management authority. We used digital maps presented on the touch table and printed maps. Research goal was to compare how participants use different types of maps to support the various design tasks. Three initial land use alternatives were developed previously for the area, based on land use functions that are related to groundwater levels. Participants were divided into two groups and then asked to provide feedback (by indicating strengths and weaknesses) on the alternatives and make changes if needed (Figure 1). Group 1 was asked to provide feedback on printed maps and Group 2 on digital maps on the touch table.



**Figure 1.** Participants of the first workshop providing input on the touch table (left) and on printed maps (right)

Participants could use different background maps to support making changes to a plan. These maps were available both on paper and digitally on the touch table. At the end of the workshop, criteria were defined to evaluate each plan. The criteria are derived from economical, social, ecological, spatial and political objectives concerning the area. A multi-criteria analysis (MCA) was conducted to derive scores of each alternative with respect to each criterion and to rank these alternatives.

### 3.2 Workshop 2: analysis

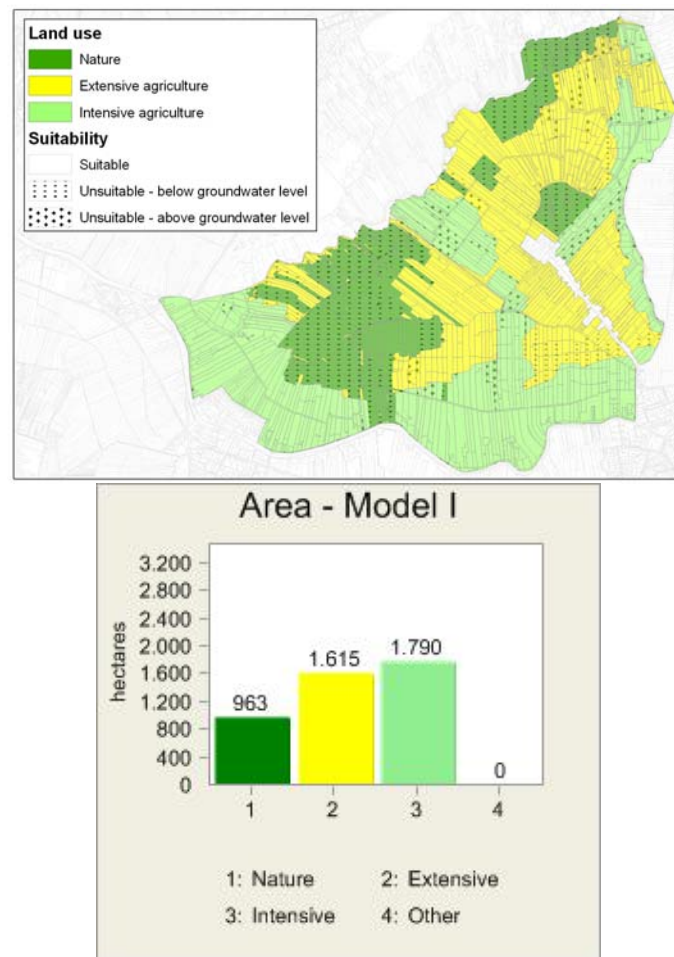
The second workshop was held with members of the various research groups in charge of conducting studies for the area. Each group was asked to present their results as a map. These maps were displayed on the touch table. Objectives of the workshop were to group, combine and integrate this knowledge. It was also a goal to measure the robustness and suitability of each land use alternative and, with this as a basis, to choose a plan for further adjustment. To do this, participants were asked to try different land use restrictions based on groundwater levels (See Table 2), dynamically seeing its feasibility displayed on the touch table. A combination of the touch table and GIS-based decision support tools was used. Participants were asked to experiment with the plans, adjust land uses where they considered them needed and make changes to the thresholds to test the robustness of the plans.

**Table 2.** Land use restrictions for ‘Extensive agriculture’, based on groundwater levels

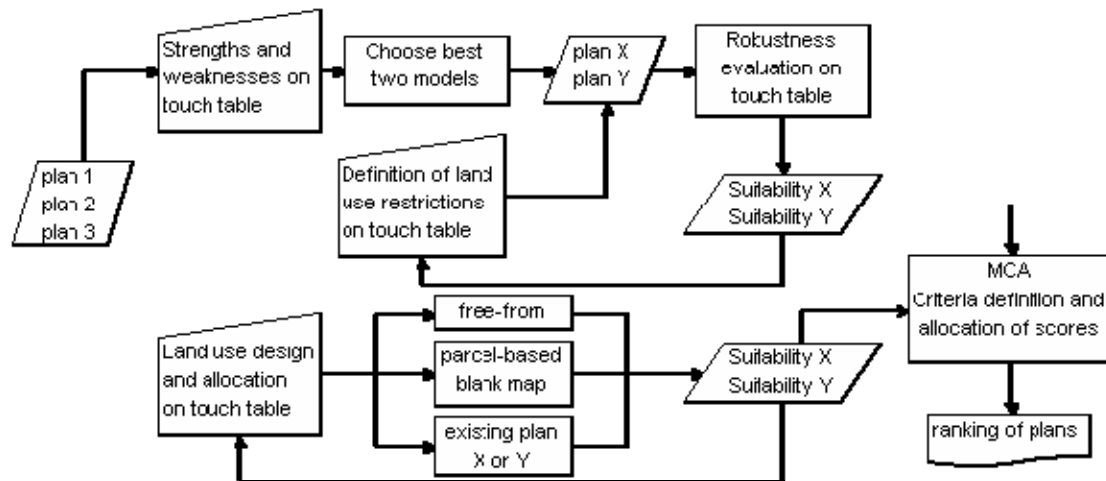
<i>Interval</i>	<i>Suitability</i>
Open water - groundwater level $\leq 0$	Unsuitable - below groundwater level
0 - 10 cm below groundwater level	Unsuitable - below groundwater level
10 - 20 cm below groundwater level	Unsuitable - below groundwater level
20 - 30 cm below groundwater level	Suitable
30 - 40 cm below groundwater level	Suitable
40 - 50 cm below groundwater level	Suitable
50 - 60 cm below groundwater level	Unsuitable - above groundwater level
60 - 70 cm below groundwater level	Unsuitable - above groundwater level
70 - 80 cm below groundwater level	Unsuitable - above groundwater level
80 - 90 cm below groundwater level	Unsuitable - above groundwater level

### 3.3 Workshop 3: design

Policy goal of the third workshop was to evaluate and adjust three initial land use plans for the area. Research goal was to explore the possibilities offered by the touch table as support instrument for exchange of both knowledge and insights concerning the planning of the area. Participants were public servants, project leaders and nature organizations. They were asked to make changes to a previously chosen land use plan and also to design a new plan. To create a new plan, three options were available namely, changing existing land uses from one of the three alternatives and the current situation, allocating land use classes on a parcel-based blank map and drawing polygons in free-form mode allocating land use classes. For each user's input, suitability, which is based on ground water levels, was dynamically calculated and mapped (See Figure 2). These tasks were performed on the touch table in a multi-user setting. Results were presented at the end of the workshop. With this as a basis, participants were asked to evaluate each plan by filling scores for each criterion in an effects table in order to rank all three plans and the current situation. Figure 3 shows a flowchart with the major steps followed during the third workshop.



**Figure 2.** Example of a land use plan designed by the participants on the touch table with dynamic suitability and areas per land use class



**Figure 3.** Major steps of the process followed during workshop 3

#### 4. Feedback from the participants

Surveys were conducted before and after the workshops to measure the participants' expectations as well as their reflections on the process and the impact of the touch table in comparison to traditionally used printed maps. We were particularly interested in exploring three aspects namely, the main differences between the usage of printed and digital maps, the added value of the touch table (in the participant's view) and its major functionalities/advantages. Results of the surveys showed a preference (65% of 35 participants) for the touch table over printed maps. Their reasons included the possibility to choose different background maps, to overlay and combine different maps using transparencies, to zoom and pan throughout the area, and to see separately what other participants have drawn. Another important reason was the possibility to both quantitatively and visually evaluate land use alternatives in a team-setup. The surveys also indicated that the use of the touch table prompted significant discussions and knowledge exchange on the area, crucial for the reaching of a compromise plan.

For the remaining workshops, it is intended to add more evaluation and visualization tools. Functionality will be added to help participants suggest changes in land use and support a negotiated result that is the best possible for all parties involved. So far we did not use the table to support negotiation. It will be interesting to see whether, when real interests are at stake, participants are still willing to participate within the framework set by the table.

#### 5. Acknowledgements

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### **Biography**

**Gustavo Arciniegas** holds B.Sc. and M.Sc. degrees in civil engineering and geoinformatics. His research interest is the use of spatial information technologies for land use planning, hazard monitoring and environmental problem solving. Currently he works as Ph.D. researcher in spatial decision support tools at the Institute for Environmental Studies, Amsterdam.

**Ron Janssen** specializes in decision support for environmental management. His research topics are decision analysis and spatial analysis/evaluation, focusing on the effective use of information and the development of spatial decision support systems. Currently he is head of the department 'Spatial analysis and decision support' within the Institute for Environmental Studies, Amsterdam.

**Nancy Omtzigt** has been employed at the Institute for Environmental Studies in Amsterdam since 1999. Her work deals with the design and implementation of geographic information systems in environmental research and education. Research activities include conceptual design and implementation of spatial decision support systems and visualization techniques for spatial data.

**Corinne Cornelisse** holds M.Sc. degree in environment and resource management. Her research topics are water management and energy transitions with a focus on the participation of relevant stakeholders. She is at present employed as junior researcher at the Institute for Environmental Studies of the Vrije Universiteit Amsterdam.