Grounding the Future in the Delta

Fransje Hooimeijer

Climate change demands a radical rethinking of delta management to ensure long-term safety and sustainability. The Dutch have a long tradition of balancing urban development and water management, using innovative approaches like polders, dikes and windmills to adapt to hydrological challenges. However, large-scale engineering interventions have weakened the connection between flood protection systems and regional water dynamics, emphasizing the need for integrated approaches (National Research Council, 2013). Drawing on the Redesigning Deltas study, this contribution examines how spatial design and civil engineering can address contemporary challenges by adopting a longue durée perspective. This approach aligns historical principles with modern strategies, emphasizing adaptive design, bottom-up governance and the importance of public engagement. Through case studies, it demonstrates how lessons from the past can inform innovative solutions for future delta management, balancing ecological, social and technical considerations.

Introduction

Climate change has heightened the urgency to radically rethink delta management practices, as current approaches cannot ensure long-term safety. Addressing this challenge requires building the knowledge to change existing methods and develop new approaches for managing deltas (Bento, 2023). The Dutch have a long-standing and internationally recognized tradition of effectively managing deltas, reflecting a strong connection between urban development and civil engineering. Their expertise in hydrological principles enabled land reclamation through the ingenious technology of polders (Burke, 1956). The dynamics of regional water systems – groundwater, rainwater and surface water – have been central to the urbanization of Dutch polders. Historically, cities in polders were hydrological constructions, with spatial layouts deeply intertwined with the division of land and water at regional and local scales (*ibid.*). However, advancements in site preparation and large-scale water pumping weakened this connection (Hooimeijer, 2014). Today, subsided polders and cities rely heavily on pumps and extensive dike systems for flood protection. To ensure sustainability, delta management must integrate flood protection systems with regional water dynamics, encapsulated in the concept of the *deltaic condition* (National Research Council, 2013).

This relationship between technical efficiency and urban design has evolved over time. Over the past millennium, societal needs and technological advancements have continually redefined the deltaic condition. As climate change exacerbates hydrological challenges, fostering a closer relationship between civil engineering and spatial design becomes imperative. Historical interactions between spatial design and wet landscapes offer principles that can guide future strategies, including site preparation, protection scales and land-use planning (Hooimeijer, 2014).

To explore new approaches to delta management, TU Delft collaborated with Deltares, Resilient Delta, Planbureau voor de Leefomgeving (PBL), Erasmus University and Wageningen University in the Redesigning Deltas study. The study investigated how spatial design and engineering can synergize to create a sustainable future for the Dutch delta. It emphasizes the role of design as a mediator and knowledge broker, helping to address climate uncertainties by envisioning alternative approaches (Hooimeijer, 2023). Design acts as a catalyst, aligning diverse ambitions, goals and financial considerations across disciplines to create spaces that are smarter, more sustainable and more affordable.

The study engaged fifteen partners from the urban planning, landscape architecture and water management sector, addressing five design challenges across the Dutch delta. Teams included Defacto, Vista and Arcadis working on Limburg's brook landscape;

Fabrications, Bosch Slabbers and Tauw in the Waal River region; Urbanisten, Lola and Royal Haskoning on Rotterdam's port-city interface; ZUS, Flux and Sweco in the polder between Rotterdam and Delft (Midden-Delfland); and Studio Hartzema, Feddes Olthof and Witteveen & Bos in Zeeland. These interdisciplinary teams collaborated in sessions with experts, developing strategies that integrated ecological, socio-economic and spatial challenges from a systems perspective.

The study's results, encompassing innovative designs and a manifesto, offer insights into the future of everyday life in the Dutch delta while drawing on historical practices. The manifesto emphasizes a bottom-up approach to delta management, mirroring pre-1814 practices, when local knowledge, smaller-scale technologies and path dependencies between land and water were pivotal (Van der Ham, 2002). These findings demonstrate how historical concepts can provide valuable frameworks for addressing contemporary challenges. By building on the synergy between spatial design and civil engineering, the *Redesigning Deltas* study proposes a way forward for delta management that harmonizes ecological, social and technical needs. Historical insights serve as a reminder that adaptive, localized solutions have long ensured resilience in dynamic environments.

This carnet will first give a summary of the historical principles of delta management to contextualize the result of the Redesigning Deltas Design study (RDD). The project by ZUS, Flux and Sweco in Midden-Delfland, which actively engaged with local stakeholders and extended the impact of the study beyond its initial scope, is highlighted to draw conclusions with insights into the future of everyday life in the Dutch delta.

Linking History of Delta Design to the Future

The historical relationship between civil engineering and spatial design in managing wet, soft soils and balancing land and water has provided essential spatial principles for site preparation, protection scales, and land-use planning (Hooimeijer, 2014). Over time, technical innovations have influenced the Dutch approach to water systems, evolving from an adaptive stance to one focused on minimizing risk. Van Dam (2016) describes an 'amphibious culture' until 1800, after which the dominant paradigm shifted to reducing risks to an absolute minimum. Learning from historical periods with limited technology offers valuable insights for developing more sustainable, nature-based solutions.

The history of Dutch water management can be divided into phases marked by technological advancements: Natural Water Management (ditches, until 1000), Defensive Water Management (dikes, 1000-1500), Anticipative Water Management (windmills,

1500-1800), Offensive Water Management (steam, 1800-1890), Manipulative Water Management (electricity, 1890-1990) and Adaptive Manipulative Water Management (return to nature, 1990 to present) (Hooimeijer, 2014). Each phase represents a shift in the balance between human ingenuity and the constraints of the natural environment.

During the phase of Natural Water Management, Dutch lowlands were marshlands, uninhabitable except when adaptations were made to the wet environment. Ditches were dug to control groundwater for agriculture, but there was no unified effort to protect against flooding. Settlements were established on higher ground, often near streams and fertile areas. A key typology of this period was the mound (*terp*), raised land used as refuge during floods, where communities maintained essential functions. These early adaptations laid the foundation for later advancements in water management (Burke, 1956).

The transition to Defensive Water Management began around 1000 with the introduction of dikes (Van der Ham, 2002). This innovation enabled the protection of larger areas, making them habitable while integrating water into settlement designs through harbours. Dike and dam cities flourished during the thirteenth and fourteenth centuries, with building sites along dikes raised using debris. These developments marked a significant evolution in balancing urbanization and flood protection.

By 1500, the use of windmills marked the shift to Anticipative Water Management. Windmills allowed for large-scale water movement, enabling the drainage of extensive areas and towns. This phase reflected a deeper understanding of hydrological systems and practical applications of that knowledge. Combined with sluices and dams, windmills transformed water management from a defensive to an anticipative stance. Settlements expanded onto previously unsuitable wet soils, driven by a forward-looking vision that anticipated future needs and incorporated technical expertise (Burke, 1956). The layout of early settlements – mound, river, coast, military stronghold (*burcht*), *geestgrond* (sandy ridges), dike and dam towns – formed the 'dry core' of what would become polder cities. These settlements prospered and expansion extended into surrounding wet soils initially used for agriculture. This process required collaborative vision and technical ingenuity, reflecting the hallmarks of the Dutch tradition in water management.

The Offensive Water Management era (1800-1890) was characterized by the use of steam power, enabling large-scale interventions such as canals, sea closures and artificial groundwater adjustments. These advances transformed Dutch cities into industrial hubs, concentrating populations around factories and harbours. Urbanization expanded rapidly, reshaping the landscape

and pushing the boundaries of water management technology (Van der Woud, 1987).

By the late nineteenth century, rapid urbanization and new technologies defined the Manipulative Water Management era (1890-1990). The rise of engines, electricity and automobiles, coupled with industrialized construction processes, created a new spatial order. This era of *maakbaarheid* ('everything can be engineered') prioritized technological solutions, leading to the disconnection of water management from natural systems. The emphasis on industrial progress overshadowed the ecological balance, altering the relationship between urban planning and water management (Van der Woud, 1987).

During the Manipulative era, three distinct periods can be identified. In the Inter War Era, technology was still in tune with natural systems. Post-World War Two was an era where confidence in technology led to a complete separation between water and urban systems. From the 1970s onward, the post-war era was criticized for its technocratic and narrow-minded approaches to social structures. There was a strong desire to break free from these conventions and rediscover the 'real identity' of the city and countryside. Respect for nature became a central theme, leading to the emergence of landscape architects as key players in urban planning. They reintroduced water as a spatial element in the city, marking a shift towards more ecologically-aware planning.

This shift set the stage for the next phase: Adaptive Manipulation (1990 to today). Although the term 'adaptive manipulation' is contradictory, it reflects the ongoing debate about how to make the right spatial adjustments to adapt to climate change. There is still a lack of consensus among experts about what the 'right' adjustments are, which highlights the complexities of integrating technological advances with respect for natural systems in the face of an uncertain future.

The above-mentioned historical practices and principles can inform modern approaches to delta management; in particular, periods with limited technological resources can guide the development of more sustainable and nature-based solutions for the future. The main concepts derived from historical principles of water management in the Dutch delta revolve around several key ideas: (i) design in levels situating human occupation on higher ground to protect against flooding; (ii) protection at the regional and local scales, creating socially cohesive dike rings that offer protection tailored to specific communities; (iii) design with a vision for the future, anticipating future developments and incorporating them into current planning; (iv) working with the natural system, recognizing and respecting the natural boundaries and carrying capacities set by the environment, which dictate the limits of human occupation.

These principles were eventually set aside as new approaches emerged that were more aligned with the evolving attitudes, needs and expectations of society. The scaling up of water defence and management systems could, in hindsight, be seen as a form of 'disruptive innovation'. This shift fundamentally altered the deltaic system to such an extent that returning to the old ways of functioning is no longer possible. As a result, the future of the Dutch delta will likely involve a combination of hybrid solutions – integrating both old and new approaches – or potentially a complete transition that could drastically reshape, or even lead to the loss of, the traditional Dutch delta as we know it.

Overview and Impact of the Redesigning Deltas Design Study

The RDD study employed several methods to facilitate interdisciplinary collaboration and design (Hooimeijer, 2023). The group of participating firms played a key role in setting the assignment and were further supported through masterclasses and workshops, which provided the designers and engineers with specialized knowledge. The study emphasized the integration of disciplinary perspectives from urban design, landscape architecture and engineering, represented by the group members. This integration was achieved through a methodology known as a 'sandbox'. A sandbox is an interdisciplinary approach used to explore tasks broadly and inventory the necessary knowledge to arrive at a shared problem definition and approach. This method allows the collective practical experience of the group to be harnessed, building a preliminary collective understanding of the design challenges, shaping the design brief, and helping to further define initial propositions as a group. This was done on the first day of the sandbox meeting, and resulted in forming five interdisciplinary teams, each composed of an urban design, landscape architecture and engineering firm. The locations were then distributed among these teams. On the second day, the teams presented the strategies they had developed for their locations. Following these presentations, the disciplines reconvened within their disciplinary groups to draw conclusions at a broader scale, ensuring the five propositions were connected into a cohesive whole.

These propositions were further refined using the 'Casco Concept' – a design instrument developed in the 1990s to stimulate sustainability (Sijmons, 1991) – in a workshop facilitated by H+N+S Landscape Architects. H+N+S had been commissioned by the RDD study to revise its existing design tool, the Layer Approach – a planning tool to help making priorities on the basis of dynamic, prioritizing slow (the substratum layer) over fast, the occupation layer (De Hoog et al., 1998). H+N+S adapted the Layer

Approach and Casco Concept to make them applicable for future delta design (H+N+S, 2023). The workshop results led to a shared foundation for all five teams: the soil and water system, rather than land use, would form the basis of future developments. This approach ensured that all proposals were grounded in the same logic, culminating in a comprehensive plan for the entire southern Dutch delta.

This unified plan was supported by a manifesto advocating a 'new Dutch' design approach to flood risk management. The manifesto emerged from the participants' desire to create an independent, collective voice from the design discipline in discussions about developing a sustainable Delta system. The manifesto consists of six key propositions, three of which are about decision making:

– We are here to stay, we take responsibility and we can change
– We need to know more
– We dare to make painful decisions

The other three are on design:

– We utilize the delta paradox: regulation within the dynamics
– We design the delta bottom-up
– The design of the delta starts with the section

These propositions are represented in the work of the five teams and are considered as shared values needed to be able to design the delta of the future.

Midden-Delfland Project

The team Midden-Delfland with ZUS, Flux and Sweco investigated the relationship between city and polder. The water regimes in both land uses perform very differently. In the polder there are many different water levels, making it a complicated and inflexible system. The three partners envisage Midden-Delfland as a National Park in which water, food and raw materials are produced for the adjacent cities, which will remain within strict contours. The design is based on a simplified water system with fewer dikes, pumps and sluices, with opportunities for increasing biodiversity, supplying raw materials such as wood and food, and offering a solution to flooding, subsidence and the threat of salinization. As a result of population growth, Delft and Rotterdam are becoming more densified within the urban contours, increasing the need for nature, water and clean air. Midden-Delfland will become a green lung that contributes to the liveability of the highly densified urban environments along the edges. Those who live in the polder will be in very close relationship with the water system; they will no longer rely on large-scale public protection measures, as each house will be able to cope with all water conditions (Figure 1).

The project is reflective of the RDD manifesto proposition

'making painful decisions' by creating a strong divide between city and countryside. It also represents the three design propositions by utilizing the small scale as a flexible unit within the larger frame of the polders and designing the soil water system in interdisciplinary fashion.

The results of the study were published in several magazines and newspapers, resulting in interest from the local political party *OpenGroenProgressief* (OGP) in the municipality of Midden-Delfland. It aims to make its party program inclusive by organizing thematic discussions in community buildings about important societal topics, in order to involve citizens in thinking how society can respond to big challenges. OGP dedicated one meeting to the importance of water management in Midden-Delfland under the title 'Pump or drown?' The event aimed to engage citizens in discussions about critical issues such as soil subsidence, rising sea levels and increasingly extreme weather patterns. The goal was to involve the community in forward-thinking conversations about how to keep Midden-Delfland safe, liveable and accessible in the future (OGP, 2023).

The party believes that by bringing together people with diverse knowledge and perspectives, the best ideas can emerge. To this end, it invited the RDD team working in Midden-Delfland, known for innovative and sometimes extreme design concepts, which can help inspire realistic solutions. Additionally, three local experts were invited to contribute their insights:

- Marcel Vissers from the Water Board Delfland, who provided expertise on local water management.
- Arie van den Berg, a farmer with extensive experience in farming in harmony with nature, offering deep knowledge about the agricultural possibilities and limitations in the area.
- Lobke Zandstra from the Water Board Delfland, who focused on the preservation and expansion of recreational water use.

Following a presentation by the RDD team, the evening continued with smaller group discussions, where participants could share their knowledge and ideas. These discussions were designed to foster dialogue about the future of Midden-Delfland, allowing residents to voice their concerns, wishes and ideas.

While the RDD research primarily focuses on long-term solutions, which can be challenging for citizens to relate to, OGP chairman Jakob Jongsma identified several actionable steps that residents can begin working on immediately. These include greening gardens to improve local biodiversity and manage rainwater more effectively, replacing solid tiles in parking spaces with open tiles to enhance water infiltration and reduce runoff, and collecting and using rainwater during dry periods instead of draining it through the sewer system. These practical measures can help residents contribute to the resilience and sustainability of Midden-Delfland,

aligning with the broader themes discussed during the event.

Following this event, the ZUS and Flux teams continued their collaboration with the Water Board of Delfland to expand and scale the ideas of their initial plan. Their goal was to apply these concepts to a broader area within the Water Board's jurisdiction, with a particular focus on addressing the issue of freshwater shortages. ZUS took the initiative further by establishing a local lab in a farming area within the region. This lab serves as a space where ongoing dialogue between designers and the community can take place, ensuring that the conversation continues beyond the initial event. By fostering this continuous exchange, the lab aims to create a platform for co-creating solutions that are grounded in both expert knowledge and local insights, contributing to the long-term resilience and sustainability of the area.

Future of Everyday Life in the Delta

The RDD study adopts a dynamic, longue durée perspective (Braudel, 1949) on the Dutch delta system, contrasting with the top-down approach in Deltares' solutions, which are based on system characteristics and focus on four scenarios: protected-open, protected-closed, seaward and flexibility (Haasnoot et al., 2019). Deltares explores these extremes to define the playing field.

In the protected-closed scenario, hard or soft protective measures – such as water defences, sand nourishment or wetlands – are implemented, and river arms are closed with dams. The protected-open scenario uses similar protective measures but maintains open river connections to the sea. The seaward scenario creates new, elevated land to shield the delta from flooding, while flexibility reduces vulnerability to sea level rise through adaptive strategies, including salt- or water-tolerant land use (e.g., floating buildings or infrastructure on piles), raising land, spatial planning and relocation.

However, the Deltares study lacks a longue durée perspective, which considers the long-term dynamics of the water-soil system in shaping these scenarios. Instead, its perspectives are purely future-oriented. The longue durée approach (Bloch, 1935; Febvre, 1935; Braudel, 1949) encompasses a tripartite system of short-term *événements*, medium-term conjunctures and long-term structural elements. This method, incorporating insights from economic, urban, social and general history, examines cycles and structural factors, such as prevailing attitudes, resistant frameworks and the enduring influence of the natural environment on human activity and communication.

Although limited to the soil-water system and part of standard urban design analysis, the RDD study of five areas – or five 'moments' in the delta – was conducted in alignment with a longue

durée approach. This approach considered both temporal and spatial dimensions, selecting locations that represent different qualities and challenges of the delta system. The resulting designs and manifesto propositions align with historical concepts.

The three decision-making propositions of the RDD manifesto – (1) we are here to stay, we take responsibility, and we can change; (2) we need to know more; and (3) we dare to make painful decisions – can be linked to historical approaches described earlier in this paper. These include designing with a vision for the future, anticipating future developments, and integrating them into current planning. For example, the historical approach of designing at different levels – such as situating human settlements on higher ground to avoid flooding – would involve deciding to stop building in deep polders and retreating to higher areas of the country, which would be a painful decision as well.

The design propositions also reflect historical concepts. Proposition 4 – we utilize the delta paradox: regulation within the dynamics – aligns with the historical approach of protection at local and regional scales, which involved creating socially cohesive dike rings tailored to specific communities. This remains relevant in contemporary Dutch society. For example, in Midden-Delfland, residents and farmers recognize the need to adapt to changing conditions, acknowledging that the engineered landscape is no longer sustainable and that they must actively participate in solutions. Propositions 5 – we design the delta bottom-up – and 6 – the design of the delta starts with the section – correspond to the historical approach of working with the natural system, respecting natural boundaries and the environment's carrying capacities.

The past, present and future of deltas are deeply interconnected through the dynamics of the water-soil system and human occupation systems that interact with it. Awareness of historical approaches is crucial for future delta management. Understanding how we arrived at the current situation requires unravelling how the delta was shaped over time and exploring how we can reassemble it in harmony with nature. Citizens need to be a part of this, because it is a system change that will affect everyday life in the delta.

Figure 1: Living with the dynamics of nature and water. Redesigning deltas design study. Zus, Flux and Sweco, 2022.

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