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From Fast Forward to Past Forward

The importance of a heritage-based planning approach in tackling drought and water scarcity in the sandy areas of the Netherlands

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The importance of a heritage-based planning approach in tackling drought and water scarcity in the sandy areas of the Netherlands

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SUMMARY

>> Climate change requires that the Dutch planning community rethinks its prevailing approach to water management. One impulse for this is that the Netherlands is increasingly confronted with drought. This is a growing problem, particularly on the elevated sandy soils in the eastern and southern parts of the country. There, regional water authorities, farmers and estate owners are confronted with extremely dry conditions during the growing season. As a result, active measures need to be taken to hold all water. Sending water is impossible, but the available precipitation can be put to much better use. This essay argues that pre-industrial land use and historical water structures, systems and practices can be helpful to do so. Based on the revitalization of a medieval watermill landscape in Noord-Brabant and the Lankheet Estate in Overijssel, the essay illustrates how to link these structures, systems and practices of the past to a future which is more drought resilient. Both cases show that climate adaptation planning can benefit from cultural heritage. Consequently, the essay makes a plea for a heritage-based planning approach in tackling drought and water scarcity. For that approach to succeed, a closer cooperation between the separate disciplinary and professional fields of water management and heritage conservation will be needed.

Key words: **drought, water scarcity, sandy soils, cultural heritage, the Netherlands.**

1 INTRODUCTION

>> It is July 2018. The Netherlands are facing an exceptionally dry summer. It has not rained for over six weeks in the village of Soerendonk in the (southern) province of Noord-Brabant. Precipitation deficit is a great threat to the crops of potato farmer Twan van der Heijden. When inspecting his land, he discovers an unusual phenomenon: thin, dark-green lines run through his barren, sallow fields.

In the national newspaper *Het Algemeen Dagblad*, Van der Heijden said that at first, he could not figure out what those lines were (Boere, 2018). The farmer then took out his drone and filmed his land from above. On the drone images, the dark-green lines on his land were clearly visible (Figure 1). The farmer's father immediately noted that the lines corresponded with where once ditches used to run. Those ditches were filled in during the land consolidation in the 1970s. Apparently, the conditions in those ditches were still more humid than elsewhere on the land. Old maps of the sandy landscape showed the father to be right. It is the finely grained and water-rich landscape from before the land consolidation that is coming to the surface because of the drought.

FIGURE 1
Landscape history revealed through drought on fields farmer van der Heijden
Source: Van der Heijden

Farmer Van der Heijden was not the only one making such a historic discovery in 2018. The drought brought to light old landscape structures in various places in the Netherlands that would normally have remained largely hidden. The contours of old, vanished structures, such as farms, cemeteries, and castles, became clearly visible in the landscape. On top of such ruins, plants have less soil available, which becomes visible when there is a shortage of water. The fields of farmer Van der Heijden however showed that it also works the other way round: filled-in ditches can, with their deeper soil, lead to larger, greener plants: they thus leave 'positive' traces in the landscape.

This raises the question whether we can learn from those old traces in our landscape. Do they only have a historical significance, or are they also relevant to the current task of tackling drought? That is the question at the heart of this essay. We explore the possible contribution of water heritage to a drought resilient sandy soil landscape in the east and southern provinces of the Netherlands. In these sandy areas, the social, ecological, and economic consequences of droughts are considerable. Regional stakeholders are looking for ways to better mitigate the impacts of drought, thereby preventing water shortages that could harm nature, farmers, industries, and citizens. A transition in water management is needed, from rapid drainage to retaining as much water as possible.

In search of landscape structures that offer long term, drought resilient solutions, it is our opinion that the past, written in the landscape, offers a way forward in this challenging planning transition. In fact, the pre-modern landscape traces on the images of farmer Van der Heijden show planners and water engineers the way to a (more) water-rich and drought resilient landscape. The thesis we develop in this essay is that both tangible and intangible water heritage is a relevant source of knowledge and inspiration for tackling drought on the sandy soils. We discuss the idea that water heritage can serve as a platform for drought resilient landscape planning. By using historical knowledge and reusing old water structures, systems, and practices, it is possible not only to preserve heritage and its surrounding landscape but also to counter the shortage of water during dry periods.

To substantiate this thesis, we will first consider the complex problem of drought in the Dutch delta. We focus on the consequences of drought on the elevated sandy soils in the Netherlands, and the possible solutions that are being explored. Second, we describe the current search for so-called 'nature-based solutions' to tackle drought and show that history can serve as a source to spatially contextualize these solutions. Third, we show that the water systems and accompanied customs and practices of the pre-modern sandy soil landscape offer starting points for drought resilient landscape planning. We illustrate this with the analysis of the revitalization of a medieval watermill landscape in the province of Noord-Brabant and the Lankheet Estate in the province of Overijssel. Our case study approach draws on different sources (historical maps, policy documents and plans) to investigate the role water heritage plays in planning for drought resilient landscapes. Fourth and finally, we discuss the findings of the case studies, and make a plea for a strategy of heritage-based planning in tackling drought on the sandy soils. For such a strategy to be successful, a closer cooperation between the largely separate disciplines and professions of heritage and water management is needed.

2 DROUGHT IN THE DUTCH DELTA

2.1 Challenging traditional water management

The Netherlands have a long tradition of urban and regional planning, which is largely based on dealing with water. It is the fight against water ('keeping dry feet') that has had a considerable influence on the way towns and landscape have been shaped, particularly in the western part of the country (De Klerk & Van der Wouden, 2021). Combating the excess of water in the Dutch delta is part of the planning culture and expressed in (historical) institutions and programs, such as Room for the River, that seek to increase the capacity of rivers to cope with high water levels (Meyer, 2016). The Dutch live in a delta where the landscape is designed to discharge water as quickly and efficiently as possible. However, climate change is currently putting this form of water management to the test.

The dry and hot summer of 2018, when farmer Van der Heijden discovered the written history on his land, showed that not only the excess but also the shortage of water is emerging as a problem. This was unexpected for many. With a lot of engineering and quick fixes, the Dutch waterboards kept the 'water machine' running in 2018, but some areas took a long time to recover from the drought (De Louw et.al.,2022). It is very likely that albeit those efforts, there is permanent damage to nature, urban contexts, and agricultural areas. The year 2018 demonstrated how much economic damage extreme drought can cause, particularly in the agriculture and horticulture sectors. It also had a negative impact on nature and on water quality in nature reserves and brooks. Moreover, 2018 was not an isolated event but was followed by the equally dry years of 2019 and 2020, and more recently 2022.

Drought, in this essay defined as 'a below normal water availability', confronts the Dutch with the limits of the 'makeability' of the current water system.[1] For decades, the Dutch landscape has been adapted to the needs of an expanding society and economy by means of technology and large-scale planning interventions, such as land consolidation and the implementation of drainage systems (Metz & Van den Heuvel, 2012; Meyer, 2016). The importance of the substratum and its eco-hydrological systems as a foundation for spatial planning gave way to technical feasibility (PBL, 2021). Interventions were geared to eliminating excess water, creating the perfect conditions for modern agriculture and urbanization. That is how the Dutch managed water, which seemingly did not cause any visible problems, since there was sufficient rainfall during the (drier) summer period.

In recent years, however, the drier periods have increased in duration and intensity. Scenario analyses for the Netherlands predict that due to climate change, prolonged periods of drought (alternating with periods of extreme rainfall) will occur more often in the (near) future (Klein Tank et.al., 2014). As a result, the relatively new problem of drought and (related) freshwater shortage rises on the Dutch spatial planning agenda. Several authorities, most notably the Delta Commissioner and the Minister of Infrastructure and Water Management, acknowledge that water boards, drinking water companies and farmers need to improve their ability to cope with (longer) periods of drought (Ministerie van IenW, 2022). Traditional water management, based on drainage and fast discharge of water, might no longer be effective in a changing climate.

2.2 Elevated sandy soils under pressure

The growing ineffectiveness of traditional water management certainly holds true for the elevated sandy soils in the eastern and southern provinces of the Netherlands. These areas are more prone to be impacted by drought. During the recent consecutive dry years, major rainfall deficits occurred throughout the country, but the elevated sandy soils had to deal with larger precipitation shortfall and the most intense drought. Groundwater levels dropped

1 Though a precise definition of drought is contested, it generally indicates a shortage of water at a certain point within the so-called hydrological cycle, often during a prolonged period. Depending on the impact of water shortage on the water-cycle, society, and nature, there are different types of droughts, such as meteorological drought and hydrological drought. The first type of drought is generally defined as a prolonged lack of precipitation. When prolonged rainfall deficit persists, most notably during the summer season, it can develop into other types of droughts, such as hydrological drought. This type of drought occurs when rainfall deficit and temperature deficiencies have such an impact on the hydrological cycle in a certain area that the balance is negatively impacted. This manifests itself, for example, in falling groundwater levels.

considerably and brook streams and fens fell dry, with negative effects for both nature and agriculture. Crops and wet nature reserves, with their exceptional flora and fauna, were damaged.

The sandy soils' vulnerability to drought is the result of several factors. First and foremost, is their (sole) dependency on rainwater. In contrast to the western lowlands, which can be supplied with fresh water from rivers and other freshwater sources, such as Lake IJsselmeer, the elevated sandy soils have no direct access to rivers. Hence, they are dependent on precipitation and groundwater for their freshwater supply, making these landscapes especially vulnerable for summer droughts and precipitation deficits. Consequently, drinking water companies, industries, and farmers use deep and shallow groundwater for their operational processes.

Second, and related to the extraction of large quantities of deep and shallow groundwater, is the intensive land-use and the design (and management) of the related water system. Traditionally, the logic of the sandy soils depends on a hydrological connection between upper and dry sand ridges ('recharge area') and lower and wetter courses of the brooks ('discharge area') through groundwater flows. Rainwater that falls on the sand ridges infiltrates, and flows through aquifers towards the brook, where it wells up, resulting in wetlands. From the late nineteenth century onwards, this gradient landscape, with its alternating surface sand ridges, plains, meandering brooks, and a predominantly small-scale mosaic of extensive farmland, was radically altered (Deltares, 2021).

Both above and below the ground, the water system was adjusted to a more intensified agricultural use, including the construction of ditches and the normalization of brook valley streams. Deep drainage systems were constructed to dewater the lower wet areas and to drop the groundwater table in the upper sand ridges, thereby facilitating intensive farming systems, maximizing crop yields by high fertilization and ample water supply (Bieleman, 2000). Furthermore, deep groundwater was extracted for drinking water and industrial use and shallow groundwater for irrigation of agricultural land. With the construction of canals, ditches, the drainage of agricultural plots and the extraction of large volumes of groundwater, the once water-rich sandy landscapes turned into a highly effective 'drainage machine'.

This machine had (and has) but one goal: directing the water as quickly as possible to the (canalized) streams and via canals and rivers to the North Sea. As a result, the precipitation surplus during fall and winter periods is drained with high speed and can no longer be of use in the dryer months. Moreover, the combination of dewatering, drainage and groundwater extraction for drinking water and industrial use lead to the structural lowering of groundwater levels.

Since the 1950s, the groundwater table in the sandy soil regions has dropped by 0,5 to 1 meter, and in some areas even by 1,5 meters (Witte et al., 2019). The structurally lowered groundwater levels result in a water system under continuous stress, particularly during prolonged periods of drought. Then, groundwater levels drop even further, and water availability for wet biotopes, soil subsidence in peatlands, agricultural use and drinking water production comes under pressure.

2.3 Water as a limiting factor

Intensive agriculture, drought-sensitive nature reserves, and groundwater use for drinking water supply at close proximity to each other not only leads to a water system under pressure, but also to ever greater conflicts in land-use and spatial planning on the sandy soils. For example, lowering groundwater tables, using shallow groundwater for irrigation of crops as well as the extraction of deep groundwater for drinking water supply, complicates the preservation of nearby situated wet nature reserves that benefit from a high groundwater level in a wide zone around the protected area. The preservation of these fragile, protected nature reserves is becoming an increasing problem.

Governments are less and less likely to be able to meet the legally defined conservation goals, as mentioned in the (European) Birds and Habitats Directive and the Water Framework Directive (Bastmeijer et al., 2021). It is expected that - in the absence of a change of policy – pressures on the water system and resulting land-use conflicts will intensify. In the years to come, water demand will increase because of expected economic and population growth. And as the current trend of increasing annual temperature continues, the sandy soil regions will face even longer and more extreme periods of drought in the (near) future (Philip et al., 2020). The process of lowering the groundwater level is further reinforced by an increase in water consumption by farmers, industries, and citizens.

During dry periods, farmers use sprinkler irrigation from shallow groundwater to keep their crops alive. In the province of Noord-Brabant, for example, registrations show an increase of groundwater use by the agricultural sector from 40 to 100 million cubic meters during the very dry year of 2018 (Adviescommissie Droogte, 2022: 44). The same holds true for the (seasonal) increase in drinking water supply because of citizens who want to water their gardens or fill their swimming pools. Already in 2020, several drinking water companies operating in the sandy soils, called on people to stop watering their garden, washing their car, and filling their pools. On hot days, drinking water consumption increased by 30 to 50 percent, and put such a strain on groundwater resources that the supply of drinking water was jeopardized (Vitens, 2021).

With the expected increasing water demand and intensifying droughts because of accelerating climate change, we are rapidly reaching the limits of the 'drainage machine' that the sandy soil landscape has become. The landscape is already barely able to cope with prolonged periods of drought and expected developments will exacerbate rather than alleviate this situation. Many hydrological experts believe that if current trends progress, water availability becomes a significant limiting factor for both the natural environment and many economic sectors on the elevated sandy soils. To prevent (future) water shortage and drought damage on the sandy soils, a radical transition in the lay-out and governance of the water system is needed (De Louw et.al., 2022).

3 REVITALIZING WATER HERITAGE FOR DROUGHT-RESILIENT LANDSCAPES

3.1 Reversing the trend of 'engineering the landscape'

Over the past century and a half, humans have adapted the sandy soil landscape to accommodate an increasingly intensive exploitation. It is not too much to say that many of the current problems caused by drought are the result of modern land-use. Successive rounds of land consolidation have engineered the sandy soil landscape to accommodate any function in any place, regardless of the conditions of soil and water. This resulted, for example, in agricultural use of the once wet, low-lying parts of the landscape, with farming up to the edge of the valley stream. Function dictates the (ground)water level, rather than the other way around.

Climate change sets pressure on this already over-tightened water system on the sandy soils. The current system lacks the necessary resilience to cope with weather extremes. Even after relatively short periods of drought various ecological and economic functions suffer from water shortages. Contemporary technological solutions, such as subirrigation, might contribute to improved soil moisture conditions, but the water volume needed for sub-irrigation can be large and potentially puts (even more) pressure on the regional water sources (De Wit et.al., 2022). If the sandy soil landscape wants to regain its resilience, water needs to be retained, stored, and buffered much longer, so that reserves are built up that can be used in times of drought. Consequently, the groundwater levels must be raised in order to 'feed' ecosystems, agricultural land, and urban use.

According to many experts, the challenge lies in designing and developing a water system that stores as much water as possible (in the subsoil) during the (wet) winter months and can retain as much water as possible during the (dryer) summer months, with sufficient capacity to drain off excess precipitation water during peak downpours (De Louw et.al, 2022). In other words, the sandy soil landscape must become a 'sponge' again, which is better able to retain the water and release it (gradually) when weather conditions require it. Recent government reports on drought resilience therefore stress the need of adapting the land use to the possibilities the soil and landscape offer, instead of adapting the soil and landscape to the desired land use (Deltares, 2021; Adviescommissie Droogte, 2022).

It is against this background, that more and more planners, hydrologists and water managers want to reverse the trend of engineering the sandy soil landscape with man-made, technological solutions to meet economic needs. To make the sandy soils more drought resilient, they instead opt for adaptation planning, based on so-called 'nature-based solutions' (Baptist et al., 2019). Many are searching for a sandy soil landscape where there is (more) room for natural, ecological, and hydrological processes. That seemingly is a great idea, but how can this be done properly? What is the route towards a climate resilient sandy soil landscape that is better suited to deal with more intense and longer periods of drought? Is, in this case, the way back perhaps also the way forward?

3.2 Heritage as an inspiration for designing drought-resilient landscapes

Of course, we cannot literally go back to the past. The past is a foreign land, 'they do things differently there', as L.P. Hartley once stated (Hartley, 2015). Today's sandy soil landscapes are more densely occupied and used than one and a half centuries ago. But if we strive for 'nature-based' solutions, the largely forgotten, neglected, and sometimes even lost past of pre-industrial land use and its water heritage can be a source of inspiration for a drought resilient future (Bakels & Elpers, 2021). Indeed, historical water systems, interwoven with past land use practices, provide a rich reservoir of solutions that seem better adapted to dealing with drought than current technology-driven ones (Willems & Van Schaijk, 2015).

The historic resources of the pre-industrial sandy soil landscape could point the way towards a situation in which natural processes were still dominant and the soil characteristics and hydrological conditions largely determined (agricultural) land use, instead of the other way round. Their low(er)-tech solutions for the use of water are not 'frozen' heritage but can also be helpful for designing the future. In a reflection on the major challenges the Dutch rural areas face, landscape architect Dirk Sijmons also hints at the pro-active role water heritage can play in 'healing, reconnecting, undoing and de-engineering what technology-driven water management has disturbed over the past one and a half century' (Sijmons, 2020: 21).

Sijmons' suggestion to reuse pre-industrial wisdom as an important tool in managing water resources comes as no surprise. Over the last decades heritage management in the Netherlands has shifted from being a separate sector in society, run by experts and focused on the conservation of individual buildings, to a 'vector' in which many stakeholders transform heritage to make and shape the living environments of the future (Janssen et al., 2017). The intertwinement of heritage and spatial planning is closely related to the idea that heritage can be used as a resource to achieve certain local development goals, such as making places attractive to residents and tourists, strengthening people's attachment to places, and branding and promoting places (Holtorf and Fairclough, 2013). Dutch heritage management tries to move from the idea that the consequences of climate change are 'a threat to heritage', to heritage being part of climate mitigation and adaptation (Fatoric & Egberts, 2020). Subsequently, it is argued that the past matters when we design new relationships with water in the wake of climate change: 'Water related heritage preserves and transmits forgotten best practices and catastrophic events. It harbors the long histories of water systems and safeguards our cultural memory for generations to come' (Hein & Kolen, 2020: 4). Water heritage is relevant to the redevelopment, redesign, or reuse of existing and ancient water systems as well as to the design of new systems that are more adapted to the consequences of climate change.

3.3 Putting tangible and intangible water heritage 'at work'

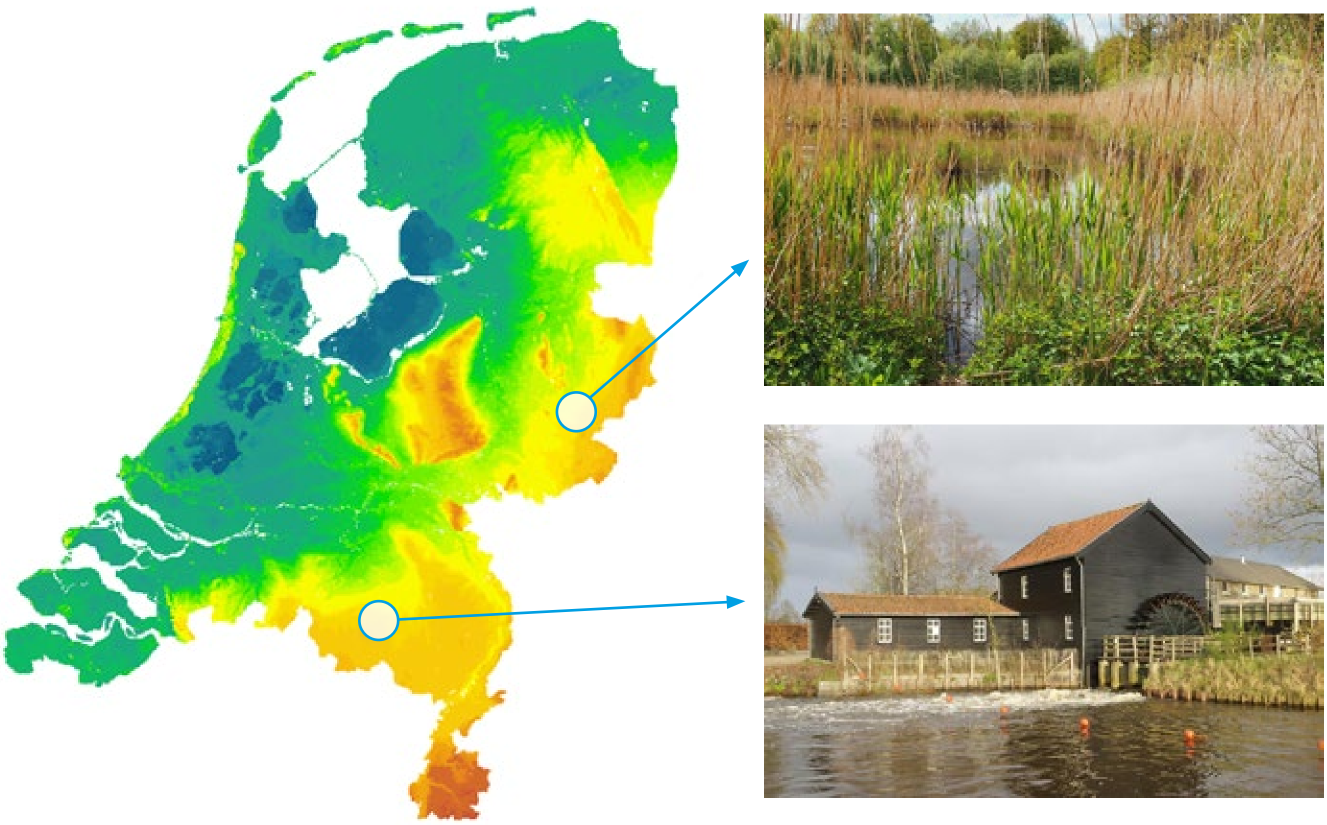
Over millennia, people have created immensely rich and varied, often interconnected systems to manage water. Today, the tangible, material remains of these systems are called 'water heritage'. Linked to that tangible heritage is often an immaterial history of intangible (forgotten) management systems, customs, practices, and behavior. That intangible heritage encompasses local knowledge and skills and regional traditions in water engineering, closely related to the specific soil and hydrological conditions of the area in question. The concept of 'water heritage' thus refers to the inherited tangible landscape and their associated intangible practices and management systems, which are believed to have much to teach us about sustainability and resilience in the face of climate change (Willems & Van Schaijk, 2015).

In contemporary heritage management it is possible to learn 'sustainability out of the past' by analyzing the evolution of water systems, their use, and alterations in time with digitalized historical sources (RCE, 2018; Vreenegoor & Kosian, 2022). The historical knowledge thus provided, can act as a basis for 'retro-innovation' in (adaptation) planning, which can be understood as an active rediscovery of marginalized and often forgotten knowledge and expertise that combines elements and practices from the past and configures these elements for new and future purposes (Zagata et al., 2020). Building on this notion, Hein & Kolen (2020) point out that new investigations of water heritage (both tangible and intangible) can serve as a source of (1) knowledge, (2) inspiration, and (3) identity-building, and therefore cooperation, in contemporary water management and climate adaptation planning.

In the next sections, we highlight how these (three) different sources of water heritage can be put 'at work' in the sandy soil landscape. We do so by means of two cases which offer a comparative perspective, namely the revitalization of a medieval watermill landscape in Noord-Brabant and the Lankheet Estate in Overijssel. Both cases are situated near a brook valley stream and aim at increasing the water retention capacity of the sandy soil landscape (Figure 2). Whereas in Noord-Brabant the largely forgotten past of pre-industrial water (mill) *structures* are put forward to counter drought and water scarcity, in Overijssel the focus is on revitalizing old water (management) *systems*, and their associated practices.

In what follows, we first describe the case of watermill landscapes in Noord-Brabant. The tangible heritage of the Venbergen, Opwetten and Spoordonk watermills and their surrounding landscape is rediscovered and redeveloped in order to increase the sponge function of De Dommel and Beerze valley streams. Second, we highlight the case of the Lankheet Estate, situated near the village of Haaksbergen in Overijssel. On this old estate, the intangible heritage of irrigation by means of flood meadows is combined with contemporary crop knowledge to revitalize the brook valley landscape of De Buurserbeek.

FIGURE 2
Lankheet Estate and watermill landscapes situated on the sandy soils in the Netherlands
Source: Actueel Hoogtebestand Nederland



4 PAST FORWARD IN NOORD-BRABANT AND OVERIJSSEL

4.1 Case 1: Rediscovering and redeveloping watermill landscapes

The Venbergen, Opwetten and Spoordonk watermills are situated in the middle course of De Dommel and Beerze valley streams in Noord-Brabant. Although these watermills were mentioned first in official documents around 1200, it is estimated that some have been operational for about 800 to 1000 years, starting around 900. They were part of a network of in total 83 watermills in Noord-Brabant, of which only 12 watermills remain.

Watermills were pivotal in pre-industrial water management on the sandy soils, as they provided a means of working with the (peak) flows of the brook valley streams. They could arguably be called the first hydropower plants, making use of the water current to process wheat, saw logs or press oil from seeds. Mills were built on strategic places, where water was abundant, with enough gradient, and where building a mill was easy and the brooks were relatively small. The surroundings of the mill provided fertile grounds, suitable for working the land. Hence, those places saw a lot of activity. This makes watermills palimpsestic places where a lot of history is 'stored' in the landscape.

Although the solitary structures of the watermills were designed to cooperate with the land, they also started to alter their surrounding landscape and became a defining factor in the ecological development and shaping of the sandy soil landscape (RHDHV, 2013). Over time watermills created so called 'watermill landscapes'. These landscapes had specific characteristics because of the functioning of the watermill and can roughly be divided in two parts. The first, upstream part was wet, due to a dam that was constructed to raise water levels in the brook in order to set the mill in motion. The landscape 'behind' the mill got wetter over time. Those backstream, wet landscapes became host to a specific array of aquatic nature, such as peat grounds, 'brookforests', sedge-marches and wet grasslands.

The second, downstream part of the watermill landscape, is often called 'millbrook', and also developed specific characteristics. It provided space to store water and the often-silty rich waters provided a natural fertilizer for the so-called 'beemden'; grasslands in the brook valleys. This part of the landscape also provided a migration and living area to all kinds of plant and animal species, among which are a variety of (currently endangered) brookfish.
For centuries, watermill landscapes thus acted as water storage areas. Running water was slowed down and halted at the dam, creating the specific landscape upstream, but also keeping the water from 'being lost' downstream. In times of downpour, running water was slowed down and gradually passed the mill, preventing flash floods downstream. In times of drought, the dam kept water available in the upstream landscape, making sure it provided the much-needed

water and preventing the damage to nature and crop. As watermills lost their function because of the mechanization of water management, so did the (surrounding) watermill landscapes. Whereas some (iconic) watermills became designated as monuments, the surrounding landscapes (and their use as water storage) were largely forgotten. The heritage of those landscapes is, however, often still visible. In places where the landscape is levelled out, but human activity is minimal, the stream valleys are still dominated by 'brookforests' and marches. In places with more human activity, there is more variety in the landscape, ranging from peat marches to forest marches, combined with wet grasslands, often bordered by wooded banks.

FIGURE 3
The Venbergse watermill
Source: Molendatabase
Photo: Gerard Sturkenboom

Until recently, the potential of historic watermills for climate solutions was hardly taken into account in planning processes to reconstruct stream valleys. Water managers and heritage professionals regarded them merely as individual and solitary monuments to be preserved, without regard for their function in the landscape and possible water storage potential. The rediscovery of the functioning of the lost landscape heritage of the watermills began with the commitment of the residents of the mills. Some of them were interested in not only restoring their watermill but also making them run again, and they began to decipher how these mills functioned in the early days (Van Paassen, 2022).

If they ever wanted to grind grain again, it was important that they could dam the water behind the mill in order to create the necessary waterflow to get the wheels running (Figure 3). They then slowly but gradually found out that by damming the water, the landscape behind the mill changed. Running the mill impacted the dynamics of the stream and the backwater areas. Based on existing historical eco-hydrological studies of water mills, they found out that their mills appeared to be part of a large and coherent watermill landscape that extended for miles upstream and resulted in a specific flora and fauna.

The newly acquired knowledge about watermill landscapes was initially met with disinterest from governments. However, the extremely dry years of 2018 and 2019 brought about a turnaround. The province of Noord-Brabant and waterboard De Dommel became more receptive for unorthodox solutions to combat drought. The potential of the (network of) watermill landscapes for climate adaptation became acknowledged, and new heritage programs at the national and provincial level created the (financial) opportunity to explore and exploit this potential. Subsequently, civic society and government organizations, like the Mill Foundation Noord-Brabant, the province of Noord-Brabant and waterboard De Dommel, joined forces to work on the redevelopment of watermill landscapes.

Currently, the water retention potential of the watermill landscapes of Venbergen, Opwetten and Spoordonk is investigated. Research shows that the capacity for water storage can greatly increase by reinvigorating the old landscape elements and structures. It is estimated that the revitalization of (old) watermill landscapes in Noord-Brabant could lead to 300 to 400 acres of extra brook valley stream landscape. In wet periods additional space is created for water storage. In dry periods, the watermill landscapes retain water longer, which prevents natural and agricultural land from drying out. By storing and buffering water, watermills also contribute to the prevention of flooding downstream (RHDHV, 2022b).

Reinstating old landscape structures in Venbergen, Opwetten and Spoordonk can meet several ecological goals, from enabling fish to migrate, to restoring aquatic nature. Revitalizing the functioning of the mills, and its accompanying dams, would make an end to the 'unnatural water-level regime' whilst enabling buffering of water during peak flows (RHDHV, 2022b). Additionally, the potential of watermills also shows that reinstating the watermill landscape contributes to the recognizability of the local landscape and increases its amenity value (RHDHV, 2022a).

The government-funded research into the potential of the watermill landscapes for contemporary, drought resilient purposes, not only results in new knowledge about the functioning of these landscapes, which can then be used for their redevelopment, but also supports a process of (regional) identity building. The organizations involved in the project also use the research to increase awareness for the special history of the watermill landscape among a wider audience. Building on the legacy of Van Gogh's famous painting of the (nearby) Collen watermill (1884), the iconic status and value of these heritage structures is being exploited to enhance the connection between urban society and the landscape.

4.2 Case 2: Revaluing and reapplying old irrigation techniques

The Lankheet Estate is situated on the banks of the Buurserbeek, a small river that springs from several streams, among which is the German Aa near Ahaus. Eventually, the Buurserbeek becomes the Schipbeek and ends in the river Ijssel near Deventer. The river played an important role in the shaping of the landscape; as a life support for the region, from grain mills, dewatering to agriculture and shipping. Haaksbergen, the small village along the Buurserbeek, proclaims that 'the Buurserbeek has always been important to Haaksbergen'.[2]

The Buurserbeek allowed famers to fertilize their land using the mineral rich water; a historical agricultural form of so called 'flood meadows'. These flood meadows were pivotal to pre-modern agriculture. For centuries, farmers used to fertilize their grasslands using local mineral rich groundwater and brookwater. The process involved flooding the grasslands, after which the mineral rich water would fertilize the land. Flooding the grasslands this way had several other benefits. Flooded grasslands are protected from freezing in winter, resulting in farmers being able to start growing crop again early in the growing season. Furthermore, insects and animals that normally would damage the crop were prevented from reaching the ground, increasing the yield of the land. In the dry months of the summer, an ingenious irrigation system, consisting of small (human made) brooks, reservoirs and canals was used to irrigate the land. The methods to create this nutrient rich landscape became suitable to growing a variety of crop, with a yield that is comparable to modern day agricultural methods. (based on three harvests a year).

These flood meadows disappeared however, when artificial fertilization made pre-modern ways of fertilizing redundant (Baaijens et.al., 2011). The earlier mentioned agricultural modernization had a large impact on the surroundings of the Buurserbeek. And starting in the 19th century, roads, waterways and residential areas further altered the flow of the Buurserbeek. Where it once took water from the Buurserbeek around 16,5 days to reach Deventer, it currently is about 9 hours. Brookforests and fens used to slow down the water, allowing it to saturate the surrounding landscape. Where previously all the small brooks used to be connected, everything got segregated. The ingenious, small scale brooksystem, once used by farmers in the region, was destroyed. Eric Brinkmann, steward of the Lankheet Estate, explains that they wanted 'to restore that system to its old glory' (Het Oversticht, n.d.).

The idea started when a brewery was looking for a new source of water. The search resulted in researching the old flood meadow system of the Lankheet

2 'Veur Hoksebarge hef benaamd de Buurserbek aait belangriek west'. Translated from regional dialect to the Buurserbeek has always been important to Haaksbergen' (Haaksbergen Natuurlijk, n.d.)

Estate. Although the brewery choose another location, the idea to restore the flood meadows remained. The process of drawing up the development of the restoration plans, resulted in consulting old maps of the estate. Those maps showed the old flood meadows of the family Van Heek, who used to own the estate. 'But we didn't know what those where', explains Eric (Het Oversticht, n.d.). An expert from the university researched the maps, and discovered that it contained not only 19th century flood meadows. Landscape elements, like the small scale brooksystem, consisting of reservoirs, wallets and a distribution system visible on the map, indicated that the map also contained a medieval flood meadow system. A historical find. These old landscape elements formed the basis of the reconstruction of this historical watersystem. (Het Oversticht. n.d.) Not to yield crop, but to combat drought, restore nature, store water and to (re)create the heritage for recreation.

At first, the local groundwater conditions proved to be too enriched[3] to meet the nature restoration goals. In tandem with the Wageningen University (WUR) and Plant Research International, the estate came up with a plan in which the water of Buurserbeek is used to irrigate the meadows (Het Landschap Van Het Lankheet, 2022). Those meadows are filled with reed (Figure 4). The reed 'purifies' the water of the high amounts of nitrogen and phosphorus, after which the water is returned to the Buurserbeek, using the old waterways. To make sure the stored nitrogen and phosphorus in the reed does not unnecessarily enrich the ground, the reed has to be mowed and taken of the land. The reed however, has a high caloric value, making it a suitable as biofuel. Working the reed filtration system this way, prevents it from having to be cleared and replanted after a couple of years (Het Landschap Van Het Lankheet, 2022).

FIGURE 4

The Lankheet 'Reedfilter'
Source: Shutterstock

3 Eutrophication: the process in which water becomes progressively enriched with minerals and nutrients, particularly nitrogen and phosphorus

With the restoration of the Buurserbeek, local brook forests and brook specific ecosystems are being developed and the flood meadows are reinvigorated using purified water. These meadows are now flower rich grasslands. And, the soil is restored to a more vital, healthy form resulting in an increased CO_2 intake and more water storage. This also reduces the risk of floods downstream, as the stream valley of the Buurserbeek is designed to store water and serves as flooding area in times of (extreme) downpour.

The intangible heritage of flood meadows might be used to create a water rich landscape, in another interview Eric expresses the relationship people develop with such places. He notes that 'what we do, is move with the landscape. We follow the water'. And their involvement in the restoration of biodiversity and creation of a robust landscape stimulates the volunteers to 'be emotional co-owners of the landscape' (Bakels & Elpers, 2021: 39). Henri, one of the volunteers working on the flooding of the meadows explains: 'everything is connected and the stories of the history of the estate is part of the identity of region' (Het Oversticht. n.d.).

Present day, 'historical functions and traditional practices are combined with a modern twist' to create a climate robust landscape. The use of (in)tangbile heritage results in a modern estate, based on the 800 year old history of the landscape. The estate consists of several landscape elements, from historical property to 14th century wet grasslands. Those wet grasslands offer an innovative way of creating a landscape able to withstand both wet and dry conditions, and at the same time create a biodiverse landscape with heritage elements for recreational purposes (Het Landschap Van Het Lankheet, 2022).

4.3 The past as a present for the future

Increasing the hydrological sponge function of the landscape is one of the cornerstones of building more drought resilient sandy soils. Both the revitalization of the heritage of watermill landscapes and the former irrigation systems on the Lankheet Estate are focused on restoring that function by means of a partial convalescence of the historical situation. It is believed that by re-using old water structures and systems, the negative effects of drought on the current water system can be counteracted.

Table 1 shows a synthesis of the case-study results and how water heritage can be used in a contemporary planning context: as a source of knowledge, inspiration, and identity-building respectively. Both cases have many similarities in the way in which the past is (re)discovered and (re)used for contemporary purposes in the face of climate change and extensive periods of drought. The systemic approach with which the water heritage is approached is striking; it is not conceptualized as a static object, but as a dynamic and evolving process, and as part of a broader, eco-hydrological system. A better understanding of the functioning of the system of water retention and irrigation respectively, is used as inspiration for re-introducing nature-based and more resilient water landscapes. These landscapes, in turn, act as sources for local and regional identity-building.

TABLE 1
Comparing the revitalization of watermill landscapes and the Lankheet Estate.

Water heritage as....	Watermill landscapes Noord-Brabant, De Dommel	Lankheet Estate Overijssel, Buurserbeek
Knowledge	Rediscovering the functioning of the cultural heritage of medieval water mills as part of a wider eco-hydrological system of backstream and downstream landscapes.	Rediscovering the cultural heritage of a medieval estate and its pre-modern agricultural system of irrigation (and fertili-zation) by means of flood meadows.
Inspiration	Functioning of watermill land-scapes and their capacity for water retention is (re)used to create wetter brook valley landscapes and combat drought.	Flood meadow irrigation system is (re)introduced on the estate to purify local brookwater and to create a more biodiverse and waterrich landscape, which better withstands periods of droughts.
Identity-building	The iconic status of the watermill landscapes is exploited by the Van Gogh National Park to enhance the social connection between urban and rural society.	The estate is positioned as a laboratory to experiment with old water management methods, to tell stories of the region's history and to make local people co-owners of the landscape.

In addition to the above-mentioned conditions, the unwavering commitment of the owners of and involved individuals with the heritage estates should be highlighted as an important part of the success. Their perseverance made it possible to overcome initial opposition or indifference on the part of governments, water boards and heritage organizations. They saw the past landscape as a present for a drought resilient future. And they recognized the potential of the water heritage, and related stories, as a means to connect people and places in times of climate change. The many volunteers currently involved show how much cultural history and heritage are unifying factors for local communities to being active in and relate to nature and landscape.

Both the watermill landscapes and Lankheet Estate are not standing practice in water management and heritage conservation. One could best position them as experimental and innovative spaces, in which heritage owners, governments and civic organizations work together and discover what works when revitalizing old water heritage structures and systems for future purposes.

The experimental status of these spaces is confirmed and perpetuated by attention from provincial, national, and international programs. In Noord-Brabant, the revitalization of the water retention function of watermill landscapes is part of a broader regional development of the Van Gogh National Park and, the flood meadows on the Lankheet Estate are being nominated by the national government as UNESCO World Intangible Heritage. However relevant and deserved this recognition is to both initiatives, the interesting question is how their results and experiences can be translated into wider practice on the sandy soils. In the following, final paragraph of this essay we will reflect on this question.

CONCLUSION AND DISCUSSION

>> In this essay, we have argued that in the search for solutions for a drought-resilient landscape on the sandy soils, water heritage can play a stimulating role. Those who follow the old traces in the landscape soon come across interesting water structures and systems that offer inspiration for the future. A future, in which scarce water is retained longer through an enlarged sponge effect of the landscape. A future, too, in which water management does not work against nature but actively cooperates with eco-hydrological processes.

Both the medieval watermill landscapes in Noord-Brabant and the Lankheet Estate in Overijssel show that knowledge about the landscape before the twentieth century large-scale interventions and land consolidation projects can contribute to a better understanding of how to adapt to periods of drought and water scarcity. The low(er)-tech and natural principles by which the hydrological dynamics of the brook valley landscape were dealt with in those days, most notably through creating backstream water storage and flood meadows, offer ideas for contemporary solutions to increase the water retention capacity of the sandy soil landscape. Indeed, these ideas have topical value. They can even be reapplied in present-day situations.

The cases of the watermill landscapes and the Lankheet Estate show that water heritage is not only a rich source of knowledge and inspiration, but also of adaptation planning potential. When we explore the (in)tangible heritage of waterways in the Dutch sandy soil landscape, we can touch upon how currently underused or vacant structures and systems can be reused. This is not only relevant for an increased understanding of the landscape and climate change, but as well as for practical, retro-innovative applications like water retention, irrigation, and outlets for peak supplies. Looking at the eco-hydrological history of the landscape gives water managers and landscape planners an idea of the nature of the landscape; how it changed over time and how the interaction of ecological processes and land use influences processes in the present-day landscape (Bas, Pedroli & Borger, 1990).

Historical knowledge is essential to unravel the logics of old water structures and systems and thus clearly identify opportunities for climate change adaptation. Of course, questions may be raised about the extent of the contribution that the revitalization of old water structures and systems can make to solving the drought issue. Set against the quantitative size of the need for water retention on the sandy soils, the contribution of both the watermill landscapes and the Lankheet Estate is negligible. However, from a more qualitative perspective, we would argue that both cases offer valuable contributions to the challenging task ahead. Following Vallerani and Visentin (2021: 126) in their discussion of new uses of old waterways, we too want to stress that water heritage like watermills and estates can act as 'cultural corridors'. These corridors connect past and future, natural base and anthropic intervention, old water management principles and new climate challenges.

Because of its rich history, water heritage can act as steppingstones for climate adaptation planning. Large groups in (local) society can relate to their history and built on that history to make the shift from 'fast forward' to 'past forward'. Many people long for a legible landscape, in which the new is embedded in the old (Drenthen, 2018). As water heritage can link contemporary challenges to the history of place, involving it in water management could smooth the interactive planning process of making the sandy soils more drought resilient (Alkemade in Monter, 2022). However, to do so more effectively, the barriers between the largely separate disciplinary and professional fields of water management and heritage conservation must be broken down. Both the process of the revitalization of the watermill landscapes and the Lankheet Estate show that it is not evident that the potential of water heritage is (re)used in contemporary water management and adaptation planning.

A world can be won when water managers recognize the value of water heritage for contemporary adaptation planning on the sandy soils and heritage professionals think and act beyond the traditional conservation reflex. When water heritage is conceptualized not as static objects, but as dynamic (re)source of systemic knowledge about the functioning of the past landscape and innovative, low-tech, and nature-based solutions to deal with drought, a whole new field of possibilities is unlocked. Building on the pioneering work for the watermill landscapes and the Lankheet Estate, provincial governments, water boards and heritage organizations should work together more intensively in the coming years to actively exploit those possibilities. Solitary experiments should be made part of a wider-range, area-based approach. Ultimately, we need to get to the point where even in the fields of a farmer like Van der Heijden, the old water structures and systems are revived and revitalized to retain more water. Only then do we stand a good chance of being more resilient to increasing drought.

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