CHAPTER 9

An Amphibious Culture: Coping with Floods in the Netherlands

Petra J. E. M. van Dam

Introduction

This paper argues that in the past the low-lying areas of the Netherlands shared an amphibious culture. The essence of this culture is a series of adaptations to a wetland landscape. I want to highlight three features of the distinctive culture that emerged in this watery environmental setting: firstly, the landscape structure as organized into compartments; secondly, the elevation of settlements; and, thirdly, water-based transportation methods, including evacuation of humans and cattle. The adaptations under discussion here involve the capacity to move swiftly and easily between wet and dry parts of the landscape under normal circumstances. At times of disastrous floods, when borders between water and land became obscured, we can see how this amphibious culture operated *in extremo*.

I sketch out this amphibious culture as a heuristic model, using the Netherlands as a case study. I shall also consider whether this model can be applied to other wetland regions, since some of the features of Holland's watery environment are replicated elsewhere in the world, including Wicken Fen, the Philippines and Thailand: the phenomena of sinking soils and increased flooding (due to multiple causes such as [human-induced] sea-level rise); higher precipitation and changes in catchments areas and river deltas; the increasing paving-over of soil with impervious materials; and the shift from water-based to land-based transport ('automotorization'). The central question that this essay addresses is: can knowledge of how human societies have tried to deal with environmental change in the past offer any lessons for today?[1]

My evidence is drawn from the floods of 1675, 1825, 1916 and 1953, for which there are relevant and recent case studies.[2] First, though, some introductory remarks about the physical aspects of flood disasters in the Netherlands and the water authorities are necessary. The typical storm pattern for these floods started with several days of strong southwesterly or westerly winds that pushed

water from the ocean into the North Sea Basin. Such weather often included heavy rain, so the dikes, which are basically earthen walls, became soaked. Then the winds developed into a strong northwesterly storm that forced the water from the North Sea into the sea arms, such as the Zuiderzee, for several days.[3] Next, the water spilled over the dikes and eroded them from within, from the landside, which was less protected than the seaward side. Then the dikes collapsed at one or more places.

The second preliminary observation concerns the landscape. In general, since 1500 or so, the difference between sea level and average soil level in the coastal plain has been small, between 0 m and 2 m below sea level, while some exceptional small areas came to lie at between 4 m and 6 m below sea level, due to reclamation of lakes and sinking soils.[4] Soils in the Low Netherlands are often filled-in sea or river beds. No mountains or stone layers come to the surface, only the occasional sand dune. So once the dikes broke, the flood water spread out and did not reach great depths. The level of flooding was counted in metres, not tens of metres. A storm surge in the Netherlands was (and is) not a tsunami. It cannot be compared to a wall of water rolling over the land and destroying everything in its path.[5]

However, some additional detail is needed here. There are three basic causes of floods in the Netherlands: storm surges; high water level in the rivers; and extreme precipitation. A storm surge may cause breaks in the coastal sand dunes and in the human-made dikes. This has led to the flooding of the low-lying coastal plain that stretches for some 400 km along the North Sea coast in the north, the west and the southwest. Another major cause of floods is the breaking of the dikes along the main rivers, the Rhine and the Meuse, and their arms, like the IJssel. This has resulted in flooding of the river basins between Nimwegen and the North Sea coast at Rotterdam, along the Rhine and Meuse, and from Nimwegen up to Kampen, along the IJssel, both stretches of some 100 km. These areas were never all flooded at the same time; if they had been, the water would have covered more than half of the country.[6] Sea flooding happened in different seasons than river floods, apart from a few weeks' overlap. Also, the selection of dikes affected was determined by wind direction so that, for instance, on two sides of a bay, not all dikes broke at the same time.

A further important element of the sea and river floods was the force of the current, though there are major differences between these river and sea currents. Typically, in areas flooded by rivers, the currents might be strong, because the river kept flowing, albeit in a wider bed. Entire villages might be carried off by a river, but it was primarily those villages that were close to the place where the water cut through the dike. Buildings situated further away had greater chances of survival, because as the water spread out, its strength dissipated. Sea floods might also result in strong currents, due to strong winds. But once the storm is over, the only remaining current is the tide, which, by itself, is quite a modest water movement. However, when land was low-lying, large masses of water were involved and forces were stronger.[7]

To complete the picture, a third type of flood needs mentioning, although it only first occurred at the end of the twentieth century. This concerns the flooding after extreme precipitation of built-up areas such as cities, due to the increasing paving-over of soil with impervious materials. Because city soils do not absorb and buffer water, as soon as precipitation increases above the margin set for the city's sewer system, the sewers spill over and the city floods. This is a new, worldwide challenge for many cities built in low-lying coastal areas. Countermeasures involve building subterranean garages and deep-lying squares that can double as water reservoirs, as examples from Rotterdam show.

A statement about specialized water institutions is needed to conclude these introductory comments. In the Dutch historiography of water history, a great deal of attention is devoted to the institutional history of the Local and Regional Water Authorities ('Heemraadschappen'; 'heem' is related to the word 'home'), which are relatively autonomous institutions responsible for water management. Initially, these bodies supervized the work of peasants. After the Middle Ages, however, they developed into boards that raised water levies and contracted out to entrepreneurs the maintenance of dikes and sluices. Meanwhile, the risk of floods was shared by an ever-increasing range of people. One of the main institutional changes in the early modern period took place when more people living further away from the dikes joined the community responsible for maintaining the dikes, increasing the number of the risk-sharing groups and the size of their territory.[8]

Historiography

The history of floods can be approached from at least three important angles: scale; experience; and risk culture. The scale (extent) of flood disasters can be measured in material terms. As Christian Pfister, an expert on the history of natural disasters, has explained, the customary way to evaluate the scale of the material impact of floods is to count the number of casualties and the amount of damage caused (including flooded villages, destroyed buildings, lost cattle and other capital), preferably expressed in monetary terms for purposes of comparability.[9] The historical geographer Elizabeth Gottschalk, in her notable survey of storms and floods, mainly considered the scale of the flooded surface.[10] Others invented longer lists of material and spatial criteria, which included wind force and direction.[11]

For the pre-statistical era and in times of social disruption in particular, reliable figures concerning flooding are rare in the Netherlands (as they are for the whole of Europe). A well-known example is the claim in a chronicle of *c.*1500 that in the St Elizabeth flood of 18–19 November 1421, which affected the area just southeast of Rotterdam, 72 villages were drowned in the Grote Waard, a claim that was repeated again and again in later sources. Yet this area never contained that number of villages.[12] But as seven is a significant figure

in the Christian tradition, this number can presumably be taken to mean 'very many' (seven multiplied by ten, plus two). Historian Otto Knotnerus has demonstrated how descriptions of flood disasters in medieval and early modern chronicles often made use of standard fragments of text. The writers copied each other's descriptions of floods and then customized them using figures related to meaningful numbers in the Christian tradition. For instance, 33 villages drowned reflects the 33 years of the life of Jesus.[13] In the same way, the number seven may refer to the seven days when God created the Earth, or to the seven cardinal sins.

Over time, verification of figures becomes possible, particularly after 1800, when more reliable serial sources become available. In her study of the flood of Waterland in 1825, for example, historian Margriet de Roever compared information from a descriptive, contemporary disaster study with administrative records relating date, place and time of death. Although Waterland was entirely flooded and this has been classified by many authors as a major disaster, only 17 casualties were recorded, distributed over five places.[14]

The second approach investigates how contemporaries experienced and perceived a flood. Manfred Jakubowski-Tiessen, Marie-Louise Allemeyer and Franz Mauelshagen, among others, studied perceptions of North Sea Floods. They showed how explanations slowly changed from attributing the causes of floods to supernatural powers (God) to attributing them to natural laws (or secondary causes, as contemporaries formulated explanations which accorded with their religious worldview).[15] Christian Rohr developed cultural history criteria to assess floods. Among these criteria are the availability of aid, the type of explanation for the disaster, the extent to which disasters occur in series, the symbolic connotations of floods and general feelings of crisis. He based these criteria on a series of case-studies of natural disasters in Austria, including river floods.[16] The historians René Favier and Anne-Marie Granet-Abisset approached the discussion of floods from a different angle – that of risk culture. During the Ancien Regime, engineers helped to transform disasters into an object of knowledge, adding the 'control of nature' to the existing responsibilities of public government. One of the results was a slow shift from a *culture of disaster* towards a *culture of risk*.[17]

Rather than seeing a risk culture as the outcome of an historical process in a particular region, Greg Bankoff has made a spatial comparison. He shifts the focus from a general historical process that might operate everywhere to look instead at how one culture might face natural hazards as risks, whereas for another they are disasters. He first studied the Philippines and concluded that Philippine society is characterized by a disaster culture. He then studied the North Sea basin and defined that society as a risk culture. As Bankoff explains:

> 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.[18]

He discerned three 'coping mechanisms' or cultural adaptations for dealing with natural disasters: preventive strategies; strategies that minimize the material influence of disasters; and strategies that reduce psychological stress.[19] In this paper, I examine three variations of the second strategy that involve minimization: the compartmentalization of the landscape structure; the elevation of settlements; and water-based transport.

Compartmentalization

Because of the polder system, the low-lying coastal zone of the Netherlands was divided into compartments with many inland dikes.[20] As a result, flooding often occurred relatively slowly, polder by polder. Consequently, inhabitants had a reasonable amount of time to retreat. In the north of Holland, the sea dike at the Zuiderzee broke on 14 January 1675 at Scharwoude, just south of the city of Hoorn. Initially, only a few polders directly behind the dike were flooded in Frysia. After the dike was closed with great effort, the major sea dike broke twice again at the same place: on 2 December and in the night of 4–5 December. As a result, more and more inland dikes also broke, one after another. Inland dikes are low and weak; they serve to separate polders, they are not meant to stand in seawater for long periods. When these dikes become soaked, they disintegrate like a jelly pudding in the sun. Eventually, the whole of West-Frysia was flooded. However, because the submersion took place so slowly, only four people drowned in this entire area, two who were standing too close to the dike's breach and two during rescue transports. This case provides so much detailed data that historian Diederik Aten was able to draw a map of the phases of the gradual submersion (Fig. 9.1).[21] It was an extreme case. In other cases, dikes would collapse within hours or days. But as even a few hours can provide enough time to evacuate an area, this landscape structure of compartments, established by human agency, ensures favourable conditions for survival during floods.

Living on elevations

Many settlements were situated slightly above the field level, on natural elevations like sandy coastal dunes or river dunes, or on human-made elevations such as dikes, dams or mounds. Concentration of settlement in swampy areas on human-made elevations is an ancient pattern that can be traced back to prehistory. This settlement type applies not just to northern parts along the North Sea and the Zuiderzee, as in Overijssel between Elburg and Kuinre and in Gelre and Utrecht between Bunschoten en Nijkerk, but also to the modern provinces of Noord-Holland and Zuid-Holland. Although many traces of this feature have disappeared through human-induced erosion processes such as ploughing, as well as due to rain and frost, archaeologists continue to find more evidence for this settlement practice.[22] The basic unit is the individual house mound, at an elevation of only 1–2 m, which was just sufficient to keep

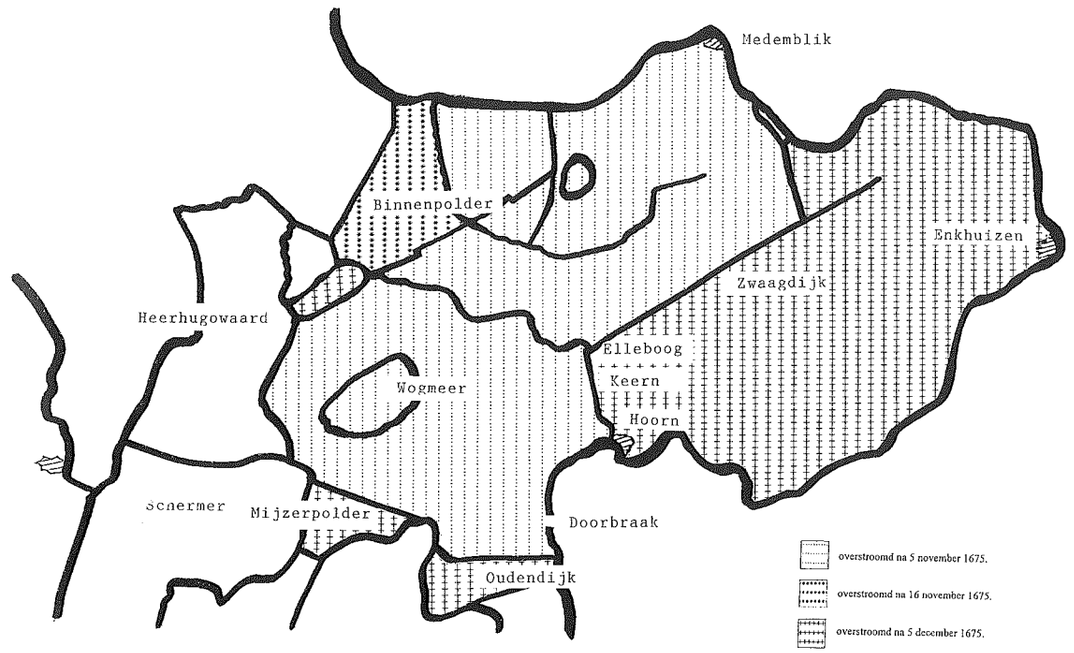

FIGURE 9.1. Schematic map of the flooding of West-Frysia of 1675.

J. DE BRUIN AND D. ATEN *EEN GEMENE DIJK? VERWIKKELINGEN ROND DE DIJKZORG IN WEST-FRIESLAND. DE WATERSNOOD VAN 1675–1676* (2004)

the major part of the house above the water table during floods, securing the survival of its inhabitants. Over time, individual mounds might grow together to form the centre of a village. In some areas, in particular in the provinces of Groningen and Frysia, the mound might develop into a 'terp', a mound some 10 m or more high.[23] But in most areas, the mounds remained low and became inconspicuous over time, only to be rediscovered again by landscape archaeologists in the late twentieth century.

In the Middle Ages, when cities developed, this pattern of living on both human-made and natural elevations continued. Often the settlement took a linear form, as in Amsterdam along both sides of the river Amstel. In the seventeenth century, when the town was extended and new canals ('grachten') were constructed, the excavated earth was used to elevate the ground level of the newly designed quarters.[24] As a result, during a flood, most cities were not destroyed and could even continue to function. Situated on elevations, cities became dry isles standing out in the shallow sea, serving as natural places of refuge for the victims of the submerged countryside. The chronicle writers of the city of Hoorn described how in 1675 the roads (which ran along the top of dikes) and canals were blocked by streams of peasant families. In 1825 the city of Amsterdam accommodated 900 refugees from the inundated adjoining territory of Waterland in and around the Toll House, the city hostel. The hostel was built on other side of the IJ, a sea arm of the Zuiderzee on which Amsterdam was situated. People traveling to Amsterdam who were too late to cross the IJ by ferry and be admitted into city before the gates closed at sunset, could find lodgings at this hostel.[25]

Cities, as reserves of labour and capital, could also provide active aid.[26] In Hoorn in 1675, the fire brigade's warning system was employed. The city burgomaster sounded the trumpet. Six neighbourhoods came to the dike led by their fire brigade commanders. These volunteers worked without payment, but the city provided basic sustenance of bread, cheese and beer. Labour was required to reinforce weak spots along the sea dikes and to raise the height of the dikes. Labour was also needed to guard the scarce dike materials (sails, wood, sand, seaweed and straw) against theft. In 1825 and 1916, military forces stationed in Amsterdam were responsible for guarding both the dikes and the properties left behind by refugees, using boats to survey the submerged. Cities also provided materials for dike repairs and boats for the transportation of such materials; public authorities occasionally seized ships in the harbour for this purpose.

Cities did, of course, suffer to some degree from the effects of flooding. In the major towns of Hoorn, Enkhuizen and Medemblik in 1675, and in Purmerend in 1916, for instance, the streets were inundated, but not by more than a few centimetres above the threshold of the entrance doors.[27] Gardens in and around the city were sometimes also destroyed. Urban trees died too, particularly if salt water remained present for a long time. Buildings were damaged and some even disappeared into the dike as part of strengthening operations. When emergency conditions demanded reinforcement of a dike, buildings close to or on the dike could be buried under the sand.

Essentially, though, the cities were preserved and thus became vital to coping with the consequences of flooding in adjacent rural areas. In addition, the city often functioned as the centre of relief organization. For the city and its immediate surroundings, the city government was an important institution. However other institutions also had offices or even headquarters in the city, the most important being the Regional Water Authorities who maintained the dikes at the regional level. During floods the Water Authorities had to prevent (further) breaches of the dikes. After the floods, they were responsible for carrying out dike repairs as soon as possible, as every delay led to larger breaches and increased the problems (and costs) of closing the dikes again.[28] The offices of Regional Water Authorities were large and prestigious buildings, often lavishly decorated, as the offices in the cities of Edam, Leiden, Rotterdam and Delft demonstrate.

Provincial Councils ('Gecommiteeerde Raden') also had their offices in the cities; this came in handy in 1675 when the Provincial Council of North Holland's headquarters, in the city of Hoorn, was very close to the major dike breach. A Provincial Council, however, was not something peculiar to one city. In fact, in the Republic, such councils consisted of representatives from a range of towns. Thus the Provincial Council of North Holland was a meeting place for the cities of North Holland, including both cities in distress, such as Hoorn, Enkhuizen and Medemblik, and cities not hit by the water, such as Alkmaar. One of the reasons for cooperation between the traditionally competitive cities was to ensure the closure of the inner dikes, so that water did not penetrate further inland and demolish the water infrastructure, which formed part of their trade infrastructure,

and included waterways, dams and land roads, often situated on dikes.[29] For cities on the coastal plain, the need to preserve agricultural land was less urgent because they depended on trade, partially based on local output, but for a great share also based on re-exporting imported goods. For instance, by the fourteenth century, cattle raising had already replaced grain growing, forcing cities to become dependent on grain imports from France and the Baltic countries, which were exported to Scandinavia.[30] Cities were of course also interested in preserving the land and protecting agriculture since many of their citizens and institutions owned land in the countryside, but this was an interest for the long-term. The immediate priority was trade. At the risk of simplifying the complexity of the early modern economy, trade was the precondition for agriculture.[31]

Water transportation and evacuation

Transportation by water was the normal mode in the Netherlands' amphibious culture. The land was riddled with waterways such as rivers, canals, ditches and lakes. Most freight was transported by ship, whether sailing ship, rowing boat or a boat towed by horses or men. In the amphibious culture, the farmer was also a shipper. He had to take his dairy products to the city market and return with grain, cloth and other useful products procured there. Every farm owned some kind of boat (Fig. 9.2). Boats were kept in boat houses, which consisted of small roofs, thatched with reeds, standing on piles. These were very similar

FIGURE 9.2. Traditional boat house of a farm situated on the Old Rhine in Holland, bottom right-hand corner.

REGIONAL ARCHIVES OF HOLLANDS MIDDEN, ALPHEN

FIGURE 9.3. Traditional boat house, Wicken Fen, reconstruction 21st century.

P. J. E. M. VAN DAM

in appearance to the one that has been reconstructed in front of the Wren Building, the visitor centre of Wicken Fen, Cambridgeshire (Fig. 9.3).[32] In the landscape of the twenty-first century, one can identify the mini-harbours situated next to farms as the relics of this amphibious culture, connecting farms to the main water route. And as farms are being bought up by city dwellers, their new owners, consciously or not, reinvent this tradition by building boat houses to house their yachts next to their countryside dwelling.

Many urban residents were merchants. And since merchants were shippers, many kept boats moored at their city houses. The boat symbolizes the ease of movement over water in the amphibious culture. It is the vital condition for amphibious behaviour, moving quickly and securely within the wetland and between wet and dry parts of the landscape. Transportation by water became even more important when large stretches of land were turned into water by flooding. The evacuation of cattle both by land and water deserves special attention. Although transportation and rescue of humans is, of course, a matter of high importance, from the standpoint of the long-term sustainability of an amphibious culture in a flood-prone country, the evacuation of cattle was also a high priority, since livestock represented a valuable, perhaps even the most important, capital good and investment in an agrarian economy.[33] In the low-lying territories of the Netherlands, keeping cattle, both for dairy products and for meat, was a major occupation.

A common practice was to store flood-threatened cattle in the church. Churches were usually built on a large house mound, 1–2 m above the already elevated city level, so they could serve effectively as refuges in times of emergency.[34]

In Waterland, some churches were built explicitly as refuge churches, among them the famously very large church of Edam dating from 1622.[35] Often the cattle had to share a church with humans, and in one particular instance the church at Oostzaan became so crowded that the church windows had to be broken to get sufficient air inside for the bodies of all the creatures sheltering there (Fig. 9.4).[36] During the flood of 1825, the church of Edam contained 500 cows, while Monnickendam's housed more than three times that number (1700).[37]

Having a refuge for cattle is one thing; moving the livestock there is another matter. The majority of the cattle were probably driven to the higher places, 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 and later report. Since most of the flooding occurred during winter storms (November–February), collecting the cattle in time was facilitated by the fact that the cows were usually sheltering in byres instead of being dispersed over the meadows. Both textual and pictorial evidence indicate that cattle were also transported by water, both during floods and at other times. Cows in boats, and often in rather small boats, are a famous motif in seventeenth-century landscape paintings. This practice continued into the twentieth century as the classic film *De Fanfare* (1958), by Oscar-winning director Bert Haanstra, vividly demonstrated. Dutch cattle used to be much sportier than their 'industrialized' contemporary successors, jumping with alacrity into and out of flat, but wobbly, boats covered with hay to mimic pastureland.

After the first emergency measures were enacted, such as placing cows in churches, cows were removed to places outside the disaster zone. In 1675, in West-Frysia, where peasants had ample time to act, cattle were simply transferred to the unaffected pastures of more distant villages. By 1916, means of communication

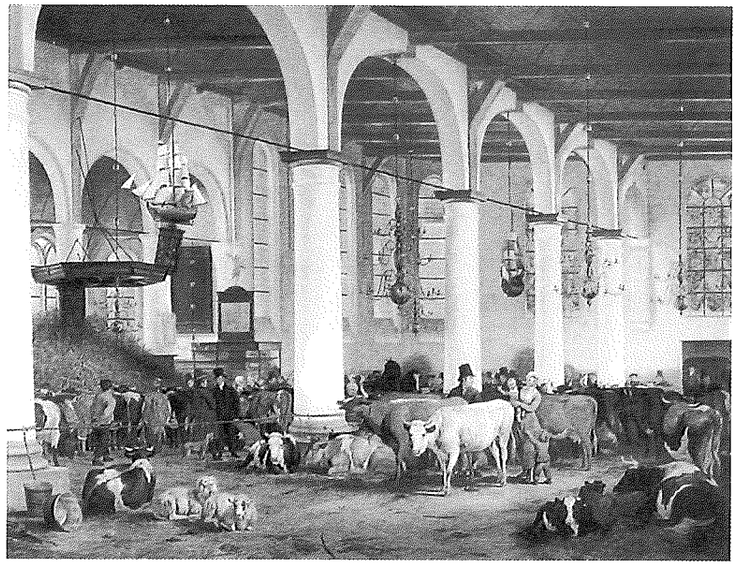

FIGURE 9.4. Evacuated cattle in the Oostzijder Church of Oostzaan during the flood of 1825.

PAINTING BY JAMES DE RIJK, 1830 (PHOTOGRAPH: W. L. DORENBOS)

and transportation had improved so much that the movement of cattle became the object of large scale planning. In the village of Broek in Waterland, all cattle were driven to the church square since there were too many to fit into the church. They were then transported to Amsterdam to make space in the church for human refugees. In Amsterdam, the cattle were concentrated in industrial buildings along the IJ and in the soccer stadium in the south of the city. In the city, shortage of manpower to milk the cows and lack of fodder were serious problems. Subsequently cattle were moved to other places south of the disaster area, in Zuid-Holland; the national railways offered free transportation. The farmers formed special committees to ensure the return of their cattle, while the government issued a special licence to slaughter and export the meat.[38]

How the inhabitants of flood-prone regions dealt with concentrations of cattle in earlier centuries is an important question for further research. Perhaps a substantial amount of hay was available locally, since hay was traditionally stored in the loft of the farms, where it was secure from water damage. Other methods of rescue were also developed, depending upon both water transport and farm adaptations. In the eighteenth century, the frequency of floods increased in the river area for a number of reasons, including weather changes and inadequate human-induced changes to the river.[39] Both farms and stables were situated on elevations. The so-called flood shed ('vloedschuur') stood on top of a mound or was surrounded by (buried into) a mound on three sides. The mound served as a wide ramp leading up to the upper floor, where the cattle were housed during the flood. The roof of the farm contained a special small door, giving residents camping on the upper floor access to their rowing boat, which would transport them to the flood shed so that they could tend the cattle.[40]

An important question for additional research is how successful the cattle rescue operations were. All in all, after the flood of 1916, the number of cows in Waterland had been halved, causing a great deal of misery among the farmers.[41] And yet, in terms of survival and potential for future recovery, this was a reasonably good outcome, for, unlike tractors, cows reproduce.

Conclusion

My preferred term for the long tradition of cultural adaptations to floods in the low-lying Netherlands is an amphibious culture. The landscape features included a relatively slight difference between sea level and average field level, and a land structured in compartments divided by interior dikes. Also, many settlements were situated sufficiently above the field level, both on natural and human-made elevations, ensuring security from flooding when dikes broke. Cities stood out like islands and were indispensable elements of the dry areas. They provided the reserves for the resumption of the more terrestrial life, including refuge for victims, provision of labour and materials for dike repair and the securing of public order. Transport by dikes and waterways made the rescue of both humans and animals possible.

During flood disasters, daily life was very much disrupted. Yet people continued to operate in the half-dry and half-wet environment. As a result, although many peasants were extremely impoverished, the basic conditions required for 'normal' life were maintained. The model of an amphibious culture helps us to understand how human vulnerability differed between groups (cattle raisers and others, for example), according to region (those with deeper and shallower polders) and also over time (with changes in modes of transportation).

The world today

From the nineteenth century, this amphibious culture largely disappeared from the Netherlands. The availability of new technology and materials (concrete and steel) led to the construction of very strong dikes and dams and special storm surge barriers, such as the renowned Delta Works (1954–85) in the southwest and the Closure Dam (1932) in the north. As these new protective infrastructures were installed and were found to be effective, the perception of flooding risk changed considerably.

It became normal to extend cities into the low-lying areas, in river beds and at the bottom of drained lakes and other polders, an important example being the construction of Schiphol Airport at Amsterdam, situated in the drained Harlam Lake, at 4 m below sea level. Highways were built in the polders and boats were replaced by cars. In cities, waterways were neglected and superseded by low-lying streets. In short, large areas of swamp were sealed over by buildings and asphalt. Consequently, for flooding to occur, a storm surge is no longer required. A long period of rain is sufficient for the soil to become unable to absorb the water and for the capacity of the drainage system to become insufficient. River flooding has also become a concern once again, as evidenced by the large river floods of the 1990s, and is related to changes in weather and in the landscape and drainage systems in central Europe.

Since the Dutch live mainly on low-lying lands, the costs of potential floods from the sea and the rivers have risen enormously. For that reason, the potential rise of sea level as a result of climate change has promoted a good deal of government action. The National Ministry of Water Management has started a huge operation to reinforce the coastline with underwater sand supplements. Big dredging ships suck up sand in the North Sea and spit it out at the coastline, underwater, so that the natural forces of wind and water raise it up and unload it upon the beach. The wind then picks up the sand and deposits it on coastal sand dunes, thus reinforcing this natural defence line. At seaside villages, vulnerable (low) parts of the coastal dunes are reinforced by dikes disguised as dunes, with a sand cover and adequate vegetation, so that tourists are not displeased.

Until recently, the main continuity with the age of the amphibious culture seemed to be the use of compartmentalization. For instance, one of the future visions of the government is to introduce the concept of compartmentalized

dike rings.[42] Some territories will have a higher security than others, and the ones with the lower security, whose dikes will break more often, will serve as additional flood plains (water reservoirs) in times of flooding.

However, in a recent television documentary, the newest ideas on government flood management were presented.[43] Curiously, policy scientists state that during a flood the government will have very little or no means to exert any control at all, because, due to the destruction of the electricity network, all means of communication will be disrupted, whether digital, radio or telephone. Evacuation by air or over land will be insufficient, because airfields will be flooded and roads totally congested, bringing all traffic to a standstill. Bas Kolen proposes a new government policy, 'vertical evacuation', advising all people to flee to the higher storeys of buildings and to remain there. In my view, this represents a reinvention of one of the traditional coping mechanisms: living on elevations.[44]

In other parts of the world, particularly in river deltas, this transition from a more to a less amphibious culture has also taken place. Thailand provides a prime example. In Bangkok, a transition from water-based transport to land-based transport occurred in the twentieth century, and involved high-wheeled large cars, capable of driving on modestly flooded roads. However the governors of this city realize that this is not the ultimate solution, especially since floods are increasing in frequency, due to weather changes and rising sea levels.[45] Water historians would do well to advise governments all over the globe to also reinvent the third coping mechanism described in this article: water transportation. In the city of Rotterdam, the newest tourist attraction is a sightseeing tour by a coach which doubles as boat on the river Rhine for part of its tour. Learning to 'live with the water', rather than fighting against it, may be the most relevant and urgent message for today's decision-makers based on the historical study of former amphibious cultures.

Notes

1. I would like to thank the organizers of the AHRC Research Network 'Local Places, Global Processes: Histories of Environmental Change', Peter Coates, David Moon and Paul Warde, for the kind invitation to join the network, which became such a vibrant forum for exchanging ideas, and Peter Coates, once more, for his advice on finalizing this text.

2. The floods of 1675, 1825 and 1916 resulted from dike breaches in areas to the west and south of the Zuiderzee (South Sea) so that the events had a fairly comparable geographic situation: the peaty low-lying wetlands. The dike breaches concerned were situated in the territories of the Water Authorities of the West-Frysian dike (north of Amsterdam, near the town of Hoorn), the Water Authorities of the Noorder IJ- en Zeedijk (Waterland, north of Amsterdam, immediately opposite the IJ), the Regional Water Authorities of Rhineland (south of Amsterdam) and the Regional Water Authorities of the Diemer Sea Dike (east of Amsterdam), and in Overijssel, where centralized dike management did not exist. The 1953 flood concerned mainly the province of Zealand, the west of Noord-Brabant and the south of Zuid-Holland and involved many Water Authorities.

3. For the Zuiderzee, see A. Fransen, *Dijk onder spanning. De ecologische, politieke en financiele geschiedenis van de Diemerdijk bij Amsterdam, 1591–1864* (Hilversum: Verloren, 2011), pp. 72, 170, 250.
4. The estimate of 0–2 m is taken from Gerardus Petrus van de Ven (ed.), *Man-made Lowlands: History of Water Management and Land Reclamation in the Netherlands*, 4th rev. ed. (Utrecht: Matrijs, 2004), p. 18 (map); the larger figures refer to the 'droogmakerijen,' the lake reclamations of the sixteenth and seventeenth centuries, like the UNESCO World Heritage monument Lake Beemster http://whc.unesco.org/en/list/899 (accessed 21/10/14).
5. For the phenomenon of the sinking peat lands, see: Petra J. E. M. van Dam, 'Sinking Peat Bogs: Environmental Change in Holland, 1350–1550', *Environmental History* 5/4 (2000), pp. 32–45.
6. For a map of the potentially flooded area, see: van de Ven (ed.), *Man-made Lowlands*, p. 17.
7. The famous flood of 1953 which drowned large parts of the southwestern Netherlands was such a case, when many dikes broke (due to lack of maintenance during and after World War II) and the low-lying land was flooded extensively: Kees Slager, *De ramp. Een reconstructie van de watersnoodramp van 1953* (Amsterdam/Antwerpen: Atlas, 2003).
8. The Dutch term for this is 'gemeenmaking', which translates uncomfortably as 'communalization' or centralization: van deVen (ed.), *Man-made Lowlands*, pp. 116, 150; see for example Milja van Tielhof and Petra J. E. M. van Dam, *Waterstaat in stedenland. Het hoogheemraadschap van Rijnland voor 1857* (Utrecht: Matrijs, 2006), p. 67. Petra J. E. M. van Dam and Milja van Tielhof, 'Losing Land, Gaining Water: Ecological and Financial Aspects of Regional Water Management in Rijnland, 1200–1800', thematic issue: 'Water Management, Communities, and Enviroment: The Low Countries in Comparative Perspective, *c.*1000–*c.*1800', *Jaarboek voor Ecologische Geschiedenis 2005/2006*, (2006), pp. 63–94. This increase in the number of risk-sharing groups did not extend to urban dwellers.
9. Christian Pfister, '"The Monster Swallows You": Disaster Memory and Risk Culture in Western Europe,1500–2000', *Rachel Carson Center Perspectives* (Rachel Carlson Center for Environment and Society, 2011) http://www.environmentandsociety.org/perspective (accessed 21/10/14).
10. M. K. Elisabeth Gottschalk, *Stormvloeden en rivieroverstromingen in Nederland – Storm Surges and River Floods in the Netherlands*, 3 vols (Assen: Van Gorcum & Company, 1971–77).
11. Christian Rohr, *Extreme Naturereignisse im Ostalpenraum. Naturerfahrung im Spätmittelalter und am Beginn der Neuzeit*, Umwelthistorische Forschungen 4 (Cologne/Weimar/Vienna: Böhlau, 2007); Adrian M. J. de Kraker, 'A Method to Assess the Impact of High Tides, Storms and Storm Surges as Vital Elements in Climatic History: The Case of Stormy Weather and Dikes in the Northern Part of Flanders, 1488 to 1609', *Climatic Change* 43/1 (1999), pp. 287–302.
12. A figure of about thirty villages is more likely: Gottschalk, *Stormvloeden en rivieroverstromingen in Nederland*, vol. 2, p. 73. Based on administrative sources such as parish registers, Leenders concluded that there were approximately 2,000 victims: Karel A. H. W. Leenders, 'Die inundacie ende inbreck van onsen Grooten Waert: De verdrinking van de Grote Waard', in Valentine Wikaart *et al.* (eds), *'Nijet dan water ende wolcken' De onderzoekscommissie naar de aanwassen in de Verdronken Waard (1521–1523)* (Tilburg: Stichting Zuidelijk Historisch Contact, 2009), p. 70.
13. Otto S. Knotnerus, 'Dollart geschiedenis(sen) – Mythen en realiteit', Stichting

Verdronken Geschiedenis (2009) http://www.verdronkengeschiedenis.nl/nl/stormvloed/docs/9-%20Knottnerus%20-%20Dollardgeschiedenissen-opmaak-3def.pdf (accessed 21/10/14).

14. Margriet de Roever, 'Watersnood in Waterland. Dijkdoorbraken van de Zuiderzee in 1825 en 1916', *Jaarboek van het Centraal Bureau voor Genealogie* 64 (2010), pp. 85–88.
15. Manfred Jakubowski-Tiessen, *Sturmflut 1717. Die Bewältigung einer Naturkatastrophe in der Frühen Neuzeit*, Ancien Régime, Aufklärung und Revolution 24 (München: R. Oldenbourg Verlag, 1992); Marie L. Allemeyer, *Kein Land ohne Deich...! Lebenswelten einer Küstengesellschaft in der Frühen Neuzeit* (Göttingen: Vandenhoeck & Ruprecht, 2006); Franz Mauelshagen, 'Disaster and Political Culture in Germany since 1500,' in Christof Mauch and Christian Pfister (eds), *Natural Disasters, Cultural Responses: Case Studies Toward a Global Environmental History* (New York *etc.*: Rowman & Littlefield, 2009), pp. 41–76.
16. Rohr, *Extreme Naturereignisse im Ostalpenraum* , pp. 55–61.
17. René Favier and Anne-Marie Granet-Abisset, 'Society and Natural Risks in France, 1500–2000: Changing Historical Perspectives', in Mauch and Pfister (eds), *Natural Disasters*, pp. 103–36.
18. Greg Bankoff, 'The "English Lowlands" and the North Sea Basin System: A History of Shared Risk', *Environment and History* 19 (2013). p. 19.
19. Greg Bankoff, *Cultures of Disaster: Society and Natural Hazard in the Philippines* (London/New York: Routledge Curzon, 2003); Bankoff, 'Cultures of Disaster, Cultures of Coping: Hazard as a Frequent Life Experience in the Philippines, 1600–2000,' in Mauch and Pfister (eds), *Natural Disasters*, pp. 265–84.
20. There are many maps in van de Ven (ed.), *Man-made Lowlands*. A polder is a territory where the water table is controlled by humans, with the aid of special infrastructure like dikes, small embankments, dams and sluices. The board of such a drainage unit is often also called a polder, although 'polderbestuur' (Local Water Authority) is more accurate.
21. Jan de Bruin and Diederik Aten, *Een gemene dijk? Verwikkelingen rond de dijkzorg in West-Friesland. De watersnood van 1675–1676* 21 (Purmerend: Vrienden van de Hondsbossche, Kring voor Noord-Hollandse waterstaatsgeschiedenis, 2004), p. 33 (map).
22. For evidence for (low) house mounds, see: Juren M. Bos, *Landinrichting en archeologie: het bodemarchief van Waterland*, Nederlandse Archeologische Rapporten 6 (Amersfoort: ROB, 1988); Epko J. Bult, *Midden-Delfland: een archeologische kartering, inventarisatie, waardering en bewoningsgeschiedenis*, Nederlandse Archeologische Rapporten 2 (Amersfoort: ROB, 1983); F. D. Zeiler, 'De "vergeten" watersnood', *Tijdschrift voor Waterstaatsgeschiedenis* 16/1 (2007), p. 23 http://www.stedengeschiedenis.nl/pages/WG/01.html (accessed 03/03/14); Leendert Louwe Kooijmans (ed.), *Nederland in de prehistorie* (Amsterdam: Bert Bakker, 2005).
23. M. Miedema, 'Oost-Fivelingo 250 v.C.–1850 na C., *Palaeohistoria* 32 (1990), pp. 111–245; M. Miedema, 'West-Fivelingo 600 v.C.–1900 na C., *Palaeohistoria* 41–42 (1999/2000), pp. 1237–445.
24. Fred Feddes, *A Millennium of Amsterdam: Spatial History of a Marvellous City* (Bussum: Thoth, 2012), pp. 75–104.
25. De Roever, 'Watersnood in Waterland', p. 78.
26. T. Bosch, 'Nijmegen en zijn "gryze Stroomgod", Hoogwater, strenge vorst en calamiteuze watersnoden, 1781–1861', *Jaarboek Numaga* 56 (2009), pp. 33–53.
27. Gottschalk, *Stormvloeden en rivieroverstromingen in Nederland* 2, pp. 265–7.
28. For an example of a major dike closing project, see Petra J. E. M. van Dam, 'Digging for a Dike: Holland's Labour Market ca. 1510', in Peter Hoppenbrouwers and Jan Luiten van Zanden (eds), *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), pp. 220–55. The history of the relevant Water Authority is described in: van Dam and van Tielhof, 'Losing Land, Gaining Water'.
29. On the infrastructure of cities, taking samples from early sixteenth-century flood disasters, see: Petra J. E. M. van Dam, 'New Orleans aan het IJ? Een waardering van oude en nieuwe dijkdoorbraken', *Tijdschrift voor Waterstaatsgeschiedenis* 16/1 (2007), pp. 11–19 http://www.stedengeschiedenis.nl/pages/WG/01.html (accessed 03/03/14).
30. Van Dam, 'New Orleans aan het IJ?'.
31. Jan de Vries and Ad van der Woude, *The First Modern Economy: Success, Failure, and Perseverance of the Dutch Economy, 1500–1815* (Cambridge: Cambridge University Press, 1997) is the standard survey work for the early modern economic history of the Netherlands, but water management is seen primarily as a source of employment.
32. The Wren Building was the location of one of the workshops of the project that lies at the origin of this paper.
33. Jan Bieleman, *Boeren in Nederland. Geschiedenis van de landbouw 1500–2000* (Amsterdam: Uitgeverij Boom, 2008), pp. 210–33.
34. For illustrations of elevated churches in Zuid-Holland, see: Van Tielhof and van Dam, *Waterstaat in stedenland*, p. 27; for elevated churches in West-Frysia, see: Bruin and Aten, *Een gemene dijk?*, p. 51; for transport of cows and cows in churches in West-Frysia: Bruin and Aten, *Een gemene dijk?*, pp. 32, 34.
35. For instance, for the floods of 1825 and 1916 in Waterland this practice is recorded for the six villages of Ransdorp, Zuiderwoude, Edam, Monnickendam, Broek in Waterland and Oostzaan; in Overijssel this happened everywhere: Zeiler, 'De "vergeten" watersnood', p. 22.
36. Zeiler, 'De "vergeten" watersnood', p. 22.
37. De Roever, 'Watersnood in Waterland', pp. 78–80.
38. De Roever, 'Watersnood in Waterland', p. 81.
39. Gerardus Petrus van de Ven and Anna M. A. J. Driessen, *Niets is bestendig...: de geschiedenis van de rivieroverstromingen in Nederland* (Utrecht: Matrijs, 1995).
40. Judith Toebast, 'Voor als de dijken doorgingen, Maatregelen tegen rivieroverstromingen bij boerderijen, zeventiende-negentiende eeuw', *Tijdschrift voor Waterstaatsgeschiedenis* 21/1/2 (2012), pp. 11–22 http://www.stedengeschiedenis.nl/pages/WG/01.html (accessed 03/03/14).
41. De Roever, 'Watersnood in Waterland', p. 84.
42. *Welvaart en leefomgeving. Een scenariostudie voor Nederland in 2040* (Centraal Planbureau, Milieu- en Natuurplanbureau en Ruimtelijke Planbureau, 2006). The new concern for compartmentalization led to a government-subsidized project of historical research into this phenomenon: Alex van Heezik, *Het voordeel eener dubbele defensie. De discussies rond het compartimenteren van dijkringen n het verleden* ([no place] Deltares publication 2008).
43. Nederland in 7 overstromingen, television documentary broadcasted by Dutch broadcasting companies, NTR and VPRO, December 2013–January 2014 http://www.uitzendinggemist.nl/afleveringen/1384223 (accessed 03/03/14).
44. Leontine van der Stadt, *Nederland in 7 overstromingen* (Zutphen: Walburg Pers, 2013), p. 171.
45. Suwanna Rongwiriyaphanich, 'The Relationships Between Land Use Changes and Flood Risk Management Planning in the Bangkok Delta-Metropolitan Region', unpublished conference paper, Water History Conference, Delft (2010).