



# Exploring pathways for sustainable water management

Once an adaptation tipping point is in sight, a switch to a new strategy is needed. Each new strategy has its own future tipping point that, again, requires a switch to be made. In the long run water management is thus a succession of strategies. Several successions are possible. How can we find the succession of strategies that provides the sustainable water management that we need?

The successions of strategies into the future are adaptation pathways in a changing environment. These pathways can be explored from many possible transient scenarios of climate and socio-economic developments<sup>5,14,15</sup>. This approach shows the range of options from which policy makers can choose. The adaptation pathways approach thus supports decision making for sustainable water management in a changing environment.

Sustainable water management is about making the best choices at the right moments for a long period of time. These choices will be influenced by events, such as floods and droughts, and changing societal perspectives on preferred strategies, as well as by new insights and knowledge in the course of time. Adaptation thus follows pathways of strategies that are influenced by current and future climate, socio-economic developments and societal perspectives. A strategy is sustainable when it can cope with various possible futures while being flexible enough to be adapted in case the future unfolds differently than anticipated.

A new method explores the range of possible adaptation pathways by simulating the dynamics of these pathways in response to the variability and change of climate and socio-economic factors for the next 100 years. A model is used that represents realistic cause-effect relations

between climate change and socio-economic pressures and their impacts on the water system and society. In each run of the model, a year-by-year set of calculations is made in which a climate realization with, for instance, corresponding precipitation results in a peak river discharge and associated impacts. Management measures may then be taken accordingly, either defined a-priori or derived from policy makers in a workshop setting through a multi-actor, interactive game<sup>6</sup>.

The pathways give information on the effectiveness and timing of measures. They also show dead-ends or the options left when a specific decision is made. Policy makers can benefit from this method by using it to develop roadmaps for sustainable water management. The method increases their knowledge of the system; water managers and other stakeholders can experience the effects of water and social events and how this influences the decision making. The method includes both natural and social uncertainties, and thus allows for finding both physically and socially robust pathways. The model that is used allows for a rapid assessment of many transient scenarios to explore many futures and responses to these futures. It appears, for instance, that climate variability may be at least as important for decision making as climate change, especially for the mid to long term.



## Using pathways in river flood protection

In the figure below a selection of the results of a hypothetical case study is presented, which assesses the impact of different decisions on flood risk management, and of different climate change scenarios on river flood protection strategies<sup>16</sup>. In this case, the cause-effect relationships relate the consequences of climate change, such as a change in precipitation, to subsequent changes in river discharge, water level and flood risk. Story lines may include strategies such as raising dikes or making 'room for the river'. This example focuses on the indicator flood risk; the critical value at which a tipping point is reached, is an a-priori defined amount of flood damage. A story line is completed when the river has been managed for 100 years.

The figure shows that a strategy without measures leads to a tipping point 15 years from now; at that time flood damage will have increased up to the critical value and a new strategy has to be chosen. The strategy of raising the dikes to cope with 1.5 times the second highest discharge in the past (DH1.5), fulfils the objectives throughout the 100-year period; for this strategy no tipping point is reached and a switch to an alternative strategy is not needed. Raising the dikes to a 1:1000 per year discharge (DH1000) results in a tipping point about 75 years ahead. After that time the alternative strategy 'room for the river' (RvR) reduces flood risk sufficiently until 2100. A choice for damage mitigation by building floating houses (Float) 'buys' some 20 years, but a switch to, for example, the 'room for the river' strategy is necessary to reach 2100.

When socio-economic developments and social events are also taken into account, the story lines may include, for instance, a situation where spatial claims from other functions result in too little space left for 'room for the river' measures. A change in perspective towards living with water rather than fighting it, on the other hand, may lead to a preference for the 'room for the river' story line.

A selection of adaptation pathways for flood risk management.

