System thinking: drawing causal loops for sediment

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Introduction:

Water related events such as flooding and water scarcity are year after year considered as one of the most important risks for the global economy (Global Risk report – World Economic Forum, 2019).

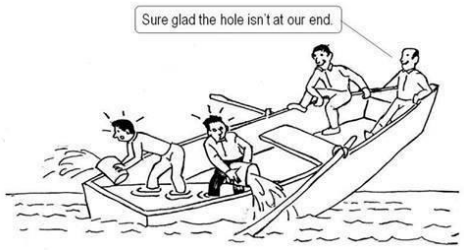
Our current interventions to tackle these challenges get however stuck in symptom management (e.g. creating large water reservoirs, strengthening dykes, etc.) without sufficient insight into i) the root causes, resulting problems elsewhere or even strengthening them and ii) how the water system interacts with other systems such as the mobility-, energy-, built environment-, food-, health system, ... which would considerably broaden the playing field in finding solutions. This requires systems thinking that takes account of the interdependencies and develops solution pathways for a transition towards a resilient water system.

Methods:

Systems thinking has been described as a language for talking about complex, interdependent issues. Within that framework, causal loop diagrams can be thought of as sentences that are constructed by identifying the key variables in a system (the "nouns") and indicating the causal relationships between them via links (the "verbs").

In the development of these causal loop diagrams it is important that all actors who have an impact or are impacted by a change in the system are involved, so that ownership is created in the identification & understanding of the underlying processes, dominant (sometimes entrenched) thinking patterns and solution pathways. This increases the support for the effective implementation of a number of adjustments.

Interesting points of intervention are system nodes, variables to which many interests are linked (e.g. the variable "required depth for shipping" has an impact on the water availability for other sectors in periods of drought, etc.). These are places within a complex system where a small shift in this variable can produce big changes in everything. If we would succeed in making this parameter less decisive when steering the water system, we would take an important step in making the water system more climate robust.



Results:

In 2018 this methodology was used to find leverage points within the water system to make it more resilient. This analysis resulted in i. the identification of reinforcing feedback loops, which we know to cause system bottlenecks ii. identification of previously not identified crucial links between variables. and identification of solution pathways.

It was within this analysis that the link with sediments became obvious. In the framework of the European Interreg project "Sullied Sediments", a part of the analysis is deepened.

Considering sediments, every year, millions of m^3 dredged sediments, have to find a new destination. Many valorization options have been investigated, but few find the way to the market. The amounts of dredged sediments are also an economic choice: we dredge to have sufficient navigable depth, for coastal defense, to have efficient water evacuation, ... Functions that will become even more important because of climate change.

To make, on the short term, the right choices for the long term, it is necessary as mentioned above, to build a mutual understanding of the underlying processes that lead to those significant amounts of dredged sediments, and of the dynamics that play a role in the use and disposal of sediments.