


Knowledge for Climate

Midterm Review Report

NWO Sustainable Earth – Knowledge for Climate project

Exploring adaptation pathways for sustainable river management into the uncertain future

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Exploring adaptation pathways for sustainable river management into the uncertain future

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1. Main objectives and expected results

A river system is a social-ecological system. In long-term river management, both the physical system and social system and uncertainties deriving from both systems need to be taken into account. Uncertainties from the physical system are commonly addressed in future studies of river management, but social uncertainties have gained relatively little attention so far. In this study we address social uncertainties, in particular deriving from the policy arena, in interaction with the physical system. In other words, our objectives and approaches address essential aspects of sustainable river management under uncertainty, including:
1. River management involves finding a balance between water availability and water demand. Scenarios to explore the future must integrate both physical and social components of the water system.
2. Existing institutions, social structures and (global) social developments with large impacts such as economic or demographic developments, are important determinants for the management of the water system. Consequently, social uncertainties must be included in scenario studies
3. Societal changes and (non) water events may lead to changes in perceptions on the river system, desired situations and governance approaches. Extreme weather events and their impacts are important triggers for adaptive river management. Therefore, we focus on the interaction between the water and social system.
4. We aim to support sustainable river management. This means that strategies are developed that are effective, robust and flexible over the long term.

The main tasks involve:
A. To determine and understand social dynamics and uncertainties deriving from the water policy arena by analysing institutions, social structures, interactions and responses of water managers to events and changing circumstances. This can be used to develop a new serious game design that includes social dynamics and to analyse the dynamics of long-term policy making. Additionally, socio-economic scenarios are developed that can be used for the serious game.
B. The results of task A. are translated into a decision-rule base, and are linked to the water model in which the social and physical system interact and thereby simulate a large ensemble of possible pathways (story lines) of river management into the future.

Expected results are:
1. Increased understanding of social uncertainties related to long-term policy-making
2. A simulation model of perspective based water managers developing long-term water management policies on the basis of a) a real-life case and b) observations of game sessions.
3. Pathways into the future that include the interaction of the social and physical system. This is derived both by multiple game-plays and by a computational simulation model
4. Design of core elements of the Rhine serious game, which is the more realistic follow up of the WaasGame, including:
    a. A game design including the dynamics of the policy arena.
    b. Socio-economic scenarios for the Rhine game

2. Summary of conducted research

To identify, explicate and study the policy arena as social uncertainty in interaction with the water system, the conducted research focused on three main activities:
A) Moderate & design a serious game
B) Perform a case study of a policy arena
C) Simulation of policy-water interaction

A. Serious gaming: moderation & design

As part of the overarching project a series of about 15 of serious game sessions have been moderated, the so-called WaasGame (Valkering et. al., 2012). In this serious game social uncertainty is represented by human actors, real water policy makers and students. During a game session the game players interact with a computational river model, i.e. the WAAS IAMM (Haasnoot et al., 2012). In these game sessions the game players were asked to develop a water management strategy for 100 years. During and after a game session the game players were confronted with both climatic and social uncertainties, effects of their policy actions and most importantly, they were made aware of their own role within this system, being an uncertainty of the system. Moreover, as part of the scientific goal of the serious game, a game play provided us a realisation of a possible future. The sequence of policy actions as a result of the policy-water interaction provides a so-called pathway into the future. Such a pathway forms a dynamic adaptive scenario. The WaasGame proved its function in 1) raising awareness about social uncertainty and by 2) generating dynamic, adaptive social-physical scenarios. However, to increase realism in the policy-decision-arena for the game players a new game is designed based on the insights and descriptions of a real policy arena, the Dutch Delta Programme. Based on this, the existing WaasGame was transformed into the RhineGame, with a major change in terms of game player roles (national-regional, process-content) and corresponding policy actions.

B. Study of a policy arena: The Dutch Delta Programme

We aim for understanding the role of the policy arena as social uncertainty in interaction with the water system. As a case study we selected long term water management in the Netherlands, and in particular the Delta Programme (Ministries of I&M and EL&I 2011). Long-term water management includes many uncertainties from both the physiological (e.g. climate) and social system (e.g. land use). The Delta Programme attempts to

develop long-term water policy recommendations for a period of 100 year, to be delivered in 2014. The policy arena of the Delta Programme itself is part of the social uncertainties in policy making, for example on how the water system is perceived or how decision-making processes take place. By analysing the Delta Programme we can identify factors that influence the policy dynamics, and how the system responds to them. For this purpose we have held a series of 16 interviews with people from the Delta Program with different roles, originating from different organisations and operating at different levels of the Delta Programme. In this case study we aimed to find an answer to the following questions:

1) The Delta Programme, what is it and how is it organised?
2) What are relevant dynamics of the DP?
3) What uncertainties can we identify?

The qualitative analysis of these in-depth interviews result into a description of the Delta Programme (structure, actors and process) and the identification of the relevant uncertainties.

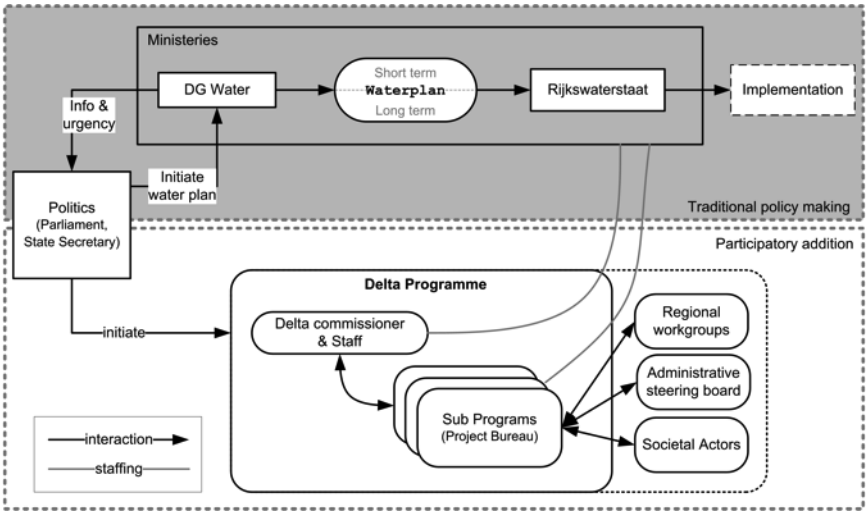

Figure 1. Overview of Dutch long-term policy development (structure, actors and processes)

C. Simulation: policy-water interaction

To represent social uncertainty AND to systematically explore its effect a simulation model was developed. More specifically a policy model was developed and coupled to the existing river model, i.e. the WAAS, used in the serious game (Haasnoot et. al., 2012). This social-ecological model represents the interaction between policy dynamics and river delta dynamics. It aims at exploring a complex system to support policy development, in which it is the view that both the social and physical system needs to be explicitly represented.

The policy model represents a realisation of social dynamics. It aims at representing an extreme social, adaptive and dynamic scenario of the policy arena as social uncertainty. Similar to the use of climate scenarios in physical models, the policy model represents extreme perspectives on policy making. Thereby the theory used to assess policy-making in the overarching research project is adopted for another use: designing policy makers behaving according to a stereotypical role, based on the perspectives concept from cultural theory (Offermans et al., 2011; Offermans & Cörvers, 2012; Offermans et al.,

2012). In other words, the policy model is a formalisation of the four perspective types: Hierarchist, Egalitarian, Individualist and Fatalist. These perspectives embed 1) expectations of the future (no, little, strong climate-change), 2) Beliefs on handling situations (preference in policy action) and 3) how system info in interpreted (priority in dealing with system info: nature, damage cost, casualties, shipping damage).

Similar to the serious game sessions, a simulation run spans 100 year. The policy agent, i.e. the computational policy maker, decides every 25 years what it will do given the current system state. By means of simulation experiments range of pathways is generated. The systematic variation of climate scenarios and the policy agent' perspectives allow for the analysis of scenarios that include both physical as social uncertainties.

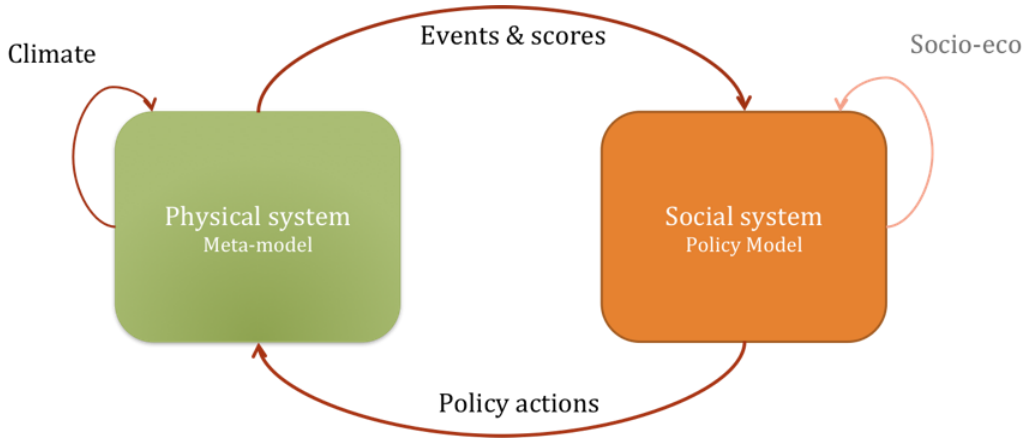

Figure 2. Overview policy-water simulation (WaasPolicy)

3. Scientific value of the research

The scientific value of the research includes:

1. Knowledge contribution:
    a. An increase of the understanding of social uncertainties.
    We did this by explicitly describing for the policy arena, i.e. which types of uncertainties can be identified, how are they manifested in water policy making, and what might be triggers/ under which conditions do they occur.
    b. Gained insight in long-term policy making
    The research distinguishes itself by making a distinction between short term and long-term policy making. The insights therefore embody the character and challenges of LT policy making as well as the factors of influence and strategies used for LT policy making.
    c. Integrating social and physical uncertainty in formal models.
    As such, we can generate pathways that include interaction with both social and physical uncertainties and so exploring a more complex future.

2. Methodological contribution
    a. Exploring a means to study social uncertainties.
    This study builds on empirical material obtained through studying the Delta Programme.

4. How and to which broader debate and/or societal issue does the project contribute?

The project strongly contributes to the debate of sustainable long-term river management in relation to climate adaptation and in particular to the Delta Programme. The project brings social uncertainties to the debate and moves the debate a step forward by 1) increasing awareness of the importance of social uncertainties for contemporary and future water management both through theory development and through game plays, 2) providing insight in the flexibility and robustness of strategies by evaluating them through a social-physical uncertainty lense, 3) generating insight in the functioning of the Delta Programme, and 4) reflecting with people throughout the Delta Program about these issues in the interviews and increasing the awareness and understanding with the developed report on the Delta Programme.

Means to contribute to the debate include in the first place the WaasGame that we have played with diverse groups of river managers. Through the game they are challenged to think about long-term water management and they experience different types of uncertainties. The game also serves as an educational tool for students in sustainability science, geography and water management (e.g. Utrecht University, Maastricht University, Twente University, Wageningen University). The project is also used for student projects (eg. School of Arts, exploring perspectives in the Mekong River Delta). Secondly, the project contributes to the debate by both scientific and professional publications and workshops (e.g., H2O and an end-book presented on a closing workshop).

5. Publications

Journal & professional papers

Valkering, P., van der Brugge, R., Offermans, A., Haasnoot, M., & Vreugdenhil, H. (2012). A Perspective-Based Simulation Game to Explore Future Pathways of a Water-Society System Under Climate Change. Simulation & Gaming. doi:10.1177/1046878112441693

Offermans, A., Valkering, P, Vreugdenhil, H. and Wijermans, N. (2012) Huidige perspectieven op water en consequenties voor draagvlak voor beleid. H2O Tijdschrift voor watervoorziening en waterbeheer (7; 25-28)

Offermans, A., H, Vreugdenhil & P. Valkering. (submitted) The Dutch dominant perspective on water; an exploration of present and future support. Journal of Environmental Science and Health, Part A

Conference papers

Haasnoot, M., van Deursen, W.P.A., Middelkoop, H., van Beek, E., & Wijermans, N. (2012). An Integrated Assessment Metamodel for Developing Adaptation Pathways for Sustainable Water Management in the Lower Rhine Delta. In Seppelt, R., Voinov, A. A., Lange, S. & Bankamp, D. (Eds.) International Congress on Environmental Modelling and Software Managing Resources of a Limited Planet, Sixth Biennial Meeting, 2-5 July 2012Leipzig, Germany.

Offermans, A. Vreugdenhil, H. , Wijermans, N., Haasnoot, M. (2011) The Dutch dominant perspective on water; risks and opportunities involved. 6th Dubrovnik Conference on Sustainable Development of Energy Water and Environmental Systems, 25 – 29 September, 2011, Dubrovnik, Croatia

Vreugdenhil, H.S.I. & Wijermans, N. (2011) Policy Dynamics of Long Term Water Management: An analysis of The Dutch Delta Program. Delta Summit, 20-25 November 2011, Jakarta, Indonesia

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Wijermans, N. & Haasnoot, M. (2012). Including policy dynamics to explore water policy pathways. In The 8th European Social Simulation Association Conference, 10-14 September, Salzburg, Austria

Wijermans, N., Vreugdenhil, H., Haasnoot, M., & Middelkoop, H. (2011). Introducing social modelling in the water world. In The 7th European Social Simulation Association Conference. 19-23 September 2011, Montpellier, France

Wijermans, N., Haasnoot, M., & Middelkoop, H (2011). Dynamic modeling: social and physical interactions to explore future water management. NCR days 2011: Controlling Dutch Rivers, 27-28 October 2011, pp. 58-59.

Other

Vreugdenhil, H., Valkering, P. & van der Brugge, R. (2012). Socio-economische scenario's voor het Rijnspel. ICIS-Maastricht.

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Offermans, A., & Cörvers, R. (2012). Learning from the past; changing perspectives on river management in the Netherlands. *Environmental Science and Policy*, *15*(1), 13–22. doi:10.1016/j.envsci.2011.10.003

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