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Inside Matters of Facts: Reopening Dams and Debates in the Netherlands

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ABSTRACT: Both civil engineering and environmentalism strongly influenced the development of water governance in the Netherlands in the 20th century. Much research has focused on these aspects separately. This article maps the interaction between governance, technology and ecological systems in the Netherlands, to provide insights into *how* these are co-evolving. The analysis is based on a combination of a literature study and an empirical case study on the debates concerning the reopening of the Philipsdam, in the Southwest Delta of the Netherlands. It shows how the negotiations that took place in constructing facts in the Philipsdam case both increased the complexity of decision-making concerning the dam itself and radiated outwards to affect other parts of the Dutch water system. We conclude that the process of constructing facts and the way these are framed once they have been established as facts are both intrinsically political and reflect the multiplicity of views of how the lake *works* and what the problem is, and how these views are incompatible at times. As such, ontological complexity is ingrained in what is represented as facts and severely complicates an apparently matter of fact decision to reopen a dam.

KEYWORDS: Uncertainty, constructing facts, modelling through, Delta Works, the Netherlands

INTRODUCTION: CONTROL BY TOLERANCE

The Netherlands is internationally well known for two governance particularities: its drug policy and its ability to fight the sea. The nation's liberal attitude towards soft drugs has harvested both praise and strong criticism. The basic idea behind the liberal policy is that the spread of narcotics cannot be controlled, but legalising the softer, less harmful varieties breaks the links to harder varieties and to organised criminal activities: better a little controlled tolerance than no control at all.

The other feat for which the Netherlands is known worldwide is the way it has been 'fighting against water' since the 12th century. With the dikes, dams and sea barriers (the Delta Works) constructed after the 1953 flood, the Netherlands was thought to be 'safe' against flooding in the second half of the 20th century. Based on the proclaimed success of the Delta Works, the Dutch have started an international campaign advocating *going Dutch*[1] in delta management. At first sight, it seems almost paradoxical: a tolerate-in-order-to-control soft-drugs policy on the one hand and an uncompromising

[1] The idiom 'going Dutch' means sharing expenses equally.

water safety policy on the other. However, a closer look at current Dutch water management practices suggests a shift is taking place towards a similar tolerate-in-order-to-control attitude. This article explores this shift and what it means in decision-making processes, by providing a brief history of the co-evolution of science, governance and ecological systems in Dutch water management since the 1950s and an empirical case study of the role of models in the debates concerning the possible reopening of the Philipsdam, in the Southwest Delta of the Netherlands.

Analytically, this article deploys a *co-evolutionary approach*, to tease out the interactions between science, governance and ecosystems (Norgaard, 1994; Gerrits, 2008; Norgaard et al., 2009). Studying the co-evolution of these three elements shows how facts are constructed, turned into and used as 'black boxes' (Latour, 1987) in water governance. Unlike, for example, the work done on complex adaptive systems, this paper does not show how the co-evolution results in a situation where facts are replaced by 'better' facts, thus looking at learning. Instead it builds on the idea developed by Law (2004) and Mol (2008), among others, that methodologies help to produce realities and facts and therewith ontological complexities, understood here as the multiplicity of ways of knowing, in this case, a lake, and the multiplicity of understandings and problem definitions underlying proposed actions. Using this lens this article aims to show that a 'normal' mode of governance (Lach et al., 2005), based on the pursuit of consensus, and certainty based on 'normal' science (Kuhn, 1962), in the case of complex socio-ecological systems, such as deltas, is not able to break through a vicious circle of inertia, or of inaction. This inertia results from the interaction between governance and science, in which the process of constructing facts by 'modelling through' is intricately linked with multiplying issue linkages and political and economic interests, resulting in selective strategic orientations that, prima facie, appear as just 'muddling through'.

The term muddling through stems from, at the time, provocative work by Charles Lindblom (1959) in which he made a plea for an iterative approach for dealing with complex problems rather than approaches that mechanically try to identify the option that best satisfies pre-set goals. Our phrasing 'modelling through' here refers to the remarkable role that hydrodynamic models have played in the case we describe in this paper. In line with Morgan and Morrison (1999) we observe the mediating role that models play with regard to decision-making processes, be it with a serious amount of political agency (King and Kraemer, 1993). This means not just staying away from discussions on the ability of models to represent particular realities (Giere, 2004), but rather looking at how models play a part in *producing* certain realities. In this respect, Kouw (2012), for example, shows how all sorts of political and institutional considerations are imprinted in models. We will look at the other side of the same coin, to see how modelling practices have influenced the policy process. We thus focus on the use and interpretation of output data (Petersen, 2006).

The analysis of the Philipsdam case is based on qualitative research conducted from January to May 2009 and in November 2011 using semi-structured in-depth interviews with ten different representatives of actor groups that were active in the governance process concerning the possible reopening of the Philipsdam.[2] Furthermore, the analysis uses observations from three different meetings: a member meeting of the Northern Horticulture and Agriculture Organization (LTO Noord), a meeting of the project group formed to study the freshwater provision of the southern part of the Zuid-Holland Province, and a roundtable conference of the permanent parliamentary committee on transportation and water management on the future of the Philipsdam. Lastly, this article draws on official project documents, reports and newspaper articles.

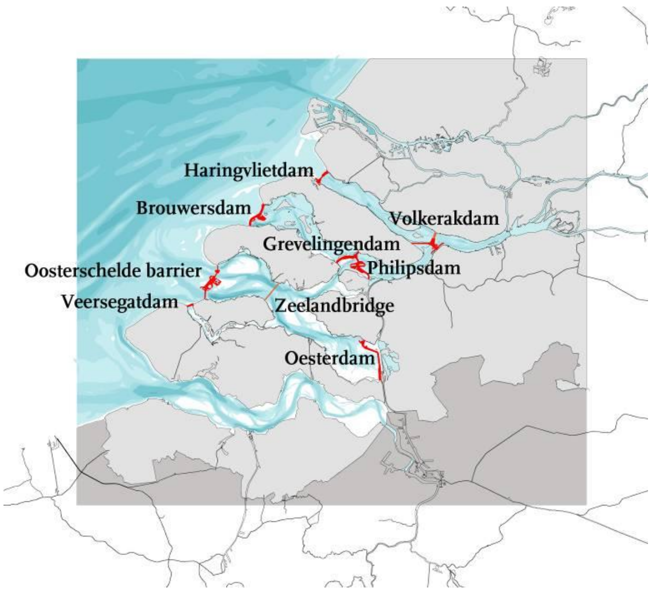
[2] For privacy considerations the names of interviewees are withheld.

The 1953 aftermath: Concrete solutions for concrete problems

In Dutch water management the focus has been consistently on keeping the land dry. Over time, the focus has shifted from land reclamation to the 20th century infrastructure-focused safeguarding of Holland's developed human, agricultural, and industrial landscape. This was followed by the integration of environmental values in the mid-1970s (Disco and van der Vleuten, 2002). In recent years, and specifically with regard to projected climate change, we see a return to an emphasis on safety, even if through environmentally friendly processes such as the 'Room for the River' policy (van der Brugge et al., 2005). This policy innovation both appeals to environmental values while in many ways remaining a traditional environmental engineering means to prevent more severe floods (van Hemert, 1999). Such floods are expected with climate change-induced increases in seasonal freshwater flows from the Rhine and Meuse rivers.

The Dutch Delta is located where the Meuse and Rhine rivers meet the North Sea. Since the first dikes and sluices were developed around 1100 (van de Ven, 2004), much has happened, especially throughout the 20th century. A crucial turning point in Dutch water management was the 1953 flooding disaster in the Zeeland Province, in which around 1800 people died. This disaster prompted the construction of the Delta Works, including the Oosterschelde Storm Surge Barrier (Figure 1).[3] The barrier, completed in 1986, is 9 km long and has a semi-open character; the barrier can be closed when extreme high water is expected and is open under normal circumstances. This semi-open character is the reason it is known both as a marvel of Dutch civil engineering and as a symbol of Dutch consensus decision-making. The latter is mainly because the semi-open character is the outcome of a political compromise between those who strove for maximum flood protection and nature conservation activists who fought for the protection of the estuary (Bijker, 2002). Disco (2002) identifies the construction of the barrier as an important turning point in the appreciation of environmental concerns in the Dutch water management arena, calling it the 'ecological turn'.

Figure 1. Overview of the Delta Works.



[3] Figure 1 shows, apart from the Oosterschelde storm surge barrier and its compartmentalisation dams, the Philipsdam and the Oesterdam, and the other dams constructed as part of the Delta Works: Grevelingendam (completed in 1965), Volkerakdam (1969), Brouwersdam (1971), and the Haringvlietdam (1971). The figure also shows the location of the Zeelandbridge (1965). This large-scale infrastructural work is not formally part of the Delta Works, but has significantly impacted the accessibility of the Islands.

Around the time of the completion of the Delta Works in the mid-1980s, the Dutch started to turn towards a more integrative water governance style (Wiering and Arts, 2006) which co-evolved with the development of sciences that supported the policymaking process. Disco and van den Ende (2003) illustrate this transition in their account of the history of hydrological modelling and how these provide 'strong, invincible arguments' to policy-makers. The development of the modelling sciences co-evolved with the shift in governance style from one of 'fighting against water' to one of 'living with water', which has been taking place since the 1980s (for illustrations see Saeijs, 2008). Critics have argued that this shift was less about creating 'room for the water', but rather more about creating 'room for the engineer' (van Hemert, 1999). The latter argues that in the 'fighting against water' mode engineers were mainly concerned with the height of dikes, whereas in the 'living with water' mode the playing field of the engineers also came to include all that happens in between the dikes. Van Hemert shows how this shift was supported by changes in hydraulic models.

The recently launched Delta Program[4] clearly shows that, despite all the institutional and discursive shifts that have occurred the dominant undertow in Dutch water governance is still 'safety', strengthened by the climate change discourse. This is borne out by the language used in the report by the second Dutch Delta Committee[5] which appears to herald a return to post-1953 safety vocabulary in the political arena. This is also the case in some scientific domains, and particularly at the science policy interface. Iconic for this move is the commentary in Nature titled: Climate Proofing the Netherlands (Kabat et al., 2005), in which the Dutch leaders of the climate change science program argue for large-scale innovations to help the Netherlands adapt to predicted climate change impacts. Wesselink et al. (2007) argue that the Netherlands is facing both a technical and a political 'lock-in'. Technical lock-in refers to the protection by the Delta Works that has created

> a false sense of security in the Dutch Delta. Political lock-in refers to the political inability to discuss safety levels: When safety levels cannot be politically discussed due to a political fear of contradicting the public conception of absolute security, a fundamental revision of flood defence policy is unattainable (ibid; p. 205).

NATURE, FACTS AND THE NATURE OF FACTS

A key element of Dutch Delta management in the 20th century has been a strong reliance on mathematical predictions of the effects of measures taken in the water system. This started around 1918, when Cornelis Lely was serving his third term as the national minister of water management. Lely, a civil engineer by training, was determined to establish a long dam to close off a large part of the Zuiderzee, a shallow bay located in the centre of the Netherlands, in order to safeguard a large part of the inlands of the Netherlands against flooding, and simultaneously creating the possibility of reclaiming agricultural land from the sea. Politically, there was resistance due to the controversy over the uncertainty about what would happen to the tidal patterns in the Wadden Sea. To settle this controversy, Lely asked Nobel Prize laureate Lorentz to chair a committee to study these patterns (Disco and van den Ende, 2003). Lorentz's laborious manual calculations were then used to determine the exact location of the dam. When the dam was completed in 1932, Lorentz's predictions proved to be very accurate. This accuracy was a big step in establishing faith in predictive calculations, which, since then, have evolved into highly technical computerised models that play a crucial role as decision-making support tools.

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[4] Delta programme (2011). Delta programme in the Netherlands. Delta commisioner.

[5] Deltacommissie (2008). Working together with water: A living land builds for its future. Findings of the Deltacommissie 2008. See also Verduijn et al., 2012.

Disco and van den Ende (2003) provide a historical account on how models grew to being used as water management instruments, showing how tidal models over time have become more and more sophisticated in terms of their computational capacities, and simultaneously have gained importance in the policy domain by determining which measures can and which cannot succeed. Kouw (2012) argues that through the increased sophistication, with their increased complexities, present-day models and simulation exercises have a tendency to become epistemologically opaque. By this he raises an important problem of modellers' capacities to reflexively conduct their modelling work. This realisation on the work of models and modellers is similar to the emphasis put on the creative, and non-scientific elements (see also Morgan and Morrison, 1999) of the work of engineers in general as this has been formulated by Ferguson (1977). With Winsberg (2009) we see models as means that mediate between theories and the world, a mediation that powerfully defines the cognitive boundaries of the system.

The Philipsdam

The Philipsdam, completed in 1987, is located about 30 km east of the Oosterschelde Storm Surge Barrier, on the border between the provinces of Zuid-Holland, Brabant and Zeeland. The construction of the Philipsdam was a direct consequence of the semi-open character of the Oosterschelde Barrier, which reduced the tidal activity of the Oosterschelde Estuary. To compensate for this reduced tidal activity the area and volume of the Oosterschelde had to be decreased. This was done by compartmentalisation through the construction of the Oesterdam and the Philipsdam. Consequently, east of these dams, a freshwater lake came into being: the Krammer-Volkerak-Zoommeer (see Figures 2 and 3).

Figure 2. Oosterschelde storm surge barrier and compartment dams.

The construction of these compartment dams was contested both locally and internationally (Boermans and Hoeneveld, 1984). Belgium was strongly concerned about the Dutch Delta plans as the vitality of its main seaport, Antwerp, was at stake. Though it was clear from the start that the Westerschelde would remain open, Belgium was concerned about its connection with the European network of inland navigation and argued for a stable Schelde-Rijn connection. The Dutch government saw such a connection as a threat to the commercial competitiveness of the Rotterdam- based inland navigation shipping sector. The dispute was eventually settled, with Belgium paying 85% of the costs for the connection and the Dutch shouldering responsibility for maintenance.

A more local issue was the salinisation of land (ibid). The island of Tholen in the province of Zeeland, which was to be directly connected with both the Oesterdam and the Philipsdam, and the western part of the province of Noord-Brabant, would both benefit from the creation of a freshwater lake on their borders to reduce salinity intrusion. The risk of salt water inflow into this freshwater lake had two sources: the sluices in the Philipsdam and the water coming from Antwerp. This problem was tackled by the ingenious design of a north-to-south flushing system in the Philipsdam sluices, discharging water from the Hollandsch Diep into the Westerschelde. This did not fully resolve salinity intrusion due to the preferential allocation of water from the Hollandsch Diep to the Nieuwe Waterweg (Rotterdam Harbour) in times of limited supply, making it necessary to either keep the sluices closed or to allow for some salinity intrusion. In addition, there are tremendous ecological effects of turning tidal water into a stagnant freshwater lake (ibid).

Figure 3. Oosterschelde, Krammer-Volkerak, Schelde Rijn Channel and Zoommeer.

One of these effects was the appearance of the blue-green algae (cyanobacteria predominantly microcystis) in the Krammer-Volkerak-Zoommeer in the early 1990s. This alga, apart from smelling unpleasant, is also poisonous, creating problems for people making use of the lake for recreational purposes and agricultural freshwater supply. In response to these problems Rijkswaterstaat (RWS)[6] started the project Exploration of Solution Directions for the Volkerak-Zoommeer in 2003. The main reason for starting this project was that "since 1994 there has been an increase in inconvenience caused by the blue-green algae and it became clear that the ecological development was not going in

[6] The executive department of the then Ministry of Transport, Public Works and Water Management, currently the Ministry of Infrastructure and Environment.

the preferred direction".[7] During this project eight different possible end-states of the lake were formulated and eventually in November 2003 two options for the 'medium term' were formulated: flushing water in the Volkerak-Zoommeer with freshwater or turning the Volkerak-Zoommeer into a saline waterbody.

In December 2004 a planning study was launched that defined the central issue as: "since the early 1990s we are facing severe water quality problems. The ecosystem is not functioning properly causing an annually returning problem with the blooming of the blue-green algae. This bloom of algae can cause other species' mortality and causes severe inconvenience to the users and the surroundings".[8] The goal of the planning study was to develop lasting solutions for the Volkerak-Zoommeer's problems, which in the long term (2040) would lead to a sustainably functioning ecosystem in the Volkerak-Zoommeer. The planning study explored both directions formulated in the exploration phase. By July 2007 it was concluded that the only feasible direction for the future of the lake were saline solutions, thus turning the freshwater lake salt, and by doing so eliminating the blue-green algae. The following section details how this outcome was achieved. This shows how various ideas on the future of the system, articulated in different modelling outcomes were contested, how, over time, these moved to one consensual advice and how attempts were made to give this final advice political legitimacy.

Modelling through

Looking at the governance process concerning the Volkerak-Zoommeer and the Philipsdam over the last two decades it is striking to see how problem statements have been adapted to new knowledge and vice versa, and how the dam reopening decision process was cognitively bound and specified by the models that were used. In our account of the reopening of the Philipsdam, we give special attention to the production of knowledge by means of hydrodynamic models, to show how water governance in the Netherlands is 'modelling through'. The debate on the Volkerak-Zoommeer has been, and still is, a debate in which science plays a leading role: first, in establishing a road map for the planning study and, subsequently, in exploring which options would 'work'. Later on, in the discussion on the freshwater provision of southern Zuid-Holland, the credibility of the established facts was contested.

Contesting facts and the outcomes of studies turn out to be a powerful weapon in discussions. When the Belgians were informed about the Volkerak-Zoommeer planning study they held their cards close to their chest, according to an employee of RWS, while: "at the same time they did come up with various demands on what we should research, and, especially, how we should research this. In turn, we didn't think that was really fair".[9] The demand on this 'how' was related to methodological issues, whose specifics are unknown to the authors of this article, apart from the statement by the RWS employee who explained: "well, they think that we should use all sorts of 3d models and whatsoever. Studies on what the consequences could be. While we think that you can also calculate this in a different way. So that's what we did, we just calculated it, but not in their way".[10] Though the Belgian attempt to influence the process by contesting the methodologies behind the construction of facts in this case was not very effective, it does show that models in this case did not just mediate, they were also the grounds of contestation and attempts to stretch and adjust the boundaries of the system.

When taking a closer look at the recent studies done on the possibilities to eliminate the blue-green algae in the Volkerak-Zoommeer we see how credibility in this case is expressed in the number of dimensions used by the model. In 2005, researchers of the University of Amsterdam approached

[7] Source: Samenvatting Verkenning Oplossingsrichtingen Volkerak-Zoommeer, November 2003, p. 5.

[8] Source: Startnotitie Planstudie Waterkwaliteit Volkerak Zoommeer.

[9] Interview, 10-2-2009.

[10] Interview, 10-2-2009.

Rijkswaterstaat claiming that flushing 150 m^3 of freshwater would solve the blue-green algae problem. Rijkswaterstaat was not sufficiently convinced by this solution, and consequently they turned to Deltares. A representative of Deltares, the key Dutch knowledge institute on deltas, reports on their advice: "in other words, flushing [with freshwater] turned out to be a solution. They had used a confined modelling instrument to reach this conclusion".[11] According to this Deltares employee the model used in this case was limited, not in the configuration of the algae modelling, but in the hydrodynamic aspects of this model: "they had made a 1-dimensional, almost 0-dimensional schematization of the basin".[12] This model resulted in a positive advice for a 150 m^3/s freshwater flushing option. With this in mind the planning study project leader asked Delft Hydraulics (now part of Deltares) with the University of Amsterdam as subcontractor, to jointly double-check the figures. The Deltares model showed a negative advice for the 150 m^3/s option. The scientists suspected that the difference in outcome was the result of the different ways in which they had modelled the algae bloom. The Deltares employee indicated that: "we have, together with Amsterdam, repeated the calculations, but now with our models. This means a more detailed hydrodynamic model (…). The result was that the horizontal and vertical movement of the water is important for the end result. Even if you make the algae models almost exactly the same, which we have done on statement level, looking at our model and the model of Amsterdam".[13]

What happened here is that the algae problem, modelled by an algae model, is divided into an algae problem and a freshwater flow problem. Through their hydrodynamic model, Deltares redefined the problem and its boundaries into its own domain. This was confirmed by one of the researchers involved from Amsterdam, who explained how this was done in practice: "I went to Delft two or three times a week. There I just entered my code, my differential equations into their model. A student did the hydrodynamic part".[14] The models thus form the grounds for the dialogue between pro and against fresh water flushing arguments, (see King and Kraemer, 1993) by merging the Amsterdam research and the Deltares modelling study.

But, then, how reliable is this result and the attendant final advice? According to the Deltares interviewee there are various variables which one can influence in a model:

> There are some aspects which you just have to think about. In that sense a model is a resource. You can indicate sensitivity, but in fact, only experience, built up in the past 25 years, with algae modelling, not just in waters in Zeeland, but also in the IJsselmeer and the Randmeren,[15] can give you the confidence that your model, under particular circumstances, approximately gives a good description of the situation.[16]

This illustrates the point raised by Morgan and Morrison (1999) about tacit knowledge, skills and judgement being irreducible elements in defining what constitutes a 'good modeller', and Kouw's (2012) idea of the 'craft' of modelling.

Despite the 25 years of experience that Deltares has with modelling and predicting effects of measures on water systems making use of models, the uncertainty related to the modelling outcomes does impact the decision-making process. An example of this influence is the uncertainty argument used in the discussion around the freshwater provision of the southern Zuid-Holland Province. At first, southern Zuid-Holland was not really interested in what would happen to the Volkerak-Zoommeer, as long as they would be compensated for the freshwater inlets which they would lose. The problems

[11] Interview, 25-3-2009. See also Verspagen et al., 2006.

[12] Interview, 25-3-2009.

[13] Interview, 25-3-2009.

[14] Interview, 28-11-2011.

[15] Dutch for 'border lakes'.

[16] Interview, 25-3-2009.

started when it turned out that there would be backward salinisation over the Volkerak sluices, leaking saline water into the Hollandsch Diep and Haringvliet. This salinisation had been predicted by Rijkswaterstaat, says an employee of one of the water boards, but: "there is quite an uncertainty. (…) Maybe, the vertical component of salinity in water is hard to model, and therefore it might be overestimated. That could be the entire problem. Then we're having this entire discussion for nothing".[17] This uncertainty also came to light at the meeting of the project group connected to this research on freshwater provision for southern Zuid-Holland. At this meeting a drinking water company requested for more details on this leakage of saline water. A representative of Rijkswaterstaat Zuid-Holland reacted to this: "[t]he numbers that we present all have a bandwidth. Because we're now at the edge of yes or no, complicated or simple measures. It's just a model. And though people prefer not to hear this, it's just a model of reality. The hardness of numbers is always a seeming hardness".[18] To deal with this uncertainty Rijkswaterstaat decided to start an experiment, testing a 'new technology' to limit the mixing of saline water and freshwater.[19]

Framed in terms of salience, credibility and legitimacy (Cash et al., 2003), the above strategies used by Rijkswaterstaat (increasing the number of dimensions used in the models and doing experiments in the field) served to increase the credibility of the knowledge produced. To increase the legitimacy of the advice Rijkswaterstaat used another strategy: expert judgment. A Rijkswaterstaat employee explains that after Deltares came up with conclusions they were

> submitted to independent [foreign] experts, for their approval (…) because, the outcome that the fresh option wouldn't work, that's not trivial, so we wanted to be sure. (…) They were blue-green algae experts. Two from Finland, since in the Baltic Sea they have similar problems. One from Berlin, from the Humboldt University, who knows a lot about algae. And someone from the NIOO, which is the Dutch Institute [for Ecology]. They were not involved in the plan yet. They were steering the group, as independent experts. They also know a lot about the blue-green algae. And finally a professor from the University of Amsterdam was also involved.[20]

In the debates this expert judgment turned out to be an effective form of 'closure': [21] after their judgment the option of the freshwater solution basically disappeared from the discussions. Though effective in promoting a single direction for policy-makers, the legitimacy of the international experts was questioned by the Amsterdam researchers: "the funny thing was that I completely didn't know these experts. Not by name. These were not the people that made me think: ok, these are the top European blue-green algae experts".[22] However, by this time the combined salience, credibility and legitimacy of the studies were sufficiently strong that the choice for a saline future for the Volkerak-Zoommeer could be made. This choice, however, led to a whole set of new 'problems', as the next section shows.

[17] Interview, 27-2-2009.

[18] Dordrecht, 18-3-2009, meeting project group; Freshwater provision for southern Zuid-Holland.

[19] This experiment conducted in the sluices of the Afsluitdijk was completed in June 2011, and according to an employee of Rijkswaterstaat the results are satisfying and the technology seems to sufficiently tackle the salt intrusion problem; source: Proef Afsluitdijk biedt oplossing zoutlek Volkerak-Haringvliet, at www.waterforum.net (Last visited on 22 June 2011).

[20] Interview, 10-2-2009.

[21] Closure here refers to the procedure of stabilising facts or artefacts, as formulated in Pinch and Bijker (1984).

[22] Interview, 28-11-2011. In this interview it was also mentioned that the Amsterdam researchers did not entirely agree with the peer-review report, and that they wrote a counter-report. The Amsterdam researchers advocated to try the freshwater flushing option when enough freshwater was available; according to the interviewee this was "too easily disregarded".

RADIATING EFFECT AND COMPLEXITY

After the lake's saline future became a closed 'fact' the central problem became that of freshwater distribution, which affected a much larger area, as summarised by the planning study project leader:

> Actually, to be honest, it was not really clever to start off the study process by approaching it as a closed system. At first the idea was to flush it or turn it saline, with limited effort, the rest of the world wouldn't notice a thing. But it turned out that a solution for the system itself was needed. Bit by bit we discovered: Guys! This is impossible! There's such a radiating effect, so much influence![23]

What had started off as quite an isolated problem, a blue-green algae problem in a lake, over time turned out to radiate to many other problems. How this emerging complexity has influenced the science and decision-making process concerning the future of the Volkerak-Zoommeer is detailed below showing that the linking of the Volkerak-Zoommeer issue to other issues is a tactic used in many instances. We will briefly discuss how the Volkerak-Zoommeer issue has been linked to the construction of the Oosterschelde storm surge barrier, geese and the brown rot fungi, which is a fungal disease particularly affecting potatoes, to show how for different actors the nature of the problem can vary. After that we will closely look at the already mentioned freshwater distribution issue, also in relation to the possible reopening of the Haringvlietdam and the impacts on the Haringvliet, which is the water body bordering the Volkerak on its north side, to show more in detail how this divergence of the problem takes place.

The Oosterschelde Storm Surge Barrier

In the planning study process the influence of the Oosterschelde Storm Surge Barrier is that of a bogeyman, with actors stating that the blue-green algae problem in the Volkerak-Zoommeer is a direct consequence of the Oosterschelde Storm Surge Barrier. At the parliamentary committee roundtable conference this link was used in discussions on who is going to cover the costs of the measures that need to be taken now. In this respect it was stated twice during the conference that since it was the national government that had built the dams, it should also cover the costs of its consequences.

Geese

Farmers, who rely for their freshwater partially on the Volkerak-Zoommeer, frame the problems in quite different terms. At a member meeting of the Northern agricultural organisation, a farmer mentioned that an important aspect is being neglected: geese.[24] One of the really big problems that he and his neighbours are facing is geese. The number of geese increases because of the many nature conservation developments to compensate for disruptions to the ecosystems, which are often combined with changes of the inland water management system. With these new 'nature' areas, more geese forage in the neighbourhood, increasing the manure load on their lands. A saline Volkerak-Zoommeer would require an alternative freshwater supply system to service the agricultural freshwater needs, which would then be constructed over land by excavating new supply channels, attracting possibly more geese.

Brown rot

A similar issue that is being linked to the Volkerak-Zoommeer is brown rot. This issue comes up when alternative freshwater supply systems are discussed. One of the options would be to use water from the Wilhelminakanaal, as a freshwater source. The Wilhelminakanaal receives water from the east, all

[23] Interview, 10-2-2009.

[24] Dirksland, 16-3-2009, farmer association meeting.

the way from the Meuse. A representative of one of the agricultural organisations explains how the brown rot fungus might pop up in this case:

> A disadvantage of the water from the Wilhelminakanaal and the Maas [Meuse] is that it contains the brown rot bacteria, which is an annoying disease in potato cultivation (…) in fact; this [western Noord-Brabant] is one of the areas in the Netherlands which is pretty much 'clean when it comes to the presence of brown rot'. By an active inlet of this water this risk will increase.[25]

The area of the Volkerak-Zoommeer is now suffering from the blue-green algae bacteria. If the Volkerak-Zoommeer is turned saline it might mean that the algae would disappear, but the brown fungus might appear in the region, thus creating an unusual trade-off between smelly waters or rotten potatoes.

Freshwater distribution: Just a cog in a complex machine

What plays a fundamental role in the background of the entire process is the discharge of more than 1000 m^3/s of river water flowing through the Nieuwe Waterweg, the open connection of the city of Rotterdam with the North Sea (see Figure 4). This is a substantial fraction of the entire freshwater flow entering the Netherlands by the two large rivers, the Rhine and Meuse.[26] Almost every interviewee mentioned the relation between the Volkerak-Zoommeer and the amount of water flowing through the Nieuwe Waterweg. At a meeting with affected farmers, the planning study project leader stated that: "the water from the rivers is needed for keeping out the sea water in the Nieuwe Waterweg (1000-1500 m^3/s) (…) Using freshwater for the Volkerak-Zoommeer (150 m^3/s) will lead to unacceptable salt intrusion in the Rijnmond area".[27] In this respect, an interesting question was posed at the roundtable conference by a member of parliament, to this project leader:

> Well, a solution could be the un-deepening of the Nieuwe Waterweg. Move the shipping activities to the west, which is an autonomous development that we'll need to accelerate. As a result you'll need much less water in the north, and you've got your water for flushing. What is your response to this? [To which the project leader replied:] Yes, that could be a possible solution, more freshwater available for flushing. My estimation would be that you would need approximately to double the flow size that we've tested so far. That's 300 m^3/s. Still that's a lot of water, which possibly flushes away the blue-green algae. But what you do then is using 300 m^3 for a system that eventually uses 30 m^3/s for agricultural purposes, and thus you are repeating the trick of the Nieuwe Waterweg, more or less. But ok, it's possible.[28]

The planning study's view on the freshwater availability in relation to the possibility of flushing the Volkerak-Zoommeer with freshwater is confirmed by a Deltares employee who was involved with the modelling studies that form part of the planning study. He explains:

> we first looked solemnly at the freshwater possibilities. Salt was completely not in the picture yet... we just looked, well, is this 150 correct [solution option as suggested by researchers from the University of

[25] Interview, 24-2-2009.

[26] Looking at the reference values published online by Rijkswaterstaat.

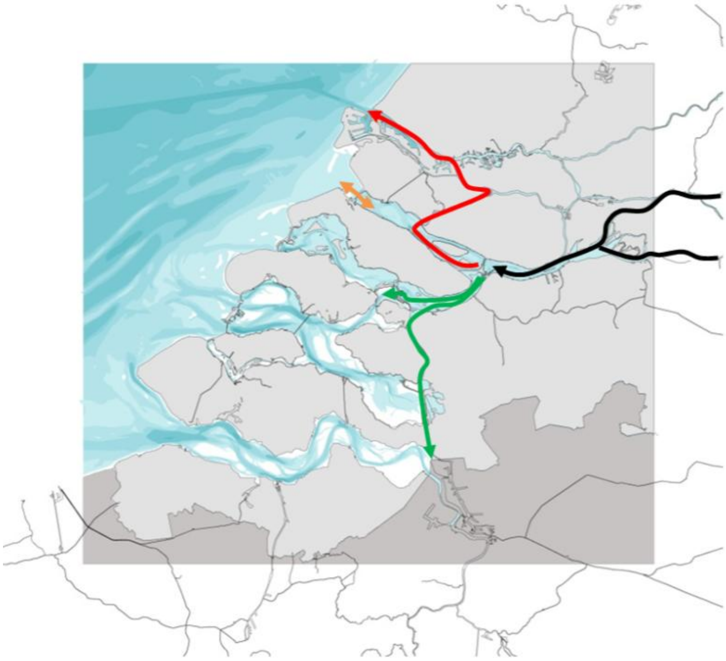
(www.rijkswaterstaat.nl/water/waterdata_waterberichtgeving/watergegevens/. The average inflow of the Meuse and Rhine is 2430 m^3/s (230 m^3/s and 2200 m^3/s, respectively), and the average outflow through the Nieuwe Waterweg is 1335 m^3/s. Based on these averages this would mean that more than half of the water that flows into the country through the Rhine and Meuse flows out through the Nieuwe Waterweg. Of course, this is a rough estimation based on averages, but it does give an idea about the substantial part of water flowing through the Nieuwe Waterweg. The 1000 m^3/s referred to in the text is the rule of thumb discharge, referred to in various interviews.

[27] Dirksland, 16-3-2009, LTO-Noord member meeting.

[28] Tholen, 23-3-2009, roundtable conference parliamentary commission, Transportation and Water Management.

> Amsterdam[29]]; are the residence times needed correct? According to us this 150 m^3/s is not sufficient. If you could divert 1000 m^3/s through the system all algae will surely disappear. (…) But there is no 1000 m^3/s freshwater available (…) 1000 m^3 is a possible theoretical solution, but in reality this water is not there, so it's not a practical solution.[30]

Figure 4. Freshwater routes through Nieuwe Waterweg (red) and possible flushing through Volkerak-Zoommeer (green) and the 'Kier' in the Haringvliet (orange).



A Water Board representative stated: "it's a consequence of human action, constantly bigger ships, constantly deeper dredging and constantly more salt intrusion. It's been a conscious choice to do this, to keep the salt out. Otherwise Gouda will turn saline".[31] This led another farmer representative to state: "look again at the entire Dutch water system. And if you do so, and you say, let's seal off the Rijnmond [Nieuwe Waterweg], then there's a lot of water that you don't need any more".[32] Another Water Board representative suggested exploring possibilities of installing, for example, an inflatable barrier in the Nieuwe Waterweg: "Well, look, what the real solution will be is something you'll have to study. It is possible though, that there are measures that can be taken in the Nieuwe Waterweg, which cost less money, that will provide you with extra water to divert through the Volkerak-Zoommeer".[33] The bottom line is that freshwater distribution in the South Western Delta is a fundamental issue that influences other debates like that on the future of the Philipsdam and the Volkerak-Zoommeer. The Volkerak-Zoommeer is just a cog in the machine, albeit a highly complex machine.

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[29] Verspagen et al. (2005). Doorspoelen of opzouten? Bestrijding van blauwalgen in het Volkerak-Zoommeer, UvA, NIOO-KNAW; RIZA; Rijkswaterstaat Zeeland. http://dare.uva.nl/record/170123.

[30] Utrecht, 25-3-2009, interview Deltares.

[31] Interview, 27-2-2009.

[32] Interview, 16-3-2009.

[33] Interview, 11-3-2009.

De Kier

The complexity of the freshwater distribution system in a coastal delta becomes even clearer when we look at another issue that is being linked to the Volkerak-Zoommeer, namely the 'Kier' (English: 'crack' or 'set ajar'). The word 'Kier' in this area refers to the initiative to partly open the Haringvlietdam and therewith let seawater into the Haringvliet, particularly aimed at allowing the salmon to migrate from the sea to the rivers as a part of an international agreement. This process has made the word 'Kier' somewhat burdened with emotions. A newspaper article on the Volkerak-Zoommeer planning study headlined: "On a 'Kier' against the blue-green algae".[34] Rijkswaterstaat was not really happy with this headline, as the project leader said: "The newspaper's headline maker probably liked it, on a 'Kier', but we were not so happy with it, because then you create a link with this [the Haringvliet] which is still quite controversial".[35] During the meeting attended by farmers, the 'Kier' issue proved indeed to be controversial. After the presentation by Rijkswaterstaat and the Water Board Hollandse Delta, questions from the audience focused on whether it was possible to reconsider the 'Kier' decision, now that this Volkerak-Zoommeer issue also came into play. The person hired as an independent facilitator responded that a "reconsideration of the Kier is not on the [political] agenda".[36] He continued by stating that though the 'Kier' may be a fixed [closed] issue, the compensative measures that are going to be taken for that can be still adjusted to the 'new' Volkerak-Zoommeer's influence.

In 2009, the deputy minister made clear that she wanted to see the Haringvlietdam on a 'Kier' by the end of 2010. As a result, this 'Kier' decision has been very influential in the process around the Philipsdam. As a Water Board representative stated:

> the same way as it happened back then with the Kier decision in the Haringvliet. There it was decided that the salt could come to a certain fixed point. (…) and consequently we're going to move the inlets. We're going to think about a solution for the drinking water supply, all on the expense of the national government. But you notice now, that they're now much more reticent in that regard.[37]

A farmer representative explained why the 'Kier' issue is controversial:

> A study on the Kier is much older. But, devising and execution are two separate things. Well, at a certain moment in time a decision was made, and agriculture said, ok, we will cooperate on this, on two conditions. Firstly we need a guarantee that the current freshwater supply will be untouched. Secondly, if the salt intrusion appears not to stop at 'Spui' [which is the fixed, agreed upon point up to which the salt is 'allowed' to enter the Haringvliet], but intrudes further, we close the dam immediately. It's not going to be a matter of open or closed, no we need to have room to manoeuvre. And well, the agricultural organizations have made a big mistake here. The deal was made in a top-down way, with too little communication with their members. As a result, they are very emotional about these issues.[38]

A Water Board employee put these sentiments in a broader context:

> After the Delta Works, the decision on the Kier was made, now the plans regarding the Volkerak-Zoommeer and the new Delta commission.. Yes, people feel a threat. These forces are rather big. We are the only ones opposing. What also plays an important role is that Zeeland and Brabant will improve their

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[34] See: de Volkskrant, 8 October 2008. Didde, R: Op een kier tegen de blauwalgen; Deltawerken Plan van Rijkswaterstaat om een doorlaat voor zout water te maken in de Philipsdam.

[35] Interview, 10-2-2009.

[36] Dirksland, 16-3-2009, LTO-Noord member meeting: "kier heroverweging staat niet op de agenda" [118]

[37] Interview, 11-3-2009.

[38] Interview, 16-3-2009.

> situation. They'll get a pipeline through western Brabant. (…) They will just receive freshwater, especially Tholen and St. Philipsland will improve their situation.[39]

Ironically, after having had a tremendous impact in the decision-making process on the future of the Philipsdam, the national coalition cabinet installed in October 2010 decided to cancel the ´Kier´ decision. In June 2011 this cancellation decision was reversed by the cabinet, in anticipation of financial claims that could be made by neighbouring countries. Wesselink et al. (2007) argue that the Netherlands faces both a technical and political lock-in. The 'Kier' decision-making process and its influence on other processes like that of the Philipsdam show how the system is caught in inertia, as decisions depend on projected outcomes of impact studies and projected outcomes depend upon the problem statements (what is taken into account, and what is not?), and therefore they are part of the political decision-making process itself.

So what, in the end, has happened to the Volkerak-Zoommeer? And what does this show us about the governance of such a complex socio-ecological system? Currently, the Volkerak-Zoommeer is still a freshwater lake and the Philipsdam is still closed. What started off as a flood protection problem, 'solved' by constructing the Oosterschelde Storm Surge Barrier and the compartment dams (including the Philipsdam), over time became a water-quality problem with the blue-green algae. After this problem was put on the agenda, the 'problem' has evolved from a (fresh) water quantity problem, into a situation that, as we have shown, has radiated in many directions and has become gridlocked.

CONCLUSIONS

The decision by the national cabinet ironically shows how large the impact of decisions can be on the one hand, but also how frustrating the practice of politics can be. Participatory processes have been taking place around the link between the future of the Philipsdam and the 'Kier' and one stroke of a pen in a coalition agreement can make these many initiatives appear as a waste of time and money. While this could lead to an increase in political cynicism it also provides insights for conceptualising science-policy-stakeholder interfaces.

The construction of facts has been a strong influence in the whole process, with several Latourian 'black boxes' (Latour, 1987) being constructed, while on the other hand there are actors trying to open them up, and deconstruct them. Crucial in the different phases of the process has been the use that has been made of these black-boxed facts. The University of Amsterdam, for example, presented the 'fact' to Rijkswaterstaat that 150 m^3 of freshwater would make the algae disappear. Rijkswaterstaat decided not to consider this fact 'closed', but instead to ask a second opinion from Deltares. Deltares presented a 'no'. Consequently, both boxes were opened up, and Amsterdam and Deltares were assigned the job to construct a new 'fact' together. The outcome, as we now know, was: Freshwater flushing cannot do the job![40] Now it would be easy to suggest that Rijkswaterstaat wanted a saline solution from the start, but this does not transpire from the interviews. Rather, these changing insights are a consequence of what Lindblom (1959, 1979) would call 'muddling through', in attempts to grapple with the socio-ecological system's inertia.

Interestingly, an important tool in the construction of facts has been the number of dimensions of the model used, with consequent alteration of results, as brought out by the dispute and its eventual settling between the Deltares model and the Amsterdam model. By introducing the term 'modelling through' we want to emphasise the mediating role that models have played in the process described here. Models function as mediators (Morgan and Morrison, 1999), between people and their stands,

[39] Interview, 27-2-2009.

[40] Interestingly this 'no' is based on the 150 m^3/s which is, according to the planning study leader the politically maximum amount available.

and between our theories and the world (Winsberg, 2009), and they shape our understanding of what the world is like. Apparently, RWS was not sufficiently convinced by the results of the Amsterdam study, and asked Deltares to take a look at the outcomes. The 1-dimensional hydraulic component, they argued was not convincing. After merging Amsterdam's algae component with Deltares' 3d hydrodynamic model, the outcomes became undisputed; they became 'black boxed' facts, at least for the time being. These facts did not solve the problem, but they became an input in a larger-scale process with shifted problem formulations.

This expansion of the problems has to do with the politics of ontology (Mol, 2008), contestations over what the nature of the problem *is*. This is illustrated by the nature conservation groups that framed the reopening of the Philipsdam as the first step in a much larger series of interrelated measures that need to be taken. Other actors that are a bit more hesitant about the whole reopening idea, linked it to the entire Dutch water distribution system. Where the planning study frames the problem in terms of a malfunctioning water system, farmers might frame the problem in terms of a problematic ecological turn (with the increased number of geese as the indicator). Models, as we have tried to show in our account, play a particular role in the politics of ontology around the lake. Through their epistemic opacity (Kouw, 2012), they 'act' as protagonists of a hydraulic ontology.

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