

Social Uncertainties in Social-Ecological Systems: Policy dynamics in the Dutch Delta Programme

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Abstract: Policy arenas are of major importance for long-term water management. Here, decisions are made. Nevertheless, the uncertainties deriving from the policy arenas have gained very limited attention so far in future studies. We analyse long-term water management in The Netherlands, i.e. the Dutch Delta Programme to identify factors causing shocks and the system's responses to that. We identified a participatory policy structure as a major shock. The results of this shock-system response analysis result in a means to address explicate and include social uncertainties.

Keywords: Water management; social uncertainty; policy arena; participatory policy structure as a shock; Dutch Delta Programme

1 INTRODUCTION

Long-term water management is challenged by the uncertainties that future holds. To deal with these uncertainties, scientists and policy-makers make use of scenarios. The use of scenarios is continuously under development, for instance the increase in the number of scenarios used in terms of alternative futures [Haasnoot & Middelkoop (in press)]. However, the tendency exists to focus on one or a few endpoints, not the pathway to a future and the role of events or surprises that might change the route towards the future [Haasnoot & Middelkoop (accepted)]. Climate change is a common uncertainty to include, however limited attention goes out to social uncertainties and the interactions between the water and the social system. In a social-ecological system like a water system there is an ongoing interaction between people and water. A change or 'new' factors in the system (a shock) can have a tremendous effect on the system. Therefore it is important to involve both physical and social uncertainties in scenarios to develop strategies that are also socially robust. To be able to include social uncertainties in long-term water management, this paper aims to increase the understanding of a social uncertainty by identifying the effect of a shock and the corresponding system's response within the policy arena of Dutch water management.

Particularly the policy arena is of major importance in water management, since here decisions are made to implement measures that impact both the water system and the social system. Although we acknowledge the relevance of other factors, these are here included via their influence on the policy arena. To include social uncertainties deriving from policy arenas, a general understanding of the relevant

policy arena is necessary. Therefore, we describe and analyse the contemporary policy arena of long-term water management of The Netherlands, i.e. the Dutch Delta Programme [Ministries of I&M and EL&I 2011]. More specifically, by taking a shock-perspective we focus on the role of the participatory policy structure as and discuss from a complex systems view what the effect of this shock is in the systems' behaviour.

2 METHOD: A CASE STUDY APPROACH

To increase our understanding of a policy arena, we follow a case study approach [Yin 1984; Flyvbjerg 2006]. With the help of a case study one can intensively analyse an individual unit (e.g. group or project) and in particular identify influential factors within their context. The unit of analysis for this paper is a policy arena. Policy arenas are namely an important part of a social-ecological system due to their forceful impacts on the system. Therefore, the case study approach is useful in identifying both shocks (changing factors with major influence) and the response of the system they affect.

2.1 Case Selection: The Dutch Delta Programme

As a case study we selected long term water management in the Netherlands, and in particular on the Delta Programme [Ministries of I&M and EL&I 2011]. Long-term water management inhibits 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 so provides shocks to the system, and how the system responds to them.

2.2 Data Collection: Interviews

We collected data on the Delta Programme through 14 semi-structured interviews. First, we conducted two scoping interviews to get acquainted with the goal, history, and structure of the Delta Programme. Based on the initial results we conducted 12 more in-depth interviews. In the selection of people we have attempted to acquire diverse views on the Delta Programme, by interviewing people from different units at different positions, see. The Delta Programme is structured around a central committee (the 'staff') and 9 sub-programmes. We interviewed one person from the staff and nine people from seven different sub-programs. Two of these were programme directors; the other seven had different functions within the sub-programmes. Additionally, we interviewed people that had a position in the 'knowledge network'. In this knowledge network knowledge coordinators from the different sub-programs and the organizations involved establish a knowledge agenda and support knowledge development. Lastly, we interviewed three people working for a knowledge institute providing asked and non-asked advice to the Delta Programme.

The interviews commenced with an introduction of the study and the interviewees were provided the opportunity to introduce themselves (e.g. background, role in Delta Programme). The interviews contained descriptive questions about the structure of the Delta Programme and in particular about the unit the person worked for (such as a specific sub-programme). This includes questions about the number of people involved, the process followed so far, and formal interactions within the Delta Programme. Additionally, each interview contained more explorative and explanatory questions. These included their view on cooperation with other sub-programmes, perceptions on the participatory approaches within the

Delta Programme, and expectations on the Delta Decisions and on expected challenges.

2.3 Data Analysis

The interviews were transcribed in an internal report and interviewees were provided the opportunity to react on their report. The interviews were then codified in basic documents. From there, a long list of possible factors that affect the system was derived. Then we identified potential shocks¹. The shocks and responses were categorized (examples of categories are 'organizational structure', 'individuals', 'history' and 'perspectives') and organized by the extent to which they were indicated by the interviewees. As such we developed a list of identifiable shocks and responses. From this list we chose to use 'participatory policy structure' as the major shock to analyse the system and its changes as a result of this shock. This shock was chosen because it affects both directly and indirectly the entire policy system and it was recognised by many interviewees as a major difference in comparison to policy-making before the Delta Programme existed.

3 THE DELTA PROGRAMME: HISTORY & DESCRIPTION

The analysis of the interviews resulted in a description of the history and Delta programme.

Water management is traditionally an important issue in the Netherlands. After a large flood in 1953 the famous Delta Works have been constructed and flood defence norms have been set for the dikes in the coastal zones. For the river areas, norms were set after the high waters in the 1990s. However, in these policies climate change played no role. Moreover, population density and economic value of vulnerable areas have increased significantly. With the contemporary knowledge of climate change and the expected inherent threats thereof for a low-lying delta like the Netherlands, the Delta Commission II was installed in 2007. They developed an advice how to protect our country in the long term against water, but also how to safeguard the fresh water supply for agriculture, industry and nature since summers are expected to become drier.

As a follow-up of the Delta Commission a 'Delta Commissioner' was installed. This is a governmental commissioner and he is supported by the Delta Programme. In the Delta Programme the national government, provinces, municipalities and water boards cooperate with societal actors, the market and knowledge institutes to prepare long-term water policies that can deal with uncertainties deriving from climate change and socio-economic changes. The goal is to protect the Netherlands from flooding for the next generations and to ensure sufficient fresh water [Ministry of I&M and EL&I 2011]. The reason is to anticipate to climatic and socio-economic developments in the future.

The Delta Programme is a four-year programme in which nine sub-programmes support the Delta Commissioner in analyzing the problems, developing strategies and making 'Delta Decisions'. Six of these nine sub-programmes are regionally

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It should be noted that identifying factors as shocks and responses remains ambiguous: whether something is a shock or a response can be arbitrary, shocks and responses can sometimes be swapped ('what is cause, what is effect?'), and relations between shocks and responses cannot always be clarified. To which shock was something a response? Moreover, multiple relations often interact rather than that they are of a singular cause and effect relation, and the factor time is a normative determinant for whether a factor is stable or considered a shock. When the timeframe increases, the number of factors functioning as a systems' shock increases too.

oriented, the other three thematic ('fresh water', 'flood defence' and 'spatial planning/urbanization'). The regional sub-programmes develop their plans in cooperation with regional governments and societal actors. They report to both the relevant ministries and to an administrative board that approve the progress and plans. The directors of each of the sub-programmes meet every week with the Delta Commissioner to develop a coherent plan. Every year the progress is reported in the report 'Deltaprogramma' to the State Secretary of the Ministry. Eventual decisions lie with the politics.

4. SHOCKS AND RESPONSES IN THE DUTCH DELTA PROGRAMME

The analysis of the interviews from a shock perspective resulted in the identification of shocks and responses in the Dutch Delta Programme. There are many shocks one can identify in studying a social-ecological system. Like any complex system, this policy-water system consists of numerous of interconnected factors that influence each other and adapt to the system continuously. Furthermore, the system itself can be viewed a set of systems within systems. It is important to be aware of this system-within-systems view as any shock or change is part of the whole system, whereas the direct effect might restrict itself on the (sub) system level. Therefore, analyzing shocks within a complex system relates to describing the role or effects of a change in a (sub) system within a certain time-span.

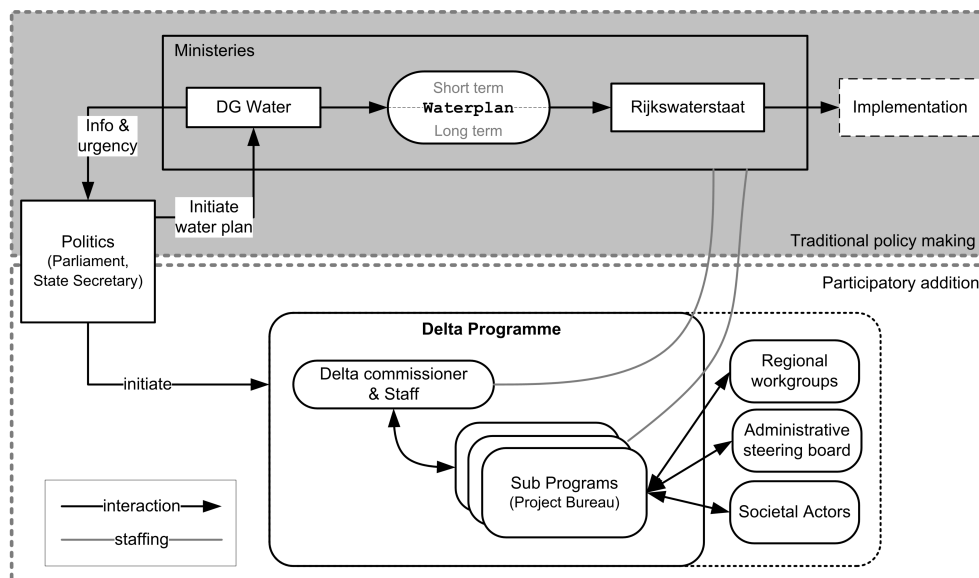


Figure 1. An overview of Dutch long-term policy development. The shock can be identified by the addition of the participatory policy structure (white box) to the traditional policy structure (grey box).

4.1 Participatory Policy Structure as a Major Shock

Within the scope of this paper, we focus on the policy system as part of a social-ecological system. This is our means to address social uncertainty in future studies. When taking a closer look at our case, the participatory approach taken in the delta Programme prominently deviates from the traditional policy structure in which the ministry of water management both develops and implements water policies (see Figure 1). Effectively this means that administrators, officials from different governmental layers and optionally societal actors are integrated in the process long-term policy development.

The focus of the analysis lies on the reason and effects that can be identified due to this change in policy structure. We distinguish three types of cause-effect

relations: 1) the reason for the shock (past), 2) the effect of the shock (now) and 3) the perceived expectations due to the shock (future). We will discuss the results of each shock relation.

4.2 Reasons for the Change of the Participatory Policy Structure

The **reason** for a change towards a participatory policy structure (shock) is given in Table 1. The interviewees reported three categories of reasons for the change: the *experiences in the past*, the current *time spirit* and the *role of persons* in forming the structure. The experience in the past refers to the bad experience with the role of the ministry of water management and in particular their operational arm 'Rijkswaterstaat'. They designed and implemented both short term and long-term policies, whereby they often had an authoritative role and attitude. In combination with the spirit of current times, with a preference for a more democratic way of policymaking, this doesn't fit anymore. Lastly, the role of a person, the Delta Commissioner (DC), was of importance to drive the change. He set out the vision for the Delta Programme with the corresponding participative process structure. The main vision of the DC is to involve partners and that everyone should be heard. Involvement and co-creation are considered important. This becomes explicit in the structure of the Delta programme. First, the existence of sub-programmes indicates a larger regional involvement. Moreover, involvement of themes other than 'flood defence' is explicitly addressed by the design of the additional sub-programmes 'Spatial planning' and 'Fresh water'. As such, these themes and their corresponding actors gain a more prominent place within the policy development. Secondly, the role of steering boards and their yearly meetings about the content and progress exceed the former type of collaboration between administrative and officials. In other words, the preparation by the officials and the approval by the administration are more intertwined.

Table 1. The reasons for the shock of having a participatory policy structure in the long-term water policy development in NL. The analysis of the interview data resulted into three categories of reasons: the experiences in the past, the spirit of time, and the role of persons

Reasons for the shock	
<i>Experiences in the past</i>	Bad experiences with the role of Rijkswaterstaat in the past: pushing & enforcing doesn't work.
<i>Spirit of the time</i>	Current view on democratic policy-making => participatory
<i>Role of persons</i>	Vision of the delta commissioner: - Involve partners; co-creation => Explicit in the structure of DP. Subprogramme spatial planning & Fresh water and steering boards for a wider range of administration. - Bottom up approach; autonomy of the subgroups (subprogramme, workgroups, programme bureau)

4.3 Effects of the Participatory Structure

Effects of having a participatory policy structure (shock) is given in Table 2. The interviewees reported three categories of (current) effects: the *added mass* of people involved, the *mixture of people* and the bottom-up set-up of the Delta Programme. The added mass relates to the increase of people involved in policy development in contrast to the past. The decision to have the Delta Programme and thereby the participatory policy structure gives rise to a whole body of people manned in subgroups: the Delta Commissioner & staff; the 9 sub-programs, the regional workgroups, the steering boards. As a consequence the interviewees report an increase in complexity. Having more people involved lead to more issues and less efficiency.

The second category of effects is the mixture of people. The setup gives rise to more collaboration between ministries & regions and administration & officials. For

instance, each sub-programme director is appointed and provided by a ministry, the teams comprise people from Water boards, Provinces, Municipalities, Rijkswaterstaat and sometimes people from knowledge institutes and societal organizations take a place/are invited in the sub-programme or workgroups. As a consequence, an increase in complexity is reported due to the difficulties in communication between different people. The differences relates to the focus (process vs. content) and background (water engineers vs. spatial planners). In addition, the power position of Rijkswaterstaat has changed from a direct to an indirect force. However, their rich participation in every part of the Delta Programme makes them still very influential.

The last category of effects is the bottom-up set-up due to the participatory policy structure. The first decisions made in the Delta Programme concern the 6 regional sub programs. Each sub-programme needs to produce decisions of how to deal with Flood Defence and the Fresh Water supply for their region. This makes the policy development a more regional process. As a consequence, the interviewees report an increase in detail and diversity of content. Each region has its own specific problems and solutions. Furthermore, each sub-programme is highly autonomous in how they perform their assignment. The different sub-programmes differ in the way they structure their organization and their policy process. They adhere to the assignment that is given for that year, but they design themselves how they reach the policy advice for that year. The nature of the policy development is therefore less hierarchical (or top-down).

Framing these effects back to the system-of-systems view we typically see the effect within the setup and staffing of the Delta Programme. This is directly related to increased complexity and diversity on the current work process done within and between each subgroup involved in the Delta Programme (i.e. staff & Delta Commissioner, sub-programme core team, workgroups, boards and societal actors).

Table 2. The current effects for the shock of having a participatory policy structure in the long-term water policy development in NL.

Effect of the shock	Fact	Reported effects
Added mass	There is a whole body of persons involved in the policy development process. Per sub-programme 15 to 20 persons are involved within the Delta Programme as a part of the sub-programme core team, (regional) workgroups or steering board.	<i>Increase in complexity:</i> more people are involved, more issues arise, less efficient
Mixture of people	Collaboration between: - Ministries and regions (mixed institutional origin) - Administration and official members (e.g. (Bi-) yearly steering group meetings) Involvement of: - Embedding spatial planners and Fresh water people. - Societal actors Institutional origin: Ministries, Water boards, Provinces, Municipalities, Rijkswaterstaat, Societal actors, Knowledge institutes	<i>Power setting change:</i> Rijkswaterstaat steers indirect now. But remains still influential (50-60 FTE in DP; 7 out of the 9 knowledge coordinators are in every SP). <i>Increases complexity:</i> Communication between process and content people; and between water persons and spatial planners.
Bottom-up set-up	The first choices to have 5 regional sub-programmes. Each prepares the delta decisions for their region. => Policy is developed from a regional setting	Increase in detail and diversity of content: region specific problems and solutions. Wider solution space. <i>Decrease in hierarchy:</i> highly autonomous sub-

	programmes
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4.4 Expected Future Effects of the Participatory Policy Structure

The **expectations** of a participatory policy structure are given in Table 4. The expectations of the shock relate to the current view on the effect in future. The interviewees reported about the expected future *problems* and the ideas they have about the delta decisions (solutions for flood defence & fresh water supply) in 2014, i.e. the *outcome*. The first perceived future problem relates to the way to reach coherent decisions together with many highly autonomous subgroups. This relates to the complexity of the assignment (solutions on a national scale, applicability on a regional scale). In the end the diversity and broadness (as a result of the high autonomy of the subgroups) need to be converged into 5 coherent decisions. How to do this is considered the challenge. A second perceived future problem is the deadline in 2014, which is approaching rapidly. As time passes, the work in the Delta Programme needs to converge to an output. This convergence process will make both problems and solutions more specific, and, as a consequence, the opinions might diverge. More concrete solutions are expected to raise more opposition. The challenge is: how to make a decision that is supported? The last perceived future problem relates to awareness or the sense of urgency. Support fails when there is no sense of urgency.

Concerning the outcomes of the Delta Programme, the interviewees report that in the end they expect that no or only 'small' measures (i.e. with low costs and low physical impacts) will be chosen (see Table 3). The Delta Decisions are just intentions, will probably be abstract, and serve as a preparation for the political process. The outcomes are considered as a governance assignment. In addition, officials are insecure about the gap between policy preparation and the final decision-making. The perceived available control over final decisions varies from 'no control at all' to 'little influence combined with fortunate circumstances' (flooding events ->urgency -> money available). They feel that in the end the Ministers make the decisions and the role of politics is strong. Interest of people is expected to be dominant over knowledge.

Table 3. The expected future effects reported by the interviewees as a consequence of having a participatory policy structure in the long-term water policy development in NL.

Expected future effects of the shock	
Problems	<p><i>Coherence vs. Autonomy:</i> Tensions between diversity of the regions and coherence of the water system; how to reach consensus in the decision-making.</p> <p><i>Abstract vs. Concrete:</i> The more concrete the problems and suggested solutions will become, the more problems one gets.</p> <p><i>Awareness/sense of urgency:</i> support fails when there is no sense of urgency/need.</p>
Outcome	<p><i>Decisions DP:</i> No or small measures will be chosen; delta decisions are intentions; will be abstract; are a preparation for political process; is a governance assignment</p> <p><i>Insecurity of officials:</i> the gap between policy preparation and decisions affects the perception of control/role over/in the final decision-making to be minimal. In the end: decisions are made by the ministers; the role of politics is strong; the availability of money; the awareness/sense of urgency depends on recent events; and lastly the role of interest of people, knowledge doesn't determine everything.</p>

The expectations on future demonstrate that the relation between policy development and actual measures is not necessarily a strong one. Having a participatory process might change the awareness and future support, but what is finally decided upon is a combination of events, politics and society.

5. DISCUSSION

5.1 Delta Programme

In the results of the case study on long-term policy development we described reasons and effects evolving from the change in a participatory policy structure (shock). The reasons included the importance of past experiences, the spirit of times and the influence of certain individuals. Moreover, the participatory policy structure can be interpreted as a means to achieve richer policy making since more governmental bodies are involved. As such it supports the idea of decentralisation, which is considered important by contemporary Dutch policy makers. In addition to a broader diversity in options the participatory structure brings, it is also assumed that it will increase support levels. Apart from the increased participatory level, the structure also implies that the Dutch government continues taking large responsibility for water management.

The participatory structure has no policy or ecological effects yet, in the sense that there are no policy actions taken. However, this doesn't imply there are no impacts. Currently there is a whole body of policy-makers assigned to the Delta Programme that are not working on other issues. Furthermore, teams of policy makers are collaborating on specified themes (e.g. flood defence, freshwater) with organisations that are normally no collaboration partners. Both the substantive focus and the change in people-environment affect the way people think and how they work. Especially the focus in content leads to a similar and shared problem space. Lastly, due to its body size, formal and informal status at both the official and the political level, ideas, solutions and decisions are taken seriously.

Future effects of the participatory structure cannot be given yet. However, the expectations of the interviewees indicate that the Delta decisions will most probably result in process outcomes. In terms of policy actions, none or only actions with small impacts will be suggested. However, due to the high level of institutionalisation of the Delta Programme a certain continuity concerning long-term policy development and the explicit involvement of uncertainties can be expected.

Interesting to note is the response to 'events' such as floods, droughts and economic crisis. Such events are often mentioned as *the* reason for change or policy implementation. However, in the context of the Delta Program, events so far only had relatively mild responses in the form of temporary extra ministerial attention and extra marketing opportunities for water boards to stress the value of their existence.

5.2 Policy System as Social Uncertainty

As a next step, to include policy uncertainties in studies about the future, we continue our discussion on a higher abstraction level (the policy system level). The process of identifying shocks for (Dutch) water management through analysing the interviews, resulted in the following relevant categories: '*organisational structure*', '*legal status*', '*perspectives*', '*individuals*', '*institutional arrangements*', '*playing field*', '*history*', '*events*', and the '*Delta Programme*'. When including the policy system as a social uncertainty, one may consider incorporating these categories.

The discussed shock 'participatory policy structure' fell under the category 'Delta Programme'. The main uncertainties derive from *the content* (what is discussed or decided on) and *the process* (how to come to decisions),

Content uncertainties not only derive from physical and technical uncertainties, but are also highly influenced by process choices. For example, whether and how flood defence, fresh water and/or spatial planning are discussed is not just a substantive

choice, but also results from the process. The Delta Programme has adopted fresh water and spatial planning as new themes and so sets the agenda in a new direction. Especially when considering long term policy making there is no certainty over the content of the agenda. Which topics are added, which are taken off the agenda and who does so? are all relevant questions when trying to understand long term policy uncertainties. Nevertheless, the agenda is likely to change as topics gradually develop in interplay with the spirit of times. Moreover, not only the problems but also the preferred way to resolve them may change over time as worldviews change [Offermans et al. 2012]. For example, one can move from more technical (e.g. dikes) to more egalitarian (e.g. building with nature) measures. Since future studies and scenario thinking typically evolves around reflecting about the future, setting future goals, etc. Considering the topics and worldviews as fixed entities encapsulates a risk, as only one thing is certain: current thinking will change.

Process uncertainties deriving from the participatory structure evolve around the question 'to what extent is the participatory structure participatory?' In other words, the (type of) outcomes of the process is affected by who is involved (institute/societal actors/citizens, role official/administrative, political involvement etc), to what extent they are involved and how the structure is defined (autonomous/hierarchical, which subgroups and tasks are defined. Who defines them?). In specifying changes in the participatory structure in contrast to the more traditional, less-participatory structure of Dutch water management, process uncertainties become clearer. Differences and so, additional process uncertainties within the Delta Programme include the number of people involved, the diversity (institutional background and official/administrative level) of people, and the level of influence of the different people. Consequently, the focus of policy-making, the design and nature of policy processes and preferred solutions can be affected.

5.3 Modelling a Policy System

Based on the empirical analysis a model of policy can be development that explicitly represents shocks as social uncertainty of policy dynamics. In other words, the shock of a particular policy structure could be explored given a participatory versus a hierarchical policy structure.

Our future steps involve the development of an agent-based model of a policy system. The agents represent the policy decision-makers placed in a water management context. A network topology then represents a policy structure being participatory or hierarchical both representing whether agents are connected or not and the type of relation they have. An agent itself is assigned with a task, role and perspective as internal attributes that play a role in choosing a policy action together while interacting with a social and physical environment. Via the environment of the agent the mediating factors such as events (economical, social and physical) with their effect on urgency and availability of money are included.

Such a policy model would allow us to systematically analyse the system responses while varying the shock and relevant mediating factors. It allows for tracing the influence between agents and, agents and environment on micro- and macro level. Thereby departing from the empirical descriptions to a multi-level and dynamic description of the structure and a particular policy outcome.

This analysis will be done by coupling the social simulation to the integrated assessment river meta-model [Haasnoot et. al. 2012]. The integrated model allows for the generation and exploration of adaptive pathways including social uncertainty of policy dynamics.

6 CONCLUSIONS

This paper describes the role of the new participatory policy structure within a social-water system (SES) using a shock-system response perspective. The case

study of the Dutch Delta Programme demonstrates that a participatory policy structure could function as a systems' shock. The shock resulted from experiences from the past, current thinking on democracy and the influence of individuals, and has led to a large number of people involved in long-term water management deriving from a variety of organisations. This shock-system response analysis results in a means to address explicate and include social uncertainties. Thereby the basis for modelling SES is laid and a first step is taken towards support for a more socially robust long-term water management.

The next step of this research includes the development towards a coupled policy-water model. Such a model as described in the discussion would allow for generating a new generation of adaptive pathways: pathways in including social dynamics

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