

# VU Research Portal

## The amphibious culture along the Zuiderzee and the big rivers in the Netherlands, 1500-1850

van Dam, Petra J.E.M.

### **published in**

A comparative reflection about the Yangtze River and the Rhine  
2022

### **document version**

Publisher's PDF, also known as Version of record

### **document license**

Article 25fa Dutch Copyright Act

[Link to publication in VU Research Portal](#)

### **citation for published version (APA)**

van Dam, P. J. E. M. (2022). The amphibious culture along the Zuiderzee and the big rivers in the Netherlands, 1500-1850. In Z. Wang, & H. A. M. Klemann (Eds.), *A comparative reflection about the Yangtze River and the Rhine* (pp. 274-295). Zhongxi book Company.

### **General rights**

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal ?

### **Take down policy**

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

### **E-mail address:**

[vuresearchportal.ub@vu.nl](mailto:vuresearchportal.ub@vu.nl)

# The Amphibious Culture along the Zuider Sea and the Big Rivers in the Netherlands, 1500 – 1850

Petra J. E. M. van Dam  
Free University, Amsterdam

## Abstract

Before 1850 the low-lying areas of the Netherlands shared what I have termed an “amphibious culture”. The essence of this amphibious culture was a series of cultural adaptations to the wetland landscape. The first such adaptation was the construction of settlements on elevations. During times of flooding, settlements provided shelter for victims from the inundated countryside. In addition, they served as centres of coordination for infrastructural repairs, as well as sources of material and financial reserves for post-flood reconstruction. A second feature was the compartmentalisation of arable land, divided by interior dikes. This served to mitigate the adverse impact of floods by temporarily containing rising water levels. A third feature was the high potential of evacuation for both humans and animals due to the dense network of waterways and the wide access to boats. The amphibious culture model is derived from the coastal area around the Zuider Sea and, in this article, is applied to another low-lying part of the Netherlands, the River Region. Ultimately, the model contributes to understanding cultural and physical coping strategies and societal resilience to flooding.

## Introduction

Before 1850 flooding was a regular event in the low-lying areas of the Netherlands. In this paper I argue that those low-lying areas shared what I have termed an “amphibious

culture”. The essence of this amphibious culture, I argue, is a series of cultural adaptations to the wetland landscape. These adaptations began to disintegrate in the nineteenth century due to the application of industrial methods to address the problem of flooding.<sup>1</sup> Developing a model of an amphibious culture connects to an important question: Can knowledge of how human societies dealt with environmental change in the past, offer any lessons for the future? The wider global history of wetlands needs extensive research in order to promote global comparisons. In this paper I examine the case-study of the early-modern Netherlands (1500 – 1850) in order to construct a model of an amphibious culture for the purpose of future comparisons.

The model is derived from the coastal area around the Zuider Sea and I will apply it to another low-lying part of the Netherlands, the River Region, through which run the rivers Rhine and Meuse. The model for the Zuider Sea Region consists of three features: Firstly, the compartmentalised structure of the landscape; Secondly, the elevation of settlements; Thirdly, dependence on water-based transportation. *In normal times* these features allowed people and their animals to move swiftly and easily and between wet and dry parts of the landscape. *During disastrous floods* when water bodies grew larger and even borders between water and land became indistinct, this amphibious culture arguably reached its full potential. Both in dry and wet periods, the Dutch behaved like amphibians, feeling at home on both land and water.<sup>2</sup> The view I am taking in this article is somewhat unusual in Dutch historiography. A large body of literature describes and discusses the long history of the strong institutions for water management, which greatly contributed to flood prevention of settlements and fields.<sup>3</sup> However, I focus on the abnormal situations when dikes broke and the protective infrastructure failed, because with rising sea levels, the occurrence of flooding

<sup>1</sup> This article started as a paper presented at the conference “River Societies: old problems, new solutions. A comparative reflection on the Rhine and Yangtze Rivers, Rotterdam/Leiden”, 22 – 25 May 2019. I thank the participants for their highly valued comments and Luke Robert for the thoughtful editing.

<sup>2</sup> I introduced this theme in my Dutch-language inaugural lecture of 29 October 2010, Van Dam, *De amfibische cultuur*; the shortened version in English is Van Dam, “An Amphibious Culture”.

<sup>3</sup> A starting point for finding this literature is the journal, *Tijdschrift voor Waterstaatsgeschiedenis*. For reports of a recent project on the history of participation and representation in the water institutions, see the Special Issue of *Environment and History* 23 (2017) 3, introduced by Van Dam, Van Cruyningen and Van Tielhof, “A global comparison”. A case study of one of the oldest and largest water institutions: Van Tielhof and Van Dam, “Losing land, gaining water”. A reflection on 20<sup>th</sup> century management decisions: S. Kruizinga and P. Lewis, “How High is High Enough?”



disasters has once again become urgent.<sup>1</sup>

For the Zuider Sea Region I have taken material from several floods, in particular those that occurred in the years 1675, 1825, and 1916, for which relevant case studies exist.<sup>2</sup> For the River Region a multitude of studies and surveys exist on flooding, the flood of 1421 being the most famous case, due to the large inundation of dry land that was never reclaimed again, a very exceptional case.<sup>3</sup> In this article, I ask if the features of an amphibious culture are equally applicable to the River Region as they are for the Zuider Sea Region. Moreover, I describe one feature which stands out for the River Region, namely flood adaptations in the design of farmhouses and other farm buildings. Some of the more important studies on flood adaption in the designs of farm buildings, particularly in the River Region, have been synthesized by Judith Toebast in a Dutch language article. Toebast, however, focuses exclusively on design differences within the River Region.<sup>4</sup> My approach integrates the design adaptations in my model of the amphibious culture and investigates how they relate to the other elements in the model. Ultimately, the model contributes to understanding the resilience of society to flooding when large flood prevention infrastructure like dikes, broke.

### Environmental Characteristics

I want to introduce and typify a few environmental characteristics of the investigated areas. It is important to note that in the two areas different types of flooding exist. In

<sup>1</sup> As representatives of a sentiment among the wider audience, journalists have picked up this idea in recent years, Van der Stadt, *Nederland in 7 overstromingen* and in the Television documentary *Nederland in 7 overstromingen*.

<sup>2</sup> The floods in the Zuider Sea area of 1675, 1825 and 1916 resulted from dike breaches in areas to the west and south of the Zuiderzee so that the events have a fairly comparable geographic situation; the peaty low-lying wetlands. The dike breaches concerned were situated in the territories of the Regional Water Authorities of the West-Frisian dike (north of Amsterdam, near the town of Hoorn), of the Regional Water Authorities of the Noorder IJ- en Zeedijk (Waterland, north of Amsterdam, immediately opposite the IJ), of the Regional Water Authorities of Rhineland (south of Amsterdam), and of the Regional Water Authorities of the Diemer Sea Dike (east of Amsterdam), and in the province of Overijssel, where centralised dike management did not exist. I use the 1953 flood for comparison, it concerned mainly the province of Zeeland, the west of the province of Noord-Brabant and the south of the province of Zuid-Holland and involved many Regional Water Authorities. Most important access to these floods: 1675: De Bruin and Aten, *Een gemene dijk?*; 1825: Zeiler, "De 'vergeten' watersnood", Wieringa, *Watersnood in Waterland*; 1916: De Roever, "Watersnood in Waterland", Aten and Wieringa, *De Waterwolf*; 1953: Slager, *De ramp*.

<sup>3</sup> Floods in the River Region: Leenders, "Die inundacie" (1421); a historical survey of river flooding: Van de Ven and Driessen, *Niets is bestendig*; a short survey also in Van de Ven, *Man-made Lowlands*, 347-350; The role of a city: Bosch, "Nijmegen" (1781-1861).

<sup>4</sup> Toebast, "Voor als de dijken doorgingen".

the Zuider Sea Region, flooding was due to storm surges. The typical storm surge began with a few days of strong south-westerly or westerly wind, pushing water from the ocean into the North Sea Basin. Such weather often included a lot of rain, so the dikes, essentially earthen walls, became soaked. The south-westerly wind would then transform into a strong north-westerly storm that pushed the water from the North Sea into the Zuider Sea and other bays for several days.<sup>1</sup> In comparison, floods occurring in the River Region were the result of thawing of the river ice and heavy rain in countries situated in the upper parts of the Rhine and Meuse basins, namely Switzerland, France and Germany.<sup>2</sup>

The history of flooding shows spatial and temporal concentration. In the mouth of the rivers, the two types of floods occurred simultaneously when storm surges coincided with high water levels in the rivers. This area consisted mainly of river islands or "waarden", like the Riederwaard, Alblasserwaard, Grote Waard, and Krimpenerwaard, to name some of the largest. Therefore, these areas experienced frequent flooding, a rate of once every 15 years was not exceptional.

In the Netherlands, at the beginning of the sixteenth and during most of the eighteenth century, the frequency of floods seems to have increased due to both natural and human agency. In the sixteenth century it is likely that a lack of maintenance — due to a long period of economic decline coupled with extraordinary military expenditure — was the primary reason behind increased flood frequency. But this cause of increased flooding has been investigated mainly for the southwestern parts of the country that lie next to the North Sea — Flanders and Zeeland — as opposed to the Zuider Sea Region. In the eighteenth century it seems likely that canalisation of the rivers contributed to the effect of natural blockages formed by melting ice in early Spring. It was therefore human intervention in the river morphology that led to an increase in flood frequency.<sup>3</sup>

Another remark concerns the scale of flooding and that is related to the morphology of the landscape. On average, in the Zuider Sea Region, the difference between sea level and average ground level was small, typically in the range of one to three meters. The landscape in the low Netherlands is extraordinarily flat, no

<sup>1</sup> Franssen, *Dijk onder spanning*, 148 for the Zuiderzee.

<sup>2</sup> Van de Ven, *Man-made Lowlands*, 24-28.

<sup>3</sup> Soens, "Flood security", Van de Ven, *Man-made Lowlands*, 26-28.



mountains or stone layers break the surface, only the occasional sand or river dune. Therefore, when a dike breaks, the flood water would rapidly spread out across the landscape without accumulating in a valley or gorge. In some places the waves might reach relatively high heights, due to the wind pressure, but this could be counted in meters, not dozens of meters. A storm surge in the Netherlands was not a tsunami, not a wall of water rolling over the land destroying everything in its wake.<sup>1</sup> The one exception to this was formed by the so-called "droogmakerijen," reclaimed lakes with soil levels at 4 - 6 meters below sea level, a type of reclamation that started in the sixteenth century. These areas would turn into veritable bathtubs in times of flood, destroying the farms located in such areas. Due to the overall subsidence of the peaty soil, a typical example of human-induced environmental change, this effect of flooding became more common over time. The peaty coastal areas sunk, and the effects of floods became increasingly severe.<sup>2</sup>

In the River Region altitude differences are bigger. Where the Rhine enters the Netherlands at the German border, near the city of Nijmegen, the altitude is 11 meters above sea level. In some of the drained river islands and other areas along the river, differences in altitudes of 6 meters or more existed, and the water might flow down at a higher speed. Therefore, in the River Region, the flood water was potentially much more destructive than around the Zuider Sea, where a mild tidal regime predominated.

### Historiography

Floods can be approached from many different angles including scale, worldview, and risk culture. The impact of flood disasters (how bad was it?) can be measured in material terms. In one of his published lectures, the Swiss environmental historian Christian Pfister stated that the most common way to do that is to count the number of casualties and estimate the extent of damages (flooded villages, destroyed buildings, lost cattle and other capital), preferably expressed in monetary value, for the purpose

<sup>1</sup> A note on dike breaking: In all cases, the high water spilled over the dikes and eroded the dikes from within, from the landside, which is the less protected side. Then the dikes collapsed at one or more places. Repairing large and deep breaches took up to three months with thousands of labourers, Van Dam, "Digging for a dike".

<sup>2</sup> The lands sinks because the drained peat oxidises and this phenomenon contributed to the formation of inland lakes, Van Dam, "Sinking Peat Bogs".

of comparison.<sup>1</sup> The Dutch historical-geographer Elizabeth Gottschalk, in her famous survey of storms and floods, mainly takes into account the flooded surface area in order to estimate the extent of the impact.<sup>2</sup>

For the pre-statistical era, before 1800 or so, and in particular during times of social disruption, reliable figures are rare in the Netherlands, and that applies to most of Europe. A famous example is the claim in a chronicle of about 1500, that in the St. Elizabeth river flood of 18 - 19 November 1421, seventy-two villages drowned in the river island Grote Waard (near the city of Dordrecht). The claim was repeated over and over again in later sources. However, as Leenders and others before him stated, such a high number of villages certainly did not exist in that area. Yet seven is a holy figure in Christianity, so this means presumably "very many". On the basis of map analysis, tax records and other administrative sources, Leenders concluded that twenty-two villages were drowned, and the total number of affected people lied between 8,250 and 20,000, a wide-ranging estimate indeed. A local chronicle mentions 2,000 deaths, which is quite possibly the loss of this once-in-a-century flood.<sup>3</sup>

After 1800, more reliable verification of figures becomes feasible. A good example by historian Margriet de Roever refers to the flood of the region of Waterland (just north of Amsterdam) in 1825. She compares information from a descriptive, contemporary disaster study with administrative records relating date, place and time of death. Although Waterland was entirely flooded and is classified by many authors as a major disaster, only seventeen casualties were recorded, distributed over five villages.<sup>4</sup>

What one should retain is that although the Netherlands has experienced hundreds of floods since written records on floods began in the sixth century A. D., with averages of up to one in fifteen years (in particular at the river mouths), only rarely did mega floods occur. A special case is the last one of 1953. It captured the imagination (and help) of the whole world, as a large part of the province of Zeeland was submerged and some 2,000 people died.<sup>5</sup> Yet such a disastrous flood is only

<sup>1</sup> Pfister, "The monster swallows you".

<sup>2</sup> Gottschalk *Stormvloed en rivieroverstromingen in Nederland*, see the maps of particular flood years, and tables at the end of each volume.

<sup>3</sup> Gottschalk *Stormvloed en rivieroverstromingen in Nederland*, II, 73, Leenders, "Die inundacie", 70.

<sup>4</sup> De Roever, "Watersnood in Waterland", 85 - 88.

<sup>5</sup> Slager, *De ramp*, 7.



representative of the extreme, once-in-a-century cases.

Another approach is investigating how contemporaries experienced a flood and how they framed it in their world views. Jakubowski-Tiessen, Allemeyer, Mauelshagen and others have studied North Sea Floods. They have showed how, slowly, explanations changed from attributing causes of floods to supernatural powers (God) to natural laws (or secondary causes as the contemporaries formulated it within their Christian worldviews).<sup>1</sup> Christian Rohr developed cultural history criteria to assess how people experienced floods.<sup>2</sup> For the contemporaries, these included how the experience of floods differed according to the presence of aid, the available type of explanation of the disaster, the extent to which disasters occurred in series, the potential of symbolic connotations, and the existence of general feelings of crisis, such as in times of war.

Historians and other scholars also reflect on the long-term effect of floods and other natural disasters. The French historians Briffaud, Quenet, Favier and Granet-Abisset state that during the Early Modern Period (1500 – 1800), engineers helped to transform disasters into an object of knowledge. This was interesting for the ruling elite who could now bring in “control of nature” as a new topic for public government. One of the results was, over time, a slow transition from a *culture of disaster* towards a *culture of risk*.<sup>3</sup>

The environmental historian Greg Bankoff has elaborated the concept of *culture of disaster* and he focusses on how this differs culturally. He first studied the Philippines and concluded they had a disaster culture. Next, he studied the countries along the European North Sea basin and defined that as a *risk culture*. “A risk society is one whose people have had to adapt to one or more related hazards as a ‘frequent life experience’: one where risk has become deeply embedded in the culture, one where it is very much an integral part of the historical processes of that society, and one that profoundly influences the political structure, economic system and social order of things.”<sup>4</sup> He discerns three “coping mechanisms” or cultural adaptations for coping

1 Jakubowski-Tiessen, *Sturmflut 1717*, Allemeyer, *Kein Land ohne Deich*, Mauelshagen, “Disaster and political culture in Germany”.

2 Rohr, *Extreme Naturereignisse im Ostalpenraum*, 55 – 62.

3 Favier and Granet-Abisset, “Society and natural risks in France”.

4 Bankoff, *Cultures of disaster*; Bankoff, “Cultures of Disaster, Cultures of Coping”, Bankoff, “The ‘English Lowlands’ and the North Sea Basin System.”

with natural disasters. The first is preventive strategies. The second concerns strategies which minimise the material effect of disasters, and the third deals with strategies which reduce the psychological stress. One can interpret my amphibious culture as a variation of the second type of coping strategies. The first category would include the building of dikes to prevent flooding. In the Netherlands this is studied in the field of water history as mentioned above.<sup>1</sup> Elsewhere I have studied how the specific literary genre of contemporary, traditional flood histories, can be interpreted as coping strategies of the third type.<sup>2</sup>

### Amphibious Culture: Compartmentalisation

Of the three elements of the model of the Amphibious Culture, the first is compartmentalisation. Because of the polder system, the land was structured in compartments.<sup>3</sup> Three general types of polders existed, the first originated from draining swampy inland areas, the second from reclaiming land at the coast, whilst the third type stemmed from the draining of lakes. Most importantly, however, all of these polders consisted of land encircled by inland dikes. Therefore, once major sea dikes or river dikes broke, the land flooded relatively slowly, polder by polder, unit by unit. Consequently, people had time to retreat.

A good example is the following: The sea dike at the Zuiderzee broke on the fourteenth of November 1675 at the village of Scharwoude, south of the city of Hoorn. Initially, only some polders directly behind the dike were flooded. After the breach in the dike was closed with great effort, the same major sea dike broke twice again, due to smaller storms, on the second of December and in the night of the fourth of December 1675. As a result, more and more soaked inland dikes broke, one after another, and finally the whole district of West-Frysia was flooded.<sup>4</sup>

However, because the submersion took place slowly, only four people drowned in the entire district, two standing at the dike near the breach and two during the

1 Van de Ven, *Man-made Low-Lands*, 132 – 139, 376 – 79.

2 Van Dam and Pieters, “Enlightened ideas”.

3 Many maps in Van de Ven, *Man-made Low-Lands*, for instance 89, 92, 151, 161, 303, 299, 305, 381, Bruin and Aten, *Een gemene dijk?*, 33. Apart from dikes, also dams with culverts and locks (discharge and shipping sluices) were important elements of the polder system, Van Dam, “Ecological challenges, technological innovations”.

4 Bruin and Aten, *Een gemene dijk?*, map p. 33.



evacuation by boat. Admittedly, this was an extreme case, the flooding was very slow, and in other cases dikes would collapse within lapses of hours or days. But even a couple of hours could be enough to evacuate an area. The rapid response to dike collapse was due to the institution of regional water authorities, responsible for the maintenance of the dikes and guarding them in periods of high water. They had warning systems at their disposal, such as the ringing of the church bells. Therefore, the compartmentalisation of the landscape is a favourable condition for survival during floods, and it is a condition set by human agency.

### Amphibious Culture: Living on Elevations

Many settlements were situated slightly above the field level. They were founded on natural elevations in the landscape or on human-made elevations like dikes, dams or low house mounds ("terp"). Concentration of settlement on the somewhat higher parts is a very old pattern that we can trace already from 800 B. C. onwards for many swampy areas, from the north to the south, and at both sides of the Zuider Sea. Archaeologists continue to find more evidence for this. Much of the memory of this feature had however become obsolete by the nineteenth century, when landscape history took off, as the traces had disappeared through ploughing and other natural and human-induced erosion processes.<sup>1</sup>

An adaptation that made living on house mounds more resistant to floods, was the design and placement of the farm buildings complexes. For the Zuider Sea Region, I want to point at one striking example. Kampereiland, a river island near to the city of Kampen, was flooded quite regularly. Situated at the eastern side of the Zuider Sea, this area was often confronted with the frequent storm winds blowing from the west and northwest. Although protected by sea dikes, all of the farms were situated on house mounds. Moreover, the farm complexes exhibited a fascinating design feature. The large hay barns stood at the seaside of the farms. Filled with hay, during the winter storms when dikes broke, they served as breakers, protecting the farmhouses

<sup>1</sup> Small house mounds in Holland north of the IJ see Bos, *Landinrichting en archeologie*; for Holland south of the IJ: Bult, *Midden-Delfland*; for Overijssel: Zeiler, "De 'vergeten' watersnood", 23; for Friesland, Miedema, "Oost-Fivelingo", 178 and Idem, "West Fivelingo", 78; Louwe Kooijmans, *Nederland in de prehistorie*, 558 - 559.

against the forces of the raging waters.<sup>1</sup>

In the Middle Ages the pattern of living on elevations was continued. Groups of farms turned into villages, and villages turned into towns. As a result, in the Early Modern Period, in the occurrence of a flood, most cities were not destroyed and even continued to function. This applied most strikingly to the city centre, as it was usually the oldest, often medieval, part of the city. The cities thus became isles standing out in the shallow sea.

Situated on elevations, cities, particularly their centres, served as natural places of refuge for the victims of the submerged countryside. The chronicle writers of the city of Hoorn describe how in 1675 the roads (situated on dikes) and canals were blocked by streams of peasant families. In 1825 the city of Amsterdam accommodated 900 refugees from the submerged adjoining territory of Waterland in and around the city tavern, situated on the IJ river.<sup>2</sup>

Cities, as reserves of labour and capital, could also provide active aid. In 1675 in the city of Hoorn the warning system of the fire brigade was used. The city burgomaster sounded the trumpet to alert the city. Six neighbourhoods rushed to the dike led by their fire brigade commanders. Such volunteers worked without payment, but the city provided with basic food: bread, cheese and beer. Labour was needed at many places at the sea dikes for reinforcing weak places and for making them higher. Labour was also needed for guarding the scarce dike materials (sails, wood, sand, seaweed, straw) against theft. In 1825 and 1916 military forces stationed in Amsterdam took care of the task of guarding the dikes and the properties left behind by the refugees. They also carried out surveys in the submerged areas by boat. City authorities provided materials for dike reparation and boats for transport of such materials via the commandeering of ships anchored in the harbour.

Needless to say, cities did suffer during floods. For instance, in the towns the cellars and streets were inundated, yet streets were submerged not more than a few

<sup>1</sup> Personal observation, many of the farm building complexes are still intact, and information of local historians during an excursion of the Society of Water History. Photographs of farm complexes in: Grooten, *Pachters van de stadserven*, page 90; map of 1792 depicting farm with hay barns at the sea side, sea side indicated by the words "shore defence" ("krib werk"), 264; photograph of 1940 depicting farm at a house mound, 342; photograph of 1880 depicting farm at a house mound.

<sup>2</sup> De Roever, "Dijkdoorbraken," 78.



centimetres above the threshold of the entrance doors, to a maximum of a meter.<sup>1</sup> As the elevated parts of cities were often the medieval core, later additions were situated lower, and certainly the non-built areas were low lying. Gardens in and around the city would be destroyed. Trees in the city would die, in particular if the water was salt and stayed for a long time. Moreover, buildings were damaged and, occasionally, those situated closest to the safe dike, might be incorporated into the dike during emergency dike building operations.

In addition, after a flood, the city would become the centre of repair activities and organisation. For the city and its immediate surroundings, the city government was important, but also other institutions had their offices and headquarters in the city. Often this included the regional water authorities (hoogheemraadschappen) which were responsible for closing the dikes again.

### Amphibious Culture: Water Transport

Transport by water was normal in the Amphibious Culture. The land was rich in waterways: rivers, canals, ditches, lakes. Most freight was transported by ship: by sailing ship, rowing boat or by boat, towed by horses or humans. In the low-lying Netherlands, most farms possessed some kind of boat. In the Amphibious Culture, a farmer was also a boatman. The farmer had to transport his harvest to the cities, and his cattle from one grazing ground to another. As most cities were situated at the edge of water bodies, many urban residents were merchants, or engaged in trading goods in one way or another, they therefore also frequently owned or had access to boats.<sup>2</sup>

The boat symbolizes the ease of transport over water in the Amphibious Culture. It is the basic condition for amphibious behaviour, swiftly and safely moving in and between wet and dry landscapes. Yet it is in times of flooding that transport by water becomes vital. During a flood, moving and saving human lives is of course paramount. Yet from the viewpoint of long-term development and of cultural survival in a flood

<sup>1</sup> Gottschalk, *Stormvloed en rivieroverstromingen in Nederland II*, 265–267, Aten and Wieringa, *De Waterwolf*, 50, 53, 67, 76.

<sup>2</sup> Symbolical for this is the sailing ship and the boat house depicted in a scene of a farm property at a map of c. 1550 in the Rijnland near Alphen aan den Rijn, reproduced in Van Tielhof and Van Dam, *Waterstaat in stedenland*, 201; refugees, rescuers, and cattle in small boats: Wieringa, *Watersnood*, 29, 34–35; Aten and Wieringa, *De Waterwolf*, 29, 41, 121, 129, 145, 147.

prone country, the survival of cattle was of almost equal concern, as it represents important economic capital.

In the low-lying territories of the Netherlands, keeping cattle, both for dairy products and meat, was a major source of income. Therefore, in order to save their cattle, farmers would herd their cattle into the church. Churches were often built on specifically constructed mounds, which reached an elevation of 1–2 meters above the already elevated level of the medieval city centre.<sup>1</sup> Churches thus served well as shelters in times of flooding, both for people and cattle.<sup>2</sup> In the district of Waterland some churches seem to have been built explicitly as refuge churches, such as the famous giant church of Edam dating from 1622. For example, in 1825, the church of Edam was reported to be able to hold 500 cows, while the church of Monnickendam could fit 1700. In Oostzaan, during the flood of 1916, it got so crowded that the church windows were broken to let in sufficient air for all bodies.<sup>3</sup> Having a refuge for cattle is one thing, getting them there is another. Probably the majority of the cattle were driven to higher ground, simply walking from the low-lying stables to the dikes and then on to the village, as the more detailed accounts for the nineteenth century onwards report.<sup>4</sup> Collecting the cattle in time was made easy by the circumstance that the cows were usually concentrated in stables, not dispersed over the meadows, for most of the flooding by sea occurred during winter storms (November–February). Yet both textual and pictorial evidence indicate that cattle was also transported by water during floods. Cows in boats, and often in rather small boats, is a famous motif in seventeenth century landscape paintings.<sup>5</sup> One immediately wonders how so large an animal could fit into a small rowboat, however, Dutch cattle were far more lean and

<sup>1</sup> Pictures of elevated churches in Zuid-Holland: Van Tielhof and Van Dam, *Waterstaat in stedenland*, 27; in West-Friesland, Bruin and Aten, *Een gemene dijk?* 51; of transport of cows and cows in churches in West-Friesland: Bruin and Aten, *Een gemene dijk?* 32, 34; Wieringa, *De Waterwolf*, 13.

<sup>2</sup> For instance, for the flood of 1825 (and of 1916) in Waterland this practice is recorded for 6 villages Ransdorp, Zuiderwoude, Edam, Monnickendam, Broek in Waterland, and Oostzaan; In Overijssel this happened everywhere, Zeiler “De ‘vergeten’ watersnood”, 22.

<sup>3</sup> De Roever, “Dijkdoorbraken,” 78–80. Famous oil painting of cattle in the Oostzijder church of Zaandam in 1825 by James de Rijk, reproduced in Zeiler, “De ‘vergeten’ watersnood”, 22, Van Dam, *Amfibische cultuur*, 13, Wieringa, *Watersnood*, 31. Same church in operation as shelter in 1916, Aten and Wieringa, *De Waterwolf*, 42. Cattle in the church of Edam in 1916, Wieringa, *De Waterwolf*, 25.

<sup>4</sup> Wieringa, *Watersnood*, 26.

<sup>5</sup> This practice of moving cattle with small boats was demonstrated in the classic film *Fanfare* (1958) by Oscar winning director Bert Haanstra, which was recorded in Giethoorn at the eastern side of the Zuider Sea area, and the practice can still be observed in nature conservation areas where low-impact farming is practiced. An many early modern paintings cattle is transported in small boats, in particular for crossing rivers.



agile than their "industrialised" twentieth century successors. They could jump into and out of flat, wobbly boats. To entice them onto the boat, the farmer would lay out fresh hay, a fodder the cattle could not resist.

Engravings and other images decorating flood histories books from the seventeenth century onwards, show how cattle was moved out of the flooded countryside in boats. The question is how successful the cattle rescue operations were. All in all, after the flood of 1916 the number of cows was reduced by half in Waterland.<sup>1</sup> The loss of cattle caused a lot of misery among the peasantry, yet in terms of survival and potential for future recovery at the societal level, cattle rescue operations proved to be an indispensable adaptation, enabling post-flood social reproduction.

### **The Amphibious Culture Applied to Living in the River Region Settlement on Elevations in a Compartmentalized Landscape**

For the River Region, just as in the Zuider Sea Region, living on elevations was established from the beginning of settlement. For some parts of the River Region the reconstruction of settlement patterns has been carried out. It shows how hamlets and villages were dispersed over the higher areas, the stream ridges and levees created by the river in a natural process of sedimentation. The lower areas, the back swamps and the lower parts of the stream ridges and levees, were prone to the occasional flood. Often farms were built on the border of a stream ridge and a basin, in order to access arable land on the stream ridge and pasture in the basin.

Over the centuries, dike building developed and a compartmentalized landscape emerged. The first dikes were short side dikes, built at right angles, on the upstream side of the villages. They served to prevent the inflow of water from higher neighbouring settlements. The next phase was building rear dikes, a defence against flood water making its way through the basins. By 1200 many such short dikes existed, but no dikes on the riverside. By 1400, however, the river villages had all built dikes on the riverside, and had closed them, so as to form a continuous, circular dike around the river isles. The interior short dikes at the island merged into lateral dikes, dividing

<sup>1</sup> De Roever, "Dijkdoorbraken," 84.

the isles into compartments.<sup>1</sup>

Unfortunately, dikes broke from time to time. From 1600 onwards, possibly earlier — research is scarce — farmers adapted to flooding by constructing their farm buildings on mounds, and by designing special features for the farm buildings. This development may have been intensified in the eighteenth century when the frequency of dike breakages increased as I have explained above. In addition, over the centuries, the devastation unleashed by floods increased. The reason behind the increase lies in an unintended consequence of dike building: the rise of the riverbed. Riverbeds rise due to natural sedimentation, yet the rate of sedimentation was reinforced by dike building. The dike acted as a restraint on the river, and the river deposited all of its sediments on land inside the dikes. Before diking the river spread its sediment over a much wider area, the full river basin. So human agency combined with nature's agency unintentionally caused more floods.

### **House Mounds and Water Transport**

House mounds tended to be quite high in the River Regions, in particular at the downstream side of the river isles, which were turned into veritable bathtubs of up to six metres deep by the flood water. Churches were also built on mounds, as were barns and sheds, either as part of the farm buildings complex or as separate buildings on separate mounds.

Churches on mounds served as shelters during floods, just as in the Zuider Sea Region. One may ask if the difference of religion was a factor in the use of churches as shelters. In the north, Protestant denominations predominated, while in the River Region many people were Catholic. Protestantism is traditionally associated with a more rational approach to life and the local church board consisted of lay people. The Catholic Church is dominated by an entrenched hierarchy of clergymen and the church as the house of God had a more holy connotation. One may thus assume the sanctioning of a Protestant church for profane use was more commonplace, in comparison to their Catholic counterparts. However, I have the impression based on the available literature that it was unproblematic to use Catholic churches as shelters,

<sup>1</sup> Van de Ven, *Man-made Lowlands*, 25, 91, 107; Van Heezik, *Het voordeel*.



but this issue certainly needs more investigation.<sup>1</sup>

Many peasant households foresaw the possibility of floodwater rising so high as to flood the basement or ground floor of the house, despite its elevated position. The farmhouses therefore contained a special elevated room (opkamer), where valuable possessions were kept, such as silverware, porcelain, textiles, furniture, the Bible, and any other books. The elevated room had its own external door, which in normal times was not accessible from outside. During flooding, this door was used by the farmer arriving by boat, while next to the door, an iron ring mounted on the wall was used for mooring the boat.

Other farm buildings, besides the main house, incorporated flood adaption features. In some cases, barns on the mounds were designed to serve as flood sheds (vloedschuur), specifically for use during floods. The shed was constructed so as to allow cattle to enter over a wide ramp, a body of earth, which served by way of staircase. In other cases, normal barns were built with elevated sections reserved for flood use. The barns also had elevated flood doors, and like the farmhouses, were equipped with mooring rings. Thus, the farmer could reach and feed his cattle, rowing between farmhouse and barn.<sup>2</sup>

A special characteristic of river flooding was the continuous and strong force of flowing water. Therefore, farmers planted shrubs on the river-facing side of buildings. In addition, households would place cushions made of plant material around the buildings to serve as protection against the eroding forces of the flowing water.

Just as in the Zuider Sea Region, in the River Region cities were situated on elevations. In the lowest parts, near the mouths of the rivers into the North Sea, medieval cities, which became the centres of later towns, were situated on manmade elevations. An example is the town of Dordrecht, which became the major destination of flood refugees in February 1421. But in higher parts of the River Region, towards the eastern part of the Netherlands, towns were also founded on natural elevations such as high riverbanks and remnants of Pleistocene glaciers. Such is the case for Nimwegen, a city with an origin stretching back to Roman times. During and after the large river floods of 1861 and other years, it served as the regional centre for

<sup>1</sup> Van de Ven and Driessen, *Niets is bestendig*.

<sup>2</sup> Toebast, "Voor als de dijken doorgingen", 15. One may wonder how the farmer coped with strong water flows. Maybe a rope was attached from farm to barn and used in a similar way as is done by ferry boats crossing the river.

accommodating flood refugees.<sup>1</sup>

Of course, in the River Region, water abounded as in all lowlands, meaning transport over water was normal. For the River Region, as for the Zuider Sea Region, stories of rescue operations executed by heroic men in small rowing boats and images depicting these stories survive in the flood histories and in fiction.<sup>2</sup> Here again, one must ask if the strong flow of the river made a difference for this element of the amphibious culture in the River Region. The question whether these operations were less successful or less frequent than in the Zuider Sea Region, needs further research.

### Conclusion

I like to label the long tradition of cultural adaptations to floods in the low-lying Netherlands as an Amphibious Culture. The landscape features included a relatively slight natural difference between sea level and average field level, and a land structured in compartments divided by interior dikes, was due solely to human agency. Settlements occurred both on natural and manmade elevations. Churches and town centres standing out like islands were important elements of the landscape. During floods they provided shelter for victims, they served as centres of coordination of dike repairs, and they provided the material reserves for restarting terrestrial life. Transport by dikes and waterways guaranteed possibilities of evacuating humans and animals. Both natural and cultural features contributed to the very swift and easy movement in and between wet and dry parts of the landscape.

Consequently, despite the disruption to daily life caused by floods, people continued to operate in a wet and dry environment. As a result, life could continue during and after the flood, notwithstanding the subsequent impoverishment of many countryside residents.

### The World Today

In the course of the later nineteenth and early twentieth centuries the amphibious

<sup>1</sup> Bosch, "Nijmegen"; Driessen, "Over de hulpverlening".

<sup>2</sup> For instance in the novel Buisman, *De dorpsveldwachter*, 2.



culture was slowly eroded and finally disappeared in the Netherlands. Human settlement grew stronger, and flooding decreased radically, in turn altering the perception of risk. The reduction in flooding was partly the result of the energy transition from organic to inorganic during the Industrial Revolution. Previously, all material used in flood protection consisted of organic materials (clay, wood, straw, reeds, and other living and dead plant matter), whilst the primary source of energy came from human and animal labour. Everything changed with the Industrial Revolution, resulting in a whole new way of producing water protection works, using new technology and new, resilient inorganic materials, all produced and processed by fossil-fuel driven machines (such as bulldozers and dredging equipment) and fossil-fuel based (chemical) substances (steel, concrete). The construction of durable dikes, dams and special storm surge barriers became possible, such as the famous Delta Works (1954 – 1985) in the South-West, and the Closure Dam (1932) in the North of the Netherlands, which turned the Zuider Sea into IJssel Lake. Institutional changes supporting these technological achievements were, from about 1800 onwards, the founding of a national Ministry of Infrastructure and Water Management, which centralized the defence of the large rivers dikes and the sea coast, and the formation of a new professional group of civil engineers and other water specialists trained at the new Delft Technological University. At the end of the nineteenth century, the changed perception of risk was expressed by the digging of new river mouths for existing rivers, resulting in cuts through the coastal sand dunes, the largest natural protection of the country against the North Sea (Nieuwe Waterweg near Rotterdam, Noordzeekanaal Locks at IJmuiden).<sup>1</sup>

Building on mounds disappeared completely. Significantly, such a deep, new trust in the protective water infrastructure established itself, that large cities expanded their outskirts into the bottom of polders, from the end of nineteenth century. In addition, building in the low areas, in river beds and at the bottom of drained lakes and other polders, became the norm in the twentieth century. For instance, Schiphol Airport in Amsterdam is situated in the drained Lake Haarlem at four to six metres below sea level.

Water transport for people is no longer important. Farmers have replaced their

<sup>1</sup> Van de Ven, *Man-made Lowlands*, Lonquest, *Two centuries of experience*, 77 – 113.

boats with tractors, while in the cities, cars have taken the place of merchant ship and city canals have been filled in to make space for streets.<sup>1</sup>

Of course, all of these changes happened over a longer period and developments differed regionally. For instance, already during the 1916 flood in Waterland, cattle after having been moved to churches, was transported to Amsterdam by tram, not by boat, in order to be sold quickly and exported to Germany. Yet in 1953, in Zeeland, small boats were still the main means of transport.

Personally, I see the main continuity with the age of the Amphibious Culture in the continued use of compartmentalisation, as the polders and circular dikes still exist and are well maintained. Significantly, compartmentalisation keeps occurring in the future visions of the government.<sup>2</sup>

In the low-lying lands, the costs of potential floods from the sea have risen enormously. Therefore, the awareness of sea level rise has created a frenzy of government activity and investment. In the past ten years, the National Ministry of Infrastructure and Water Management carried out a huge operation reinforcing the coastline of the North Sea with underwater sand supplementations and low, vulnerable sections in the defensive coastal dunes are reinforced by dikes — disguised as dunes with local flora, to avoid displeased tourists. And in the River Region, river beds were dredged so as to accommodate more water, and on land basins have been created to store river water temporarily.<sup>3</sup>

The amphibious culture can be regarded as a model, an ideal type, a concept or just a metaphor. It contributes to gaining more insight into how the vulnerability of people differed per group (cattle raisers against other agriculturalists for example), per region (higher and lower lands, deeper and shallower polders), and also over time (change from water-based to land-based transport systems).

I wonder if we can apply this model of the amphibious culture developed for the Netherlands to other wetland regions, and how they transitioned from a more to a less amphibious culture. A potentially good example is the region of Bangkok at the Chao Praya River in Thailand. Here we see a transition from water-based transport to land-based transport occurring in the early twentieth century, which involved high-

<sup>1</sup> Feddes, *A Millennium*.

<sup>2</sup> *Welvaart en leefomgeving (Welfare and environment)*; Van Heezik, *Het voordeel*.

<sup>3</sup> Prins, *Kustwerk Katwijk*.



wheeled, large cars, capable of driving on modestly flooded roads.<sup>1</sup> Another good case concerns the lowlands of the Red River in Vietnam, south of Hanoi. For the beginning of the twentieth century, some of the floods in the lowlands have been studied extensively and local adaptation strategies described, such as elevated houses and compartmentalisation of the landscape.<sup>2</sup>

One may wonder if, in response to the increased risks of flooding due to rising sea and river levels (and to more frequent storms and heavy rainfall), a revival of elements of the amphibious culture might be advisable to the low Netherlands, and potentially to low coastal and river regions worldwide.

### Bibliography

- Allemeyer, M. L., *Kein Land ohne Deich...! Lebenswelten einer Küstengesellschaft in der Frühen Neuzeit* (Göttingen: Vandenhoeck & Ruprecht, 2006).
- Asperen, H. van (2020), "Charity after the Flood: The Rijksmuseum's St Elizabeth and St Elizabeth's Flood Altar Wings", *The Rijksmuseum Bulletin* 67 (2019) 1, 36 – 59. [www.jstor.org/stable/26605048](http://www.jstor.org/stable/26605048) (last accessed 11/5/2020).
- Aten, D., and F. Wieringa, *De Waterwolf in Waterland. De overstroming van 1916 in Waterland en de Zaanstreek* (Schoorl: Pirola, 2015).
- Bankoff, G., *Cultures of disaster. Society and natural hazard in the Philippines* (Londen/New York: Routledge Curzon, 2003).
- Bankoff, G., "Cultures of Disaster, Cultures of Coping: Hazard as a Frequent Life Experience in the Philippines, 1600 – 2000," in: C. Mauch and C. Pfister (eds.), *Natural disasters, cultural responses. Case studies toward a global environmental history* (New York etc.: Rowman & Littlefield Publishers, 2009) pp. 265 – 284.
- Bankoff, G., "The 'English Lowlands' and the North Sea Basin System: A History of Shared Risk", *Environment and History* 19 (2013) 3 – 37 doi: 10.3197/096734013X13528328438992 (last accessed 11/5/2020).
- Bos, J. M., *Landinrichting en archeologie: het bodemarchief van Waterland* (Amersfoort: ROB, 2008) Nederlandse Archeologische Rapporten 6.
- Bosch, T., "Nijmegen en zijn 'gryze Stroomgod', Hoogwater, strenge vorst en calamiteuze watersnoden, 1781 – 1861", *Jaarboek Numaga* 56 (2009), 33 – 53.
- Bruin, J. de, and D. Aten, *Een gemene dijk? Verwikkelingen rond de dijkszorg in West-Friesland. De watersnood van 1675 – 1676* (Purmerend: Vrienden van de Hondsbossche, Kring voor Noord-Hollandse Waterstaatsgeschiedenis, 2004).
- Buisman, J. F., *De dorpsveldwachter. Een verhaal uit den watervloed van 1825* (Nijkerk, no year).
- Bult, E. J., *Midden-Delfland: een archeologische kartering, inventarisatie, waardering en bewoningsgeschiedenis*

<sup>1</sup> Rongwiriaphanich, "The Bangkok Delta-Metropolitan Region".

<sup>2</sup> Peytavin, "La Crue de la Fleuve Rouge", Gourou, *Le Tonkin*, Tessier, "Outline".

(Amersfoort: ROB, 1983). Nederlandse Archeologische Rapporten 2.

- Dam, P. J. E. M. van "Sinking Peat Bogs: Environmental Change in Holland, 1350 – 1550", *Environmental History* 5 (2000) 4, 32 – 45.
- Dam, P. J. E. M. van, "Digging for a Dike. Hollands Labour Market ca. 1510", in: P. Hoppenbrouwers, J. L. van Zanden (red.), *Peasants into farmers? The transformation of rural economy and society in the Low Countries (Middle Ages – 19th century) in light of the Brenner debate* (Turnhout: Brepols 2001), 220 – 255.
- Dam, P. J. E. M. van, "Ecological challenges, technological innovations. The modernization of sluice building in Holland, 1300 – 1500," *Technology and Culture* 43 (2002) 3, 500 – 520.
- Dam, P. J. E. M. van, *De amfibische cultuur: een visie op watersnoodrampen*, oratie [inaugural lecture], Vrije Universiteit, Amsterdam, 29 oktober 2010, 26 p.: [www.DARE.nl](http://www.DARE.nl): <http://hdl.handle.net/1871/18457> (last accessed 11/5/2020).
- Dam, P. J. E. M. van, P. van Cruyningen, M. van Tielhof, "A Global Comparison of Premodern Institutions for Water Management," *Environment and History* 23 (2017) 3, 335 – 340.
- Dam, P. J. E. M. van, "An Amphibious Culture. Coping with floods in the Netherlands," in: Peter Coates, David Moon, Paul Warde (eds.) *Local Places, Global Processes* (Oxford, 2016), 78 – 93.
- Dam, P. J. E. M. van, and H. Pieters, "Enlightened ideas in commemoration books of the 1825 Zuiderzee flood in the Netherlands", in: P. Brandon, S. Go and W. Verstegen, *Navigating history: economy, society, knowledge and nature* (Leiden 2018), 275 – 297. <https://research.vu.nl/en/publications/enlightened-ideas-in-commemoration-books-of-the-1825-zuiderzee-fl> (last accessed 11/05/20).
- Driessen, A., "Over de hulpverlening door en vanuit Nijmegen na de watersnood van 1861," in: *Jaarboek Numaga* 43 (1996), 77 – 96.
- Favier, R., and A. Granet-Abisset, "Society and natural risks in France, 1500 – 2000: Changing historical perspectives", in: C. Mauch and C. Pfister (eds.), *Natural disasters, cultural responses. Case studies toward a global environmental history* (New York etc.: Rowman & Littlefield Publishers, 2009) pp. 103 – 136.
- Fransen, A., *Dijk onder spanning. De ecologische, politieke en financiële geschiedenis van de Diemerdijk bij Amsterdam, 1591 – 1864* (Hilversum: Verloren, 2011).
- Gottschalk, M. K. E., *Stormvloed en rivieroverstromingen in Nederland — Storm surges and River Floods in the Netherlands*, Volumes I – III (Assen: Van Gorcum & Comp., 1971 – 1977). Text in Dutch with English summaries per year.
- Gourou, P., *Le Tonkin* (Paris, 1931).
- Grooten, J., *Pachters van de stadserven op het Kampereiland, 1432 – 1998* (Kampen: J. Grooten, 1998).
- Heezik, A. van, *Het voordeel eener dubbele defensie. De discussies rond het compartimenteren van dijkringingen in het verleden* ([no place] Deltares, 2008).
- Jakubowski-Tiessen, M., *Sturmflut 1717. Die Bewältigung einder Naturkatastrophe in der Frühen Neuzeit* (München: R. Oldenbourg Verlag, 1992) Ancien Régime, Aufklärung und Revolution 24.
- Kruizinga, S., and P. Lewis, "How High is High Enough? Dutch Flood Defences and the Politics of Security", *Low Countries Historical Review*, 133 (2018) 4, 4 – 27. <https://www.bmgn-lchr.nl/articles/10.18352/bmgn-lchr.10365> (last accessed 11/05/20).
- Leenders, K. A. H. W., "“Die inundacie ende inbreck van onsen Grooten Waert’ De verdrinking van de Grote Waard”, in: V. Wikaart et al. (eds.) “Nijet dan water ende wolcken” *De onderzoekscommissie naar de aanwassen in de Verdrongen Waard (1521 – 1523)*, (Tilburg: Stichting Zuidelijk Historisch



- Contact, 2009) 65 – 74.
- Lonquest, J., et al. (eds.), *Two centuries of experience in Water Resources Management. A Dutch — U.S. Retrospective* (Alexandria, Virg.: Institute for Water Resources, U. S., Army Corps of Engineers, and Rijkswaterstaat, Ministry of Infrastructure and the Environment, 2014). [http://www.iwr.usace.army.mil/Portals/70/docs/iwrreports/Two\\_Centuries.pdf](http://www.iwr.usace.army.mil/Portals/70/docs/iwrreports/Two_Centuries.pdf). (Last accessed 27/5/20).
- Louwe Kooijmans, L. (ed.), *Nederland in de prehistorie* (Amsterdam: Bert Bakker, 2005).
- Mauch, C., and C. Pfister (eds.), *Natural disasters, cultural responses. Case studies toward a global environmental history* (New York etc.: Rowman & Littlefield Publishers, 2009).
- Mauelshagen, F., “Disaster and political culture in Germany since 1500,” in: C. Mauch and C. Pfister (eds.), *Natural disasters, cultural responses. Case studies toward a global environmental history* (New York etc.: Rowman & Littlefield Publishers, 2009) pp. 41 – 76.
- Miedema, M., “Oost-Fivelingo 250 v.C. – 1850 na C.,” *Palaeohistoria* 32 (1990) 111 – 245.
- Miedema, M., “West-Fivelingo 600 v.C. – 1900 na C.,” *Palaeohistoria* 41/42 (1999 – 2000) 1237 – 1445.
- Nederland in 7 overstromingen, television documentary broadcasted by NTR/VPRO December 2013 – January 2014; <http://www.uitzendinggemist.nl/afleveringen/1384223> (last accessed 11/05/20).
- Peytavin, M., “La Crue de Fleuve Rouge et les inondations du Tonkin,” *Bulletin Economique de l’Indochine* 16. (1916) pp. 297 – 367.
- Pfister, C., “The monster swallows you: Disaster memory and risk culture in Western Europe, 1500 – 2000,” *Rachel Carson Center Perspectives*, (2011) 1; <http://www.environmentandsociety.org/perspectives> (last accessed 11/05/20).
- Prins, A., *Kustwerk Katwijk. Waterkeren, parkeren en recreëren* (Katwijk, 2015). <https://www.kustwerkkatwijk.nl/public/index.php> (last accessed 11/05/20).
- Roever, M. de, “Watersnood in Waterland. Dijkdoorbraken van de Zuiderzee in 1825 en 1916”, *Jaarboek van het Centraal Bureau voor Genealogie* 64 (2010) pp. 71 – 94.
- Rohr, C., *Extreme Naturereignisse im Ostalpenraum. Naturerfahrung im Spätmittelalter und am Beginn der Neuzeit*. (Cologne/Weimar/Vienna: Böhlau, 2007), *Umwelthistorische Forschungen* 4.
- Rongwiryaphanich, S., “The relationships between land use changes and flood risk management planning in the Bangkok Delta-Metropolitan Region”, paper Water History Conference, 2010, Delft.
- Slager, K., *De ramp. Een reconstructie van de watersnoodramp van 1953* (Amsterdam/Antwerpen: Atlas, 2003).
- Soens, T., “Flood security in the Medieval and Early Modern North Sea area: a question of entitlement?” *Environment and History* 19 (2013) 2, 209 – 232.
- Stadt, L. van der, *Nederland in 7 overstromingen* (Zutphen: Walburg Pers, 2014).
- Tessier, O., “Outline of the process of Red River hydraulic developments during the Nguyen dynasty (nineteenth century)”, In: M. A. Stewart and P. A. Coclanis (eds.), *Environmental Change and Agricultural Sustainability in the Mekong Delta*, (Springer, 2014) *Advances in Global Change Research* 45, 45 – 68, DOI: 10.1007/978-94-007-0934-8\_4.
- Tielhof, M. van, and P. J. E. M. van Dam, *Waterstaat in stedenland. Het hoogheemraadschap van Rijnland voor 1857* (Utrecht: Matrijs, 2006).
- Tielhof, M. van, and P. J. E. M. van Dam, “Losing land, gaining water. Ecological and financial aspects of regional watermanagement in Rijnland, 1200 – 1800”, *Jaarboek voor Ecologische Geschiedenis 2005/2006* Special issue Water-management, Communities, and Environment. The Low Countries in Comparative Perspective, c. 1000 – c. 1800, 10, 63 – 94. Available on Google Books (last accessed 11/

- 5/2020).
- Toebast, J., “Voor als de dijken doorgingen, Maatregelen tegen rivieroverstromingen bij boerderijen, zeventiende-negentiende eeuw”, *Tijdschrift voor Waterstaatsgeschiedenis* 21 (2012) 1/2, 11 – 22, <http://www.stedengeschiedenis.nl/pages/WG/TWG-auteur.html#T> (last accessed 11/5/2020).
- Ven, G. P. van de (ed.), *Man-made lowlands. History of water management and land reclamation in the Netherlands* (Utrecht: Matrijs, 4th rev. ed., 2004). An accessible Chinese-language edition was published jointly by the International Commission on Irrigation and Drainage (ICID) and Star Map Press in 2007, ISBN 9787802123519.
- Ven, G. P. van de, and A. M. A. J. Driessen, *Niets is bestendig ...: de geschiedenis van de rivieroverstromingen in Nederland* (Utrecht: Matrijs, 1995).
- Welvaart en leefomgeving. Een scenariostudie voor Nederland in 2040* (The Hague: Centraal Planbureau, Milieu- en Natuurplanbureau en Ruimtelijke Planbureau, 2006).
- Wieringa, F., *Watersnood in Waterland. De ramp van 1825* (Schoorl: Pirola, 2010).
- Zeiler, F. D., “De ‘vergeten’ watersnood”, *Tijdschrift voor Waterstaatsgeschiedenis* Special issue Disaster and Reaction, 16 (2007) 1, 19 – 27, <http://www.stedengeschiedenis.nl/pages/WG/TWG-auteur.html#XY> (last accessed 11/5/2020).