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# Forced Solidarity: Maintenance of Coastal Defences Along the North Sea Coast in the Early Modern Period

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## ABSTRACT

For people living on soft soils near or below sea level in the pre-modern period, flood protection increasingly became a major challenge. This article analyses the organisation of flood protection along the southern shores of the North Sea, from the late Middle Ages to the eighteenth century. One of the main problems was that usually only those communities directly on the coast were charged with maintaining sea defences, while flooding increasingly affected a much wider hinterland. Attempts to spread the costs to include communities situated further from the shore came up against significant political and economic barriers. Nevertheless, in several places the responsibility for flood protection was successfully and permanently transferred to areas that included the hinterland. Very large water districts sometimes emerged, dramatically increasing the number of land users liable to pay for dike maintenance. The article identifies four conditions that were necessary to achieve these radical institutional changes.

## KEYWORDS

Water management, flood protection, institutional change, North Sea coast

## INTRODUCTION

Since the Middle Ages, most places along the southern shores of the North Sea have been protected from flooding by dikes and dams. Managing sea defences was originally the responsibility of the communities situated directly along the coast. By implication, flood protection was mainly a local affair. In the course of the early modern period, these arrangements became less effective as a consequence of human and environmental changes, such as declining tolerance of



floods and changes to the landscape. Increasingly, the demographic and financial resources of the coastal communities proved insufficient to guarantee the necessary level of flood protection. This was a real problem, because floods not only affected the land immediately on the coast, but also the hinterland; flooding could reach areas up to eighty kilometres away from a dike breach. Interestingly, the many conflicts resulting from floods eventually produced greatly divergent management systems, all within a relatively small area. This article investigates these variations and attempts, more precisely, to explain why reforms to solve the problem, by making the hinterland jointly responsible for the costs of flood protection, were only implemented in some cases and not in others. Where, when and why did regional institutions replace local institutions for the maintenance of coastal defences?

This article has been inspired by the different outcomes of two recent studies on Dutch water management: one on the water district of Rijnland, published in 2006, and another on a dike called the Diemerdijk, published in 2011.<sup>1</sup> The first showed how management of a dike stretching from Amsterdam to the west was fundamentally reformed in the sixteenth century; the second told a completely different story regarding a dike stretching from Amsterdam to the east. These remarkable results call for an institutional-comparative analysis of the management of coastal defences. Traditionally, most historical research on the coastal defences has reflected the institutional fragmentation of the time, when dike maintenance was managed by a plethora of parishes, villages, monasteries and districts, all of which operated on a limited scale. This also applies to the specialised institutions that emerged: the water boards in all their different guises, with names such as *wateringen*, *everingen*, *polders*, *hoogheemraadschappen*, *Deichachte* and *Deichgenossenschaften*. A new strand of literature has opted to study larger areas in order to obtain more general conclusions.<sup>2</sup> Thus the present article investigates the lowlands from Northern Flanders (present-day Zeeland Flanders in the Netherlands) to North Frisia (situated just to the south of Denmark), from the late Middle Ages to the eighteenth century (see Figure 1).<sup>3</sup>

The recent literature not only favours a wider geographical scope, but also searches for explanatory factors within a broad historical context. We will therefore seek the causes of divergence in management systems among a broad range of elements, including social, economic, environmental and political factors. Previous research interpreted the declining level of flood protection in the late Middle Ages as an indirect result of changing property relations. It has also

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1. Van Tielhof and Van Dam 2006a; Fransen 2011.

2. Special reference must be made here to the work of Knottnerus and Soens, e.g.: Knottnerus 1992, Knottnerus 2004, Soens 2009, Soens 2013. For the German North Sea coast, studies extending beyond local cases include those by Uphoff 1995 and Allemeijer 2006.

3. Further research could include the 'English Lowlands', which were, as Greg Bankoff recently argued, in all respects part of the North Sea Basin system. Bankoff 2013.

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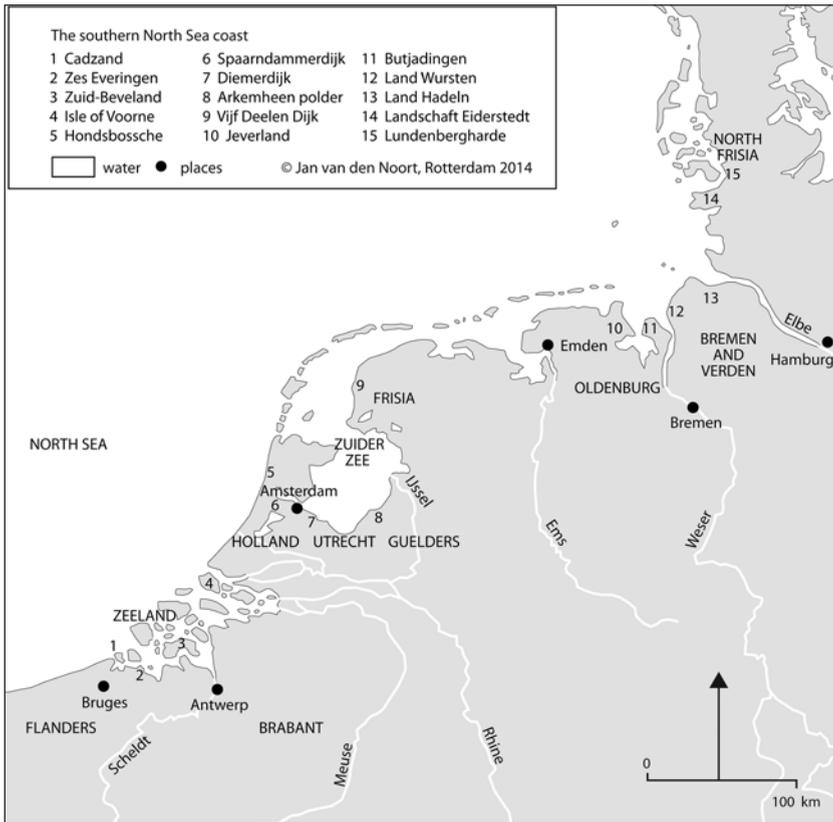


Figure 1. The southern North Sea coast.

been suggested that the political fragmentation of the region might explain the design of dike maintenance systems in the early modern period, and the same could apply to the existence of a developed market economy. We will add an element that, remarkably, has so far not been addressed in research: the spatial element. We will do this by using the concept of scale, and related concepts such as scale change and scale enlargement, as analytical tools.<sup>4</sup> We argue that a scale-based analysis of the problems around the organisation of flood protection enables an integration of different explanations. This contributes to our understanding of why some regions were able to introduce radical innovations in coastal defence maintenance systems quite early on, and others were not.

The text is structured as follows. First, the relevant debates on the maintenance of coastal defences are introduced. The second section discusses the

4. On the relevance of these concepts for historical research, see Escalona 2011.

increasing challenges that the water authorities faced when trying to ensure what they judged to be an adequate level of flood protection, and analyses these challenges in terms of scale. The third part describes the forms of ad hoc help that communities in the interior gave to communities situated on the coast, and analyses the extent to which this help mitigated or repaired the flaws in the locally organised system. The fourth section investigates radical reforms that permanently enlarged the areas that were liable to pay for certain sea defences. The fifth section looks into the failures to introduce such reforms and alternative ways to maintain the dikes.

### I. MAINTENANCE OF COASTAL DEFENCES IN THE HISTORICAL LITERATURE

Three debates are of particular relevance to our topic. These concern the impact of property relations on the quality of water management; the relation between dike maintenance systems and the development of a market economy; and the effects of political fragmentation on water management.

Recent publications, notably those by Tim Soens on the Flemish coastal plain, emphasise the impact of changing property relations on the quality of water management, especially the distribution of the land among specific categories of landowners. Peasants, institutional landowners, city dwellers, noblemen, the state: all could have different attitudes towards their landed property and varying interests in the management of water. This approach has yielded many interesting results. For example, significant social changes occurred in Flanders during the late Middle Ages, including a serious decline in peasant landownership. These changes were accompanied by changing priorities regarding water management. Growing inequality between landowners and an increase in the amount of land owned by large landowners, who often lived in cities, had a noticeable effect on the level of investment in flood protection and drainage. Such investment tended to decline, which sooner or later led to increasing damage from storm surges.<sup>5</sup> These studies are in line with earlier work on the early modern history of the German North Sea coast. In some places, an increasing amount of land was transferred to members of privileged groups in society. These often succeeded in obtaining exemptions from water management duties, which left smaller landowners to shoulder the burden. In Oldenburg, for example, polarisation between small and large landowners coincided with land loss.<sup>6</sup>

A second debate concerns the economic reasons behind the so-called communalisation of the sea defences, which marked a radical change in the organisation of maintenance. Communalisation usually covered three major

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5. See, in particular, Soens 2009, 2011, 2013.

6. Norden 1984.

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changes at once: communalisation in a strict sense (transferring responsibility for dike maintenance from individual land users to the community), professionalisation (replacing maintenance in kind by professional labour on the dike) and monetisation (introducing monetary levies paid by land users). The three aspects were often interrelated, which made communalisation a highly complex process; it often evolved in phases, and in some cases the process was reversed and later implemented again. Communalisation, known as *Kommuniondeichung* in German and *gemeenmaking* in Dutch, could have a major impact on the institutional design of water management, as water boards became administrative and employing institutions, giving water authorities greater responsibilities.<sup>7</sup> Most sea defences in the Netherlands and North-west Germany were communalised at some point between the fifteenth and the twentieth centuries. The historiography provides several explanations for the often-contentious transition to a communal system, ranging from a conservative mentality to the self-interest of certain groups or individuals.<sup>8</sup> Many studies emphasise the importance of having a well-developed market economy. Insufficient circulation of money and an inadequate supply of dike labourers proved to be major obstacles to the introduction of communal maintenance. As a survey by Piet van Cruyningen demonstrated, the transition to professional maintenance systems was related to the emergence of commercial agriculture.<sup>9</sup>

Finally, several studies have identified the decentralised political situation in these areas along the North Sea coast as a complicating factor when it came to effective water management. The autonomy of the seven provinces of the Dutch Republic was undisputed, at least formally. Resolutions on foreign policy and on questions of war and peace were taken by the States General, but on most other subjects, including water management, no central policies existed.<sup>10</sup> As a result of this, management of the big rivers, which flowed through a number of provinces, proved very complicated. The provinces nonetheless succeeded in changing the distribution of water among the various branches of the Rhine at the beginning of the eighteenth century, albeit only after a time-consuming set of negotiations.<sup>11</sup> Alfons Fransen has shown how conflicts between the provinces of Holland and Utrecht on financing the maintenance of the Diemerdijk lasted for over 500 years.<sup>12</sup> More centralised Dutch water management slowly emerged after 1795, when a unitary state was created.<sup>13</sup>

7. As analysed in Van Tielhof and Van Dam 2006a.

8. Knottnerus 2005b; Beekman 1905–1907, 506; Feikes 1937, 191.

9. Van Cruyningen 2013, 190–194; also Uphoff 1995; Knottnerus 1992, 67–69; Gallé 1963, 173–175; Feikes noted the relationship as early as 1937.

10. Israel 1995, 276–277; Van de Ven 2004, 150–151.

11. Van de Ven 2004, 170.

12. Fransen 2011.

13. See, on this process, Bosch 2000.

## II. INCREASING CHALLENGES TO ADEQUATE FLOOD PROTECTION

As long as the floods mainly affected the population living close to the sea, dike maintenance could generally be organised in an efficient way at the local level. The landscape was very dynamic in these parts, however, due to the fragility of the soil (no rock, but peat, sand and clay). During the early modern period, changes occurred on the coast and in the hinterland that compromised the existing organisation of flood protection. In this section, we present some of the most important environmental changes that affected the scale of flood protection. These changes were the result of interaction between human agency and the environment.<sup>14</sup> A general rise in the level of the North Sea was not to blame, as was earlier assumed, because it turns out that the sea level is unlikely to have risen much, if at all, between 1000 and 1800.<sup>15</sup> The increased frequency of catastrophic North Sea storms during the late medieval ‘Age of Storms’ therefore must have been the result of the complex interactions between human and environmental factors.<sup>16</sup> We should also remember that the landscape was not so dynamic everywhere, nor did changes to the landscape always heighten the risk of flooding. When environmental conditions did not challenge the existing local maintenance systems, the latter could remain in place until the modern period.

One major change in the landscape that had important implications for the scale of flood protection was the subsidence of the soil, which led to a deteriorating relationship between the level of the sea and the level of the land. In fact, a slow process of inversion occurred, during which lands that had been above sea level sank to near or below it. In particular, this affected the peat soils found in all the territories along the southern North Sea coast. Peat soils are subject to subsidence for a number of reasons: the peat becomes oxidised when it is merely exposed to the air, and boggy soils become compacted when drained. The rate of subsidence can be as much as one metre per century. In the central peat area in Holland, the peat bogs are thought to have been several metres above sea level in around 800 AD, but to have sunken to near or below sea level by 1500 AD.<sup>17</sup> A more or less convex landscape of raised peat bogs became a concave landscape: a deep dish with raised edges (the dikes). The sea defences, which had originally only protected a region immediately bordering the sea, became more and more important for districts stretching further inland.

The level of the land sank much faster when it was exploited for peat or salt extraction. Although in both industries low dikes were created to help the extraction process along, in the long run these industries had a devastating

14. As made abundantly clear in the historical literature, e.g. Knottnerus 2005a, 6; Knottnerus 1992; De Kraker 1997; Soens 2009; Van Dam 2001a.

15. Vos and Van Heeringen 1997, 9, 13.

16. Soens 2013, 209–217.

17. Van Dam 2001a, 34.

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impact on the land. Entire layers of land were removed, leaving a lowered and fragmented landscape that was very vulnerable to the destructive forces of water during floods. Peat extraction lowered extensive areas of the provinces of Flanders, Zeeland, Holland and Utrecht and led to the emergence of substantial interior lakes. Peat extractors destroyed natural barriers by levelling off raised peat bogs that had acted as watersheds.<sup>18</sup> Salt-making was widely practised by the Frisians in the Middle Ages, and archaeological excavations testify to its damaging impact all along the German North Sea coast (for example, near Butjadingen in Oldenburg).<sup>19</sup> Peat and salt extraction were also often practised on the foreshores, lands lying outside the dikes that only flooded at high tide. Exploitation of peat soils for peat or salt extraction, inside and outside the dikes, occurred everywhere along the southern shores of the North Sea, but was most intense near the large urban centres of Bruges, Antwerp and Amsterdam, metropolises which followed in each other's footsteps as centres of international trade. The Flemish coastal plain, the isles of Zeeland, north-western Brabant and many parts of Holland and Utrecht were intensely exploited and turned into landscapes with a reduced number of natural watersheds. In such landscapes, flooding could have tremendous consequences.

The disappearance of foreshores also interfered with the local organisation of flood protection, as did land reclamation on the shores. Foreshores reduced the destructive force of storm surges by breaking the waves. When foreshores were eroded and the dikes were left directly exposed to the sea, these dikes had to be strengthened with wooden revetments or even stone covers. The cost of such maintenance was so high that coastal communities were not normally able to afford it. Land reclamation had other effects as well: the history of the southern North Sea coast is littered with projects aiming to reclaim land that had silted up. Depending on the region, these reclamations were called 'polders', 'Grodens' or 'Kogens'. Between the fifteenth and the eighteenth centuries, 75 new polders were created between the Dollard and the Weser alone.<sup>20</sup> The new dikes not only protected the reclaimed land but also served to protect the old lands; the owners of these lands could now turn their own dikes into a kind of second defence line, which required much lower maintenance costs.

All of these changes – subsidence and destruction of soil, the disappearance of foreshores and the creation of new polders – had the effect of shifting the ideal scale of flood protection. A situation had emerged where flood protection was organised at a local level, while floods had their impacts at a regional level. We can call this a scale mismatch.<sup>21</sup> Such a mismatch can be repaired by a scale change, in this case a scale enlargement of the organisation of flood protection. Studies have often emphasised the importance of choosing the optimal

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18. Mijnsen-Dutilh 2007, 147; De Kraker and Borger 2007.

19. Krämer 1991, 102.

20. Uphoff 1995, 209–211.

21. Escalona 2011, 20.

scale in water management and the problems surrounding it. John Kerr, for example, reminds us that large-scale irrigation systems are more effective in a technical sense, but the quality of management is usually much better in small-scale organisations, due to the social relations that exist at this level.<sup>22</sup> As we shall see, up-scaling dike maintenance systems from a local to a regional level proved difficult to achieve.

### III. AD HOC SUPPORT

The first attempts to rectify the scale mismatch in the organisation of flood protection took the form of ad hoc regulations on support from the hinterland. Communities that did not border the sea could be forced to help in extraordinary situations, such as when a storm surge created a large breach in the dike, when a dike had to be moved further inland or when general improvements over the whole length of a dike proved necessary. When the reconstruction works were completed, the dike was transferred back into the care of the communities normally responsible for its maintenance. Support could be delivered in kind, in money or in a combination of both. This should not be confused with support during emergency situations, which obliged all able inhabitants to come to the dike when it threatened to break.<sup>23</sup>

In Flanders, the count had been entitled to make land users in neighbouring districts help those in flooded areas since the twelfth century. He exercised restraint in using this right. Augustijn has shown, for example, that in North-east Flanders, support was only given after the major storm surges of 1334, 1424, 1511, 1530 and 1570, when land users threatened to abandon their lands *en masse* because of the huge repair costs. The help was clearly intended for solving unique and isolated problems. The Flemish counts were not motivated by a general wish to prevent land loss, but wanted to protect economically important peat reserves or prevent the deterioration of trade routes.<sup>24</sup> Interventions by the Count of Flanders could also be motivated by his wish to relieve his own landed property from high costs. Thus, in 1576, the Count of Flanders ordered several polders near Terneuzen, where he himself owned a great deal of land, to cooperate and finance the sea defences together.<sup>25</sup>

Precise regulations on help from hinterland communities applied to the dike stretching from Amsterdam to Muiden along the southern shores of the Zuider Zee, called the Diemerdijk (see Figure 2). Responsibility for maintaining the dike rested with the land users in two carefully defined areas: one near the shores of the Zuider Zee, with a surface area of about 3,164 hectares, and

22. Kerr 2007, 104–106.

23. Knollmann and Bauer 1995, 116 n. 169.

24. Augustijn 1992, 532–537.

25. De Vleeschauwer 2012, 79. The statute soon became a dead letter due to political disturbances.

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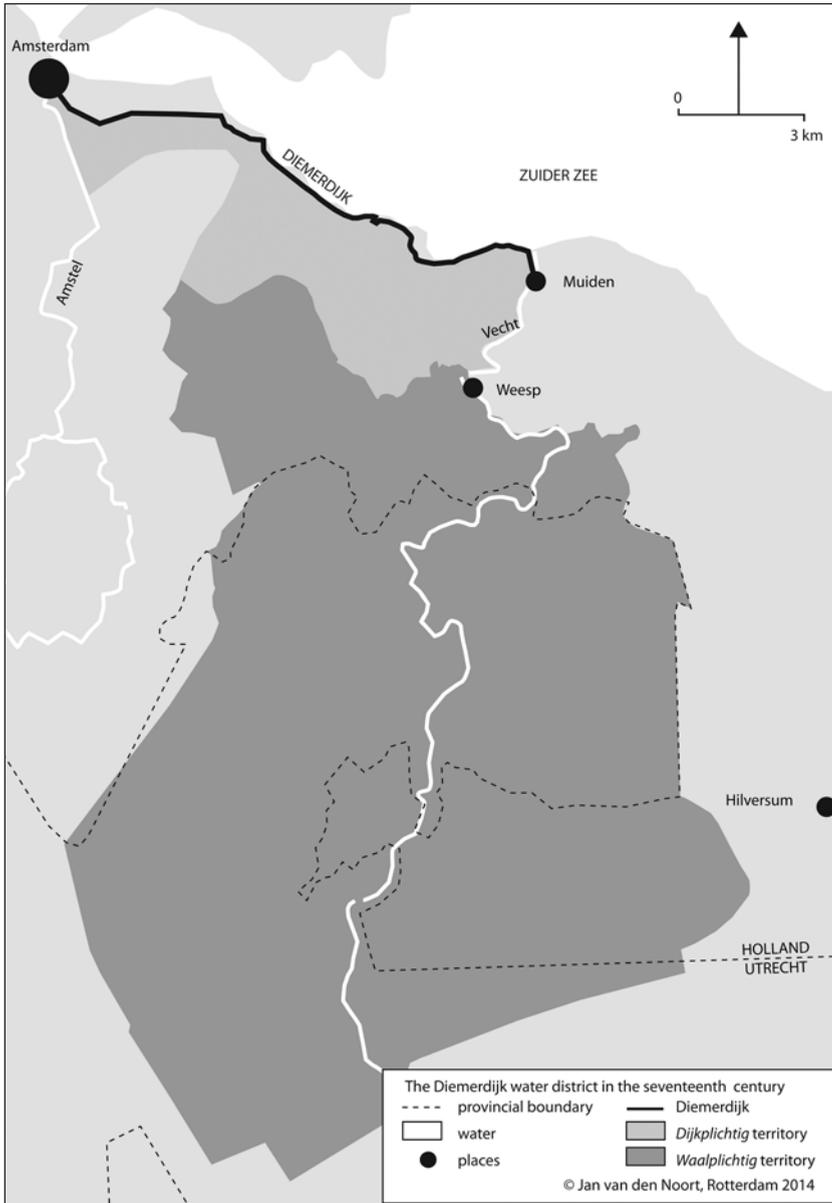


Figure 2. The Diemerdiijk water district in the seventeenth century.

the other further inland, measuring 18,007 hectares.<sup>26</sup> The communities in the first area were burdened with the ordinary maintenance of the Diemerdijk and were called *dijkplichtig*; the communities in the other area had to contribute to extraordinary costs and were called *waalplichtig*. The dijkplichtig communities were entitled to support from the waalplichtig communities when the dike had been damaged to such an extent that an empty barrel could float through it. The repair works were only deemed sufficient when the dike was one barrel above the normal flood level. The specification of the two areas and their maintenance duties dates from around 1437, and was undoubtedly related to the floods of 1421 and 1424.<sup>27</sup>

In general, there was a reluctance on the part of communities to help their neighbours.<sup>28</sup> The fear of creating a precedent was such that it was often explicitly formulated that support was only given on a voluntary basis.<sup>29</sup> When providing support, communities stressed that they were not bound by any regulation or law, and that the support was only to be given for a single incident. One example is the isle of Voorne in the south of Holland, where the Polder van Zwartewaal suffered badly from the storm surge of 1509. The neighbouring polders gave help, but ‘voor deze reyse, uit gratie en zonder prejuditie van dien’ [‘for this single time, as a favour, and with no consequences’].<sup>30</sup> In cases such as these, we should not take the term ‘voluntarily’ too literally. A great deal of pressure from political authorities was needed to persuade districts to support their neighbours. This was the case in Land Wursten, where the Petriflut of 22 February 1651 damaged the sea defences in the two southern districts to such an extent that massive outside help was needed. When requested in the strongest terms to come and work on the dikes, most of the inhabitants of the northern districts in Land Wursten declined and those who did agree to come and help, underlined that it was only on a strictly voluntary basis.<sup>31</sup> Sometimes people who had been required to give support demanded written guarantees that it would be for one time only. The oldest written document about the Hondsbossche (or Hondsbossche Zeewering), a sea dike near Petten in the northern part of Holland, is such a guarantee. Apparently the Rijnland district, located in the central part of Holland, had given some support to the Hondsbossche after a dike breach. A privilege was granted to Rijnland, dating from 1388, saying that neither its inhabitants nor their descendants would ever again have to help with dike works in Petten.<sup>32</sup> A written guarantee

26. Fransen 2011, 339–340.

27. Fransen, 2011, 15, 61, 65; Fransen 2006, 151, 154.

28. Ehrhardt 2003, 156–157; Fischer 2003, 134; Allemeijer 2006, 172–182; Soens 2009, 213–220.

29. Siebert 1969, 159.

30. Beekman 1905–1907, 910.

31. Ehrhardt 2007, 207.

32. Kluppel 1857, on the year 1388. The privilege was granted by Albert (1336–1404), Duke of Bavaria, Regent of Holland from 1358 and Count of Holland from 1389.

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was one of the conditions imposed by the parish of Altenbruch when it offered to send carts and people to the parish of Westerende-Otterndorf to help repair the damage following the 1717 Christmas Flood. The whole of Land Hadeln – where both parishes were located – had suffered huge human and material losses, but Westerende-Otterndorf had suffered the most (183 people drowned). Altenbruch obtained a declaration in writing that the help would be for this case only, with no consequences for the future, and that the favour would be returned if Altenbruch suffered a comparable fate.<sup>33</sup>

The decision to refuse or limit the help given was sometimes motivated, at least partially, by the inability to do so. When people were victims of the flood themselves, helping others who were suffering even more could ruin whatever chance they might have had of restoring the balance in their lives and livelihood. The historiography on the German North Sea coast, in particular, refers to conflicts where it is likely that poverty lay behind the reluctance to help others with money, labour duties and dike materials. The refusal of the parishes of Spieka and Imsum in Land Wursten in 1652 must thus be seen in the context of their precarious social and economic situation resulting from damage to their own stretches of dike in 1651 and on earlier occasions.<sup>34</sup> In such cases, the refusal to give assistance was understandable and even legitimate. It is always difficult to ascertain the extent to which reluctance to help was due to incapacity, however, and it was not usually acknowledged by higher authorities.<sup>35</sup>

This short survey of practices of ad hoc support suggests that people who counted on feelings of neighbourly solidarity were likely to be disappointed. Intervention by territorial lords was frequently instrumental in organising help from communities in the hinterland, and they seem to have acted only when their own relatively narrow interests were at stake, such as when a large proportion of the flooded land was state property. The distribution of land ownership could thus play a decisive role in stimulating occasional support. Another preliminary conclusion is that the level of development of the market economy does not seem to have been very relevant, because occasional help could be and actually was given both in money and in kind. In general though, ad hoc support was clearly insufficient to overcome the mismatch between the regional benefits of flood protection and its local organisation. The help was minimal, due to the reluctance of the people who had to deliver it; it was inefficient due to the lack of a routine; and it usually came very late. Support was typically given several months or even years after the flood, once it had been established what exactly had been damaged, how much it would cost to repair it and who should contribute what, when and how.

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33. Fischer 2007, 120–122.

34. Ehrhardt 2007, 210.

35. Jakubowski-Tiessen 1992, 245–248.

#### IV. THE STRUCTURAL TRANSFER OF FINANCIAL RESPONSIBILITY TO A LARGE AREA

Considering the general resistance to delivering support, it is surprising that, in many districts, a structural solution was nonetheless found eventually. In these cases, a wide hinterland was made to contribute structurally to the costs of the sea defences, including both the normal and the extraordinary costs. To understand how and when these revolutionary reforms emerged, data were collected on the extent of the surface area that would contribute to the cost of certain sea defences, and how this changed over time. These data are presented in Table 1. The length of each dike is given to illustrate the institutional fragmentation. Different water boards were responsible for each small length of dike.<sup>36</sup> The table gives the political entity in which the dike was located, the year of the reform, and the circumstances that triggered the reform. Finally, the table gives two areas (as far as these could be established from the often fragmentary source material): one before and one after the crucial reform was implemented. The areas indicate the surface of land over which the annual structural costs of maintenance were divided.

Table 1. Changes in the area that contributed to the cost of sea defences.

Sea defence	Length	Political entity	Date of reform	Triggered by	Area before reform	Area after reform
Hondsbosche	4 km	Holland	1478	Flood 1477	?	58,897 ha
Zuid-Beveland	130 km	Zeeland	1509	Flood 1509	c. 21,000 ha	c. 30,000 ha
Cadzand	5 km	Flanders	1537	Floods 1530, 1532	c. 880 ha	c. 2,200 ha
Zes Everingen	11 km	Flanders	1559	Flood 1552	2,700 ha	6,300 ha
Vijf Deelen Dijk	28 km	Friesland	1579	Flood 1570, warfare	10,347 ha	27,948 ha
Spaarndammerdijk	21 km	Holland	1578/93	Flood 1570, warfare	4,936 ha	58,463 ha
Arkemheen polder	10 km	Guelders	1611	Floods 1570, 1602	1,566 ha	3,500 ha

Sources: see Appendix.

The oldest case is also that with the widest hinterland: the Hondsbosche, which we briefly mentioned earlier. In the long stretch of dunes protecting the north-west of the Netherlands, there is a gap near a village called Petten, in the far north of the province of Holland. This gap was enlarged during storm floods in the late Middle Ages, and dike works were subsequently begun to fill the void between the dunes to the north and to the south. The sea defences here were vitally important, despite being only a few kilometres in

36. As we shall see, the long dike encircling the isle of Zuid-Beveland was not maintained by regional water authorities but divided into 14 parcels, each allotted to a parish or a group of parishes.

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length. The potential impact of a breach increased as the landscape behind the Hondsbossche changed. Subsidence of the soil occurred throughout the northern part of Holland, as a result of drainage for agriculture, and through peat extraction. The oldest maps of the region, which date from the sixteenth century, show several huge lakes separated by tiny strips of land. When the Hondsbossche broke, water flooded southwards via the lakes and the IJ, attacked the defences along the southern shores of the IJ and proceeded as far as central Holland. The inundation caused damage up to eighty kilometres away from the Hondsbossche, in the districts of Rijnland, Delfland and Schieland. We saw earlier that the Rijnland district obtained a written guarantee in 1388 that its inhabitants would never again have to help with dike works in Petten. This privilege was disregarded when the disastrous St Elisabeth Flood hit the Hondsbossche in 1421. At first, eighteen villages in the neighbourhood were ordered to repair the dike, but when this proved insufficient, many more districts and villages, situated both in the northern and the central part of Holland, were called upon in 1424 to send men to work on the dike. In total, 490 men were required.<sup>37</sup> Half a century later, in 1478, definitive arrangements were made for the ordinary and extraordinary maintenance costs of the Hondsbossche, this time not in kind, but in cash. Central Holland was let off the hook. Six districts, each paying a different tariff, were created, covering almost the whole northern part of Holland. A water board was created in the process.<sup>38</sup> From then on, this short but highly significant sea defence was paid for on a structural basis by land users in an area covering almost 60,000 hectares.

The history of the Hondsbossche shows that the change from a local to a regional system coincided with the replacement of labour duties by monetary levies. It was impossible to base daily maintenance on labour recruited from such a huge area. This is confirmed by the fact that in almost all other cases listed in Table 1, scale enlargement was either introduced in areas where dike maintenance was already organised on a monetary basis (*Zes Everingen*, *Cadzand*, *Vijf Deelen Dijk*) or coincided with the change from maintenance in kind to cash payments (*Hondsbossche*, *Spaarndammerdijk*, *Arkemheen polder*). This underlines the importance of having a well-developed market economy in which money circulated widely and wage labour was readily available. Two case studies on large water management projects at the beginning of the sixteenth century show that large numbers of dike workers could be hired in Holland at that time. In 1505, 1,500 labourers were recruited in Holland for a land reclamation project called *Het Bildt* in the province of Frisia.<sup>39</sup> Five

37. Kluppel 1857, on the year 1422 and the year 1424.

38. Aten 1997, 5–6; Van Answaarden 1992, 59–60. Van Answaarden erroneously gives 1477 as the year of the reform.

39. Kuiken 2013, 63–65.

years later, major repair works at the Spaarndammerdijk in Holland were carried out by about 1,000 dike workers, mostly recruited in the northern part of Holland.<sup>40</sup>

An exception to the rule, and puzzling at first sight, is what happened on the isle of Zuid-Beveland, in the province of Zeeland, in 1509. A reform created an area of 30,000 hectares responsible for flood protection, but this did not coincide with monetisation. The story here starts in a familiar way: parishes situated in the interior of the island were fiercely resistant to helping parishes along the shores. As a result, in the fifteenth century and at the beginning of the sixteenth century, the most urgent reforms to the maintenance system on Zuid-Beveland were held back.<sup>41</sup> There was a mismatch between the arrangements and the landscape: peat extraction had lowered large parts of the island, whilst reclamations of a former sea arm had turned sea defences into inner dikes, unburdening the parishes alongside those dikes. The Habsburg Emperor Maximilian, who ruled a conglomerate of Dutch provinces from 1506 to 1515, finally settled the matter. In 1509, the 130-kilometre dike encircling the isle of Zuid-Beveland was divided into fourteen parts and parcelled out over all the parishes on the island, including those situated inland.<sup>42</sup> There was no change in a monetary sense: the inhabitants of the inland parishes were expected to perform duties in kind. This was possible thanks to the rectangular shape of the island. Parishes were never situated further than about ten kilometres, or a two-hour walk, from the part of the dike allotted to them. In fact, this was not a real scale change: no huge water district was created, and the parishes simply organised maintenance of their limited stretch of dike independently. It was a fundamental reform, nonetheless, that introduced a more even distribution of costs over coastal area and hinterland alike.

While the Hondsbossche and Zuid-Beveland cases each illustrate, in their own way, the importance of the circulation of money, the Flemish cases of the Zes Everingen and Cadzand reveal the impact of landownership. While it was usually impossible to make neighbouring polders contribute their fair share to the sea defences in late medieval Flanders, things changed when the sovereign himself, or people from his entourage, had a direct interest in a particular coastal region. In 1559, an ordinance was issued for a group of six polders, the 'Zes Everingen', regulating the costs of maintenance of the dike that ran for almost eleven kilometres along the Honte sea arm. In future, not only the six polders, but also a number further inland would contribute to all ordinary and extraordinary costs on a permanent basis. An area more than double that

40. Van Dam 2001b, 230, 237.

41. Dekker and Baetens 2010, 39.

42. Dekker and Baetens 2010, 39–40. This reform did not totally live up to expectations, however, as 20 years later the isle was flooded in the storm surges of 1530 and 1532. The north-east of the isle was lost permanently as a result, and it is now a nature reserve. The majority of the isle was nevertheless secured, thanks to Maximilian's reforms.

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of the Zes Everingen themselves was now involved in maintenance costs.<sup>43</sup> Although there is no documentation about how and why this ordinance came about, we know that princely domains were located immediately to the west of this region, that could not have been maintained if the Zes Everingen had been lost.<sup>44</sup> Thus successive landlords (Charles V, 1515–1555, and his son Philip II, 1555–1581) had a personal interest in providing flood protection in and around the Zes Everingen. A similar situation may have been behind the 1537 reform in Cadzand, also in Flanders. In the course of the first half of the sixteenth century, Charles V had extended his landed property on this island.<sup>45</sup>

From Table 1, we can see that reforms of this kind were always triggered by disastrous events. The Spaarndammerdijk can serve as a good example of how floods and warfare could both act as catalysts for change. The Spaarndammerdijk was a 21-kilometre-long dike on the southern shore of the sea arm called IJ, stretching from Spaarndam in the west to Amsterdam in the east (see Figure 3). In the Middle Ages, it was maintained by the inhabitants of five communities along the dike. The dike was parcelled out over many hundreds of land users, as was normal in this kind of individual maintenance system. They were supervised by the village authorities, as well as by the water authorities of the large drainage district of Rijnland, situated to the south of the villages. Among the environmental changes complicating the task of the five communities was the growing strength of the tidal waves from the Zuider Zee, of which the IJ was an extension. In the sixteenth century, the inhabitants claimed that the Spaarndammerdijk had once been a low summer dike, but it had been transformed into a sea wall.<sup>46</sup> Another change was the transformation of the landscape to the south. Drainage for agriculture and intensive peat extraction had lowered the land. Natural watersheds had been destroyed and solid ground had turned into a number of large lakes. Around 1500, these large lakes merged into one huge lake.<sup>47</sup> When the Spaarndammerdijk broke, lands were flooded for more than thirty kilometres southwards. The inadequacy of the arrangements became increasingly obvious in the course of the sixteenth century. The village authorities requested reforms and required substantial help on a number of occasions, but the breakthrough in the stagnating discussions about the maintenance system arrived during a period of crisis. This crisis was caused by the revolt of the Dutch population against their lord, the Spanish king Philip II. The revolt began in 1568 and hit the five villages particularly hard. In the 1570s houses were burnt, people fled or died, property was stolen and the remaining residents were left destitute and in no position to resume

43. De Kraker 1997, 310.

44. De Kraker 1997, 89, 310.

45. Gottschalk 1958, 178 (on the reform) and Soens 2009, 217 (on landownership).

46. OAR inv.no. 1181 a3 on articles 69–72.

47. Van Dam 2001a, 35; Van Tielhof and Van Dam 2006a, 68–76; Van Tielhof and Van Dam 2006b.

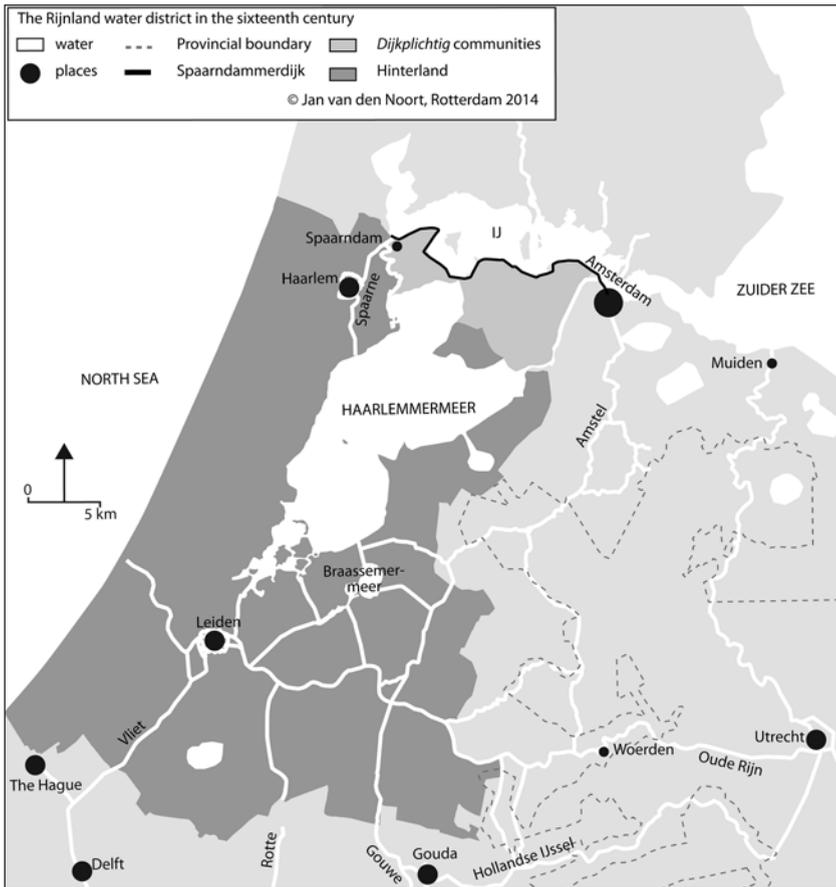


Figure 3. The Rijnland water district in the sixteenth century.

their maintenance tasks.<sup>48</sup> Dike maintenance was now radically reformed with two agreements, one dating from 1578 and the other from 1593.<sup>49</sup> The water authorities of Rijnland took complete responsibility for the dike, maintenance was communalised, and the costs were met by monetary levies collected from the five villages as well as from the communities in the rest of the drainage district. In this case, the costs were divided over a very large area and there were not even any differentiated tariffs.

The cases listed in Table 1 share another characteristic: that of state intervention, usually of a very determined character. This was largely related to

48. 't Hart 1974, 29. The Spaarndammerdijk itself withstood the All Saints' Flood in 1570, but the area was nevertheless flooded because neighbouring dikes had broken.

49. Van Tielhof and Van Dam 2006a, 150.

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the resistance shown by land users in the hinterland when confronted with a new structural burden. It is this element in particular that explains the fierceness of many conflicts around the introduction of communal maintenance. In those cases, not the three elements of communalisation as such (making the community responsible for maintenance, monetisation and use of professional labourers), but the simultaneous expansion of the area liable for contributions provoked conflicts of such complexity that they required state intervention. Very often this took the form of arbitration. State officials were in the best position to arbitrate in the endless disputes about how to distribute costs fairly and evenly. Should they be shared over all the land, or was it fair to let good land pay more than bad land? Should land near the sea, which would suffer more from flooding, have to pay more than areas further inland? If so, how many different tariffs should be used and how was the region to be subdivided? One relatively simple case was that of Arkemheen polder, situated on the south-eastern corner of the Zuider Zee, in the province of Guelders. In 1608 it was decided that the dike ordinance should be reformed to include all land that had been flooded after the storm surges of 1570 and 1602. To identify these lands, interviews were held with elderly people all over the region and a map was drawn, showing a much larger area than the original polder.<sup>50</sup> After the dike reform in 1611, all the lands that had been identified in this way paid for the sea defences. Labour duties were replaced by monetary levies. However, the area was divided into lands paying the full tariff and lands paying half the amount. Although in this case, it was possible to come a long way with rational arguments, the parties had been unable to settle the matter themselves and had asked officials from the provincial Court of Guelders to arbitrate.

The Frisian Vijf Deelen Dijk was notorious for its conflicts about the distribution of costs and its need for state intervention to solve them. The sixteenth-century disputes were a result of several important environmental changes on the eastern coastline of the Zuider Zee. On the one hand, damage from tidal waves had increased in the late Middle Ages and the foreshores had disappeared. This led to rising maintenance costs for the dike, which stretched for 28 kilometres along the Zuider Zee from the mouth of the Middel Zee sea arm to the shipping port of Makkum (see Figure 4). On the other hand, a large land reclamation project (Het Bildt, mentioned earlier in relation to the large number of dike workers) had closed off the Middel Zee in 1505 and turned a long stretch of former sea dikes into inner dikes. As a result, the communities along the Zuider Zee (called *Buitendijkers*) were confronted with high and rising costs, whilst the communities living just to the east of them, along the former Middel Zee (called *Binnendijkers*), were only responsible for the inner or secondary dikes. These arrangements were obviously unfair, although the *Binnendijkers* always found reasons to defend them. In the 1560s, for example, they argued that in the past they had had to cope with the expensive

50. ZA inv.no. 179, fol. 10v.-11v., 13r. See for the map Hagoort 2006, 28, 30.

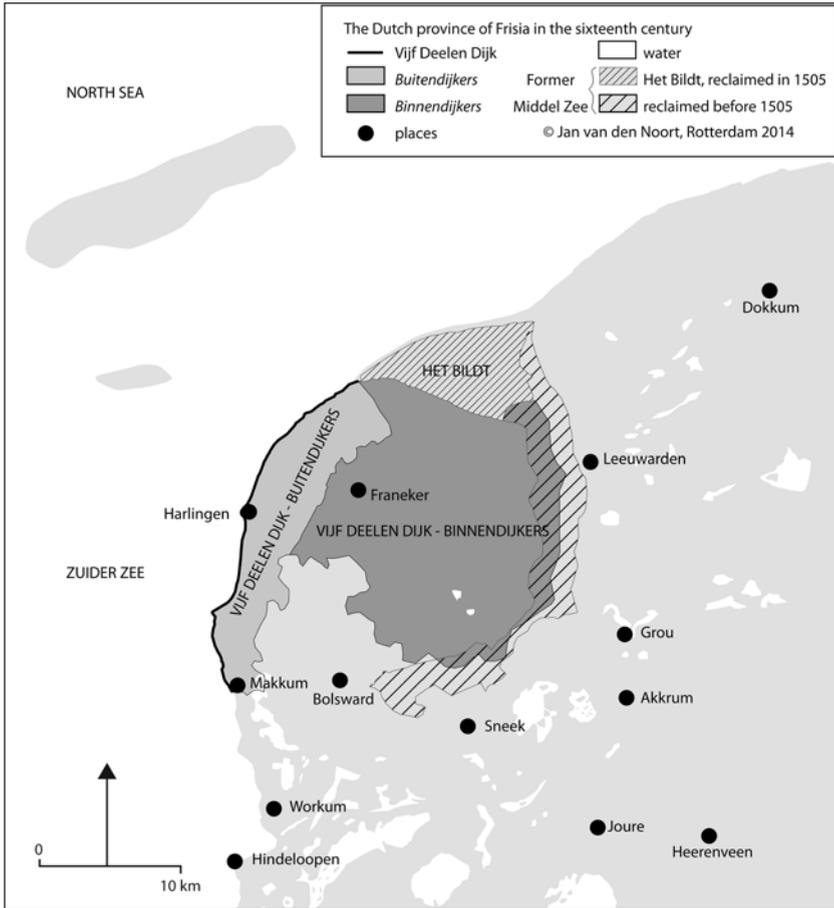


Figure 4. The Dutch province of Frisia in the sixteenth century.

sea dikes along the Middel Zee, while the Buitendijkers had only had to look after the easy Zuider Zee dikes with all their foreshores. Was it not fair, now that the situation had reversed, to accept the new uneven distribution?<sup>51</sup> The Buitendijkers and Binnendijkers were clearly not going to solve the problems on their own.

In the course of the sixteenth century, several Habsburg governors intervened and exerted heavy pressure on both the Binnendijkers and the Buitendijkers to compromise. The maintenance of the Vijf Deelen Dike was reformed in two steps, not coincidentally after the severe floods of 1530 and 1532 and the All Saints' Flood of 1570. In 1533, an ordinance called the *Groot Arbitrement*

51. Minnema Buma 1853, 76. For a modern article on these conflicts, see Tolle 2010.

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ruled that the Binnendijkers should contribute to the costs of the most expensive parts of the dike, its wooden revetments. This was extended to the earthen parts of the dike in further ordinances of 1569 and 1574. In 1579, definitive arrangements were made, whereby the Binnendijkers and the Buitendijkers were each made responsible for exactly half of the dike, including the wooden and earthen parts and ordinary and extraordinary maintenance, as well as the remaining repair works that were needed following the recent floods. This was not insignificant, as the damage caused by the All Saints' Flood was estimated at the huge sum of 300,000 guilders.<sup>52</sup> The arrangements of the 1533 Groot Arbitrement involved the creation of a water board for the Vijf Deelen Dijk, which had previously been maintained by the villages. Although formally arbitration procedures, the top-down character of these reforms is obvious. Two provincial governors acquired the status of heroes in Frisian history, thanks to their determined behaviour in this matter: George Schenk van Toutenburg, for imposing the Groot Arbitrement in 1533, and Caspar de Robles, for dominating the decision-making process on the ordinances in the 1570s. In 1576 a monument was erected on the dike in honour of De Robles: the Stone Man, with his two-faced head simultaneously supervising both halves of the dike.<sup>53</sup>

All of the reforms listed in Table 1 took place in the Netherlands, and most were accomplished in the context of intensive state formation by the Habsburg sovereigns. The Habsburg state did not have a clear water management policy and generally relied on local and regional actors for all matters of drainage and flood defence. However, the Habsburgs pursued income-maximisation policies that, in certain circumstances, motivated them to interfere in the rules of water management. This motivation could come from ownership of a great deal of land in the flooded region, but another motive is probably to be found in the wish to maintain revenues from taxes on land, trade and shipping. The sluices in the Spaarndammerdijk, for example, were part of the most important internal trade route in Holland, and toll revenues directly depended on the solidity of this dike and its sluices. The Frisian coast, where the hinterland was made to contribute to the maintenance of the Vijf Deelen Dijk, had many small shipping ports. Most of these ports were in turn intimately connected to the Amsterdam staple market, the rising centre of international trade and shipping. Perhaps more relevant still were the land taxes: floods directly diminished the revenues from these taxes.

The analysis of the reforms shows that there were at least three conditions for the successful introduction of a regional system of flood protection.<sup>54</sup> The

52. Minnema Buma 1853, 84.

53. Ter Haar and Polhuis 2004, 60–61; Fagel 2009. De Robles was chair of the arbitration committee for the dikes. Minnema Buma 1853, 96, 103.

54. In rare cases, dike maintenance seems to have been organised regionally from the beginning, with the costs and duties in kind being distributed over all landowners in a drainage district, including those with land in the interior. This was probably the case on the isles of Schouwen and Walcheren in Zeeland. Henderikx 2001, 147.

first was a well-developed market economy. The second was a catalyst, such as a ruinous flood, that produced the necessary support for radical reforms among the different groups of stakeholders, because hope for recovery under existing arrangements had been lost. A flood reaching far inland, furthermore, reminded everybody that flood protection was of great interest to land users in the whole hinterland. The third condition was state intervention: the creation of large water districts contributing to the coastal defences was never a bottom-up affair, but always the result of top-down reforms.<sup>55</sup>

#### V. ALTERNATIVES: THE TAXPAYERS' SOLUTION, OR LAND LOSS

We can test this result by studying what happened when one of those conditions for a scale change in the organisation of water management was absent; that is, when no strong pressure from above was exerted, or when markets were underdeveloped. The first situation is found in the small Flemish *watering* of Gaternisse, which struggled for 150 years to make the neighbouring communities share in the costs of its sea defences. It seems that authorities (both at the provincial and the central state levels) did not judge this to be important enough and only gave some temporary support, although they should have been able to force a change in the obviously unreasonable arrangements. Gaternisse finally disappeared into the waves during the All Saints' Flood (1570).<sup>56</sup>

Another example in which coercive power was absent is that of the cross-border water districts of the Dutch Republic (1581–1795), with its decentralised structure. The autonomous provinces could not force each other to accept dike ordinances. This makes the Diemerdijk an interesting case. We have seen that the medieval regulations for this particular dike divided the costs over a dijkplichtig area (near the coast and charged with daily maintenance) and a waalplichtig area (the hinterland, which contributed towards extraordinary costs). The first area was situated in Holland, whilst a large part of the waalplichtig area was situated in Utrecht (see Figure 2). Any redistribution of costs was a political affair at the highest level. When the two provinces were united under the Habsburg dynasty in the sixteenth century, neither Charles V nor Philip II made decisive reforms to the model of cost division. Under the Dutch Republic, the States of Holland often initiated talks on structural reforms, usually after floods (in 1591, 1609, 1610, 1625, 1676 and 1702), but the States

55. This does not imply, of course, that regional water management had to be organised in a top-down manner. The creation of large drainage systems in Flanders and Holland in the thirteenth and fourteenth centuries, for example, was mainly the result of bottom-up forces. The few sources we have from this early period, however, show that interference by territorial lords and the German emperor proved indispensable for resolving differences on the design of these regional drainage systems. Van Tielhof and Van Dam 2006a, 42, 45.

56. Soens 2009, 214–215.

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of Utrecht always successfully resisted.<sup>57</sup> Political fragmentation prevented an even division of the costs over the whole territory that benefited from the Diemerdijk, covering more than 21,000 hectares.

Allowing the Diemerdijk to deteriorate was really not an option, and this is where an alternative solution came in: the taxpayers' route. The importance of the Diemerdijk to the immediate vicinity of Amsterdam, the hub of world trade, was too great to risk floods and land loss. The hinterland was important for the supply of fresh water to Amsterdam, especially for the brewing industry. The waterways were intensively used as shipping routes, and the inhabitants of Amsterdam owned land and country estates in the region. The Diemerdijk played a crucial role in the military water defence line that was used when the French armies invaded the Netherlands in 1672. All this explains why the city of Amsterdam not only provided large sums of money whenever flood damage had to be repaired, but was also very much involved in the practical organisation of repair works and general dike improvements. Amsterdam insisted, however, on having its money back. The States of Holland ended up paying huge subsidies: for example, 32,000 guilders in 1590, some 800,000 guilders in the 1670s, 100,000 guilders in 1714 and 400,000 guilders in the 1730s.<sup>58</sup> This money ultimately came from the pockets of the taxpayers of Holland. The solution was adequate to prevent land loss, but could be considered suboptimal in the sense that the costs were not allocated to those benefiting from the coastal defences. More importantly, it was definitely suboptimal in view of the enormous amounts of time and effort consumed by the recurring discussions on the allocation of costs.

Making taxpayers liable for covering deficits in coastal defences was also the solution found in the province of Zeeland in the course of the seventeenth and eighteenth centuries. The States of Zeeland were unable or unwilling to force reluctant polders in the interior to contribute to the costs of their neighbours on the coast.<sup>59</sup> They went down the road of least resistance and began systematically to grant subsidies for flood protection. Special regulations were drawn up and a special term was even introduced to indicate polders which were recognised as not being able to pay for their own sea defences: the *calamiteuze* (calamitous or catastrophic) polders, also often called the *noodlijdende* (indigent) polders. Although in principle, they were to be supported by a mix of contributions from neighbouring polders and state subsidies, the polders succeeded in minimising their contributions and state subsidies came to play a dominant role. These took the form of direct subsidies or, more often,

57. Fransen 2011, 97-99, 101, 154, 159, 186.

58. Fransen 2011, 122-123, 164, 189, 241.

59. Piet van Cruyningen is currently preparing an article on the calamitous polders in the eighteenth century, in which he explains exactly why the States achieved only few results in this respect.

exemptions and remittances of land tax.<sup>60</sup> The subsidies became a huge financial burden for the States of Zeeland in the eighteenth century.<sup>61</sup> At least the taxpayers' money was not wasted: in Zeeland in the seventeenth and eighteenth centuries, land loss was minimal. So, as in the case of the Diemerdijk, the taxpayers' route could be an effective solution in terms of the sustainability of the landscape.

The fact that these subsidies became such a huge burden for the province forces us to ask whether introducing regional water districts in Zeeland would have solved the problem of the calamitous polders. Almost all of the sea dikes in this province were situated on isles and most of them were only partly protected by dunes. As a result, the relationship between the length of the dikes and the surface of the hinterland was unfavourable. In this highly fragmented landscape the resistance of the hinterland to sharing the costs of the encircling dikes was thus probably caused by the fear of really high water levies. This fear was justified: the subsidies for the coastal defenses were considered problematic even when distributed over the total tax paying population in Zeeland. So the specific institutional framework that emerged around the calamitous polders suggests a fourth condition for a successful scale change to a regional water system: a reasonable proportion between the length of the dike and the protected hinterland. This condition was obviously not fulfilled in the case of the polders in Zeeland.

To test the role of economic development, we now turn to consider the German North Sea coast, where markets developed much more slowly than in Flanders, and also more slowly than in the low lying parts of the Northern Netherlands. Small-scale commodity production and medium-sized family farms were still dominant in the beginning of the sixteenth century. Around the middle of the eighteenth century, however, large-scale commercial farming was the rule almost everywhere along the German coast, as Otto Knottnerus showed.<sup>62</sup> Strangely enough, the emergence of agrarian capitalism does not seem to have facilitated the communalisation of dike maintenance much, as huge problems around the introduction of monetary levies persisted in the eighteenth and even in the nineteenth century. Cash payments were resisted and people defended the traditional system of maintenance in kind by arguing that it was much more efficient and resulted in better dikes.<sup>63</sup>

How can we reconcile conflicts around monetisation with a well-developed market economy? There is no simple answer to this question, but one element must have been the limited importance of leasehold, in particular of short term lease, being defined as lease for a maximum of ten or twelve years. In the sixteenth and seventeenth centuries a growing part of the land was held

60. Beekman 1905–1907, 913–915.

61. Van Cruyningen 2012, 21.

62. Knottnerus 2004, 171.

63. Fischer 2003, 283; Allemeijer 2006, 182; Uphoff 1995, 62, 67.

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in short term lease, but this tendency was reversed in the eighteenth century.<sup>64</sup> In most of the German territories, leaseholders played a limited role in the rise of large-scale commercial farming, as most of the successful farmers exploited their own landed property. The way of exploitation was important for dike maintenance systems, because leaseholding stimulated the development of the land market and the circulation of money while leaseholders possibly also had a more rational attitude towards monetary levies than farmers exploiting their own land. In the regions where monetised dike maintenance was introduced early, short term lease had become the dominant mode of exploitation of land ownership by the late Middle Ages or the sixteenth century: Flanders, Guelders, Zeeland, Holland and Frisia.<sup>65</sup> The relationship is also suggested by the early monetisation of dike maintenance in small parts of North Frisia where short term lease was widespread.<sup>66</sup>

Another barrier against monetisation was poverty of the population. The rise of large landholdings was part of a polarisation process that simultaneously created a group of smallholders and crofters. These numerous small landowners preferred labour duties to monetary contributions, if only because of a serious lack of cash. In 1788, the communal system of maintenance was abandoned on the isle of Pellworm only a few years after it had been introduced by order of the Danish King Christian VII, Duke of Schleswig-Holstein. The Court of Gottorf had recommended this because ‘in einer Landschaft, wo es so sehr an Gelde fehle und so viele unvermögende vorhanden wären’ [‘in an area where there is such a shortage of cash, and so many paupers’], a monetary levy for dike maintenance was disadvantageous.<sup>67</sup>

In a few specific cases the local population’s resistance to communal dike governance was most probably related to the right of landowners on accretions forming on the shore. In some regions, most notably Groningen, Land Hadeln and Kehdingen, land owners located directly on the coast possessed the right to wash lands forming in front of their lands.<sup>68</sup> This enabled them to expand their land with small strips of new and fertile land. In Kehdingen, the parcels of the dike turned into symbols of personal prestige of the people responsible for them and the traditional maintenance system was nothing less than a matter of principle. Only after World War II was communal dike maintenance introduced in Kehdingen.<sup>69</sup> The limited importance of short term lease, the presence of a group of poor smallholders and crofters lacking cash, and the right to wash lands show how property relations could complicate the monetisation of dike

64. Knottnerus 2004, 171.

65. On the rise of short term leasing in various parts of the Netherlands, see Van Bavel 2008, especially 180, 186, 190–192, 194–195.

66. Feikes 1937, 101.

67. Allemeijer 2006, 130–131, 188–189.

68. Knottnerus 2004, 176.

69. Fischer 2003, 16–18, 164–165, 296, 332–333.

maintenance in the eighteenth century. The list is not complete, and probably in each region another mix of social, economic and institutional conditions was responsible.<sup>70</sup>

Where economic circumstances prevented communalisation, the obstacles to scale enlargement were at least as large. Not surprisingly, it is very difficult to find successful scale changes in dike maintenance systems on the German coast in the early modern period. There are many instances of occasional support from the hinterland (although always conflict-ridden) and there are also many examples of state subsidies. To the extent that the hinterland provided structural support, however, it was always limited to a small part of the costs. Jeverland provides an example: from the seventeenth century, the costs of the wooden revetments were distributed over all the parishes in Jeverland, whether or not they were located near the coast. The reason for the involvement of this large geographical area seems to have been that the ruler of Jeverland himself owned a lot of land on the coast, so it was in his personal interest to spread some of the costs of flood protection over the greatest possible area.<sup>71</sup> It would not be correct, however, to suggest that rulers only actively modified dike maintenance systems when their own interests as landowners were at stake. In many of the German territories in the course of the seventeenth and eighteenth centuries, rising state power manifested itself in a growing involvement in flood defence. General regulations were issued and in many places high state officials (*Deichgraf*, *Oberdeichgraf* or *Generaldeichgraf*) were sent to supervise the parishes, water boards or other local water management organisations. This happened, for example, in the Duchy of Bremen and Verden during the Swedish period (1648–1712). The Swedish government, aware of the fact that the many dike breaches had negative consequences for tax income, tried to bring flood defence systems under its systematic control. The first general dike ordinance was issued in 1692 and an *Oberdeichgraf* was appointed in 1696.<sup>72</sup> As early as the first half of the seventeenth century, sovereign representatives were appointed to supervise dike maintenance in several districts of North Frisia (Tondern, Eiderstedt and Nordstrand).<sup>73</sup>

Increasing central regulation and supervision of the sea dikes in the German territories generated many improvements, but did not develop into substantial scale changes in management systems. The efforts to redistribute the significant costs over a wider hinterland had very limited effects, as two examples illustrate. The first is the financial support for the Lundenbergharde district in Schleswig-Holstein, just to the north of the Landschaft Eiderstedt. The dikes

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70. Communalisation also faced problems when common property was involved or when privileged groups (like the clergy or the population of towns) enjoyed exemptions from dike maintenance. Jakubowski-Tiessen 1992, 236–237.

71. Siebert 1969, 157–158.

72. Fischer 2003, 104–105.

73. Allemeijer 2006, 72–75.

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of Lundenbergharde were important for part of Eidersted and the land users in Lundenbergharde could not afford to maintain them adequately by themselves. At some point this was recognised, and from 1648 all the landowners in the Landschaft Eiderstedt (with its eighteen parishes and two cities) had to pay the *Lundenberg-Teichs-Conservations-Gelder*, a small land tax. It was utterly inadequate, however. The dikes had to be relocated further inland on several occasions and eventually, during the 1717 Christmas Flood, Lundenbergharde was swallowed by the waves.<sup>74</sup> The environmental context was certainly important here: the Landschaft Eiderstedt was a peninsula with very long sea dikes in proportion to its surface, so the landowners were already heavily burdened with their own coastal defences.

The second example of insufficient outside help is that of the well-studied coastal province of Oldenburg: Butjadingen. To begin with, the burden of dike maintenance was spread very unevenly among the five districts of Butjadingen. Furthermore, there was only limited support from the wider region. In 1681, a fund (*Deichkasse*) was established to cover the expenses on particular stretches of dike that were reinforced with wood or stone and maintained and repaired by contractors. This fund received levies from the districts in Butjadingen itself, but also from districts in Stadland, located to the south of the peninsula.<sup>75</sup> Four districts further south, however, were harder to persuade. These four districts, which were low-lying and protected by the Butjadinger sea defences, were about as large as Butjadingen itself, so they could have made a difference. However, they were unwilling to help.<sup>76</sup> In spite of state subsidies and some important improvements to the maintenance system in Butjadingen, an unsustainable situation developed in the course of the early modern period. The worst episode in the sad story of floods and land loss was the catastrophic 1717 Christmas Flood, in which more than 2,300 people drowned, nearly a third of the population.<sup>77</sup> When the state stopped subsidising the Oldenburg coastal defences in the second half of the eighteenth century, the region sank into a deep economic depression, followed by poverty, social polarisation and demographic decline.<sup>78</sup>

74. Allemeijer 2006, 66, 167, 174.

75. Norden 1984, 223.

76. For example, when ordered to contribute to the stone constructions in Eckwarden in the eighteenth century, they started legal proceedings that dragged on for nearly 80 years. Knollmann and Bauer 1995, 147–149.

77. Jakubowski-Tiessen 1992, 273; Norden 1984, 46.

78. Knottnerus 2004, 173; Norden 1984, 224, 395.

## VI. CONCLUSION

How can we explain the fact that local management systems were successfully transformed into regional organisations in some regions, but not in others? The application of a scale-based approach makes it clear that there were enormous barriers to reform. First, a regional system of flood protection required a highly developed economy. A sufficient number of dike labourers had to be available for hire, and communalisation of dike maintenance required a high level of monetisation. Dikes could not be maintained in kind by people living far from the coast. Second, because land users in the hinterland never volunteered to share structural responsibility for the dikes, scale change to a regional system was impossible to realise by the parties with a direct interest in the situation and required intervention from above. This implied that an authority was needed, able and motivated to change the existing arrangements and ruling over both the coastal communities and the interior. Third, transforming local into regional water management systems was only a good solution when the landscape was suited for it: the length of the sea dike had to be in proportion to the surface of the protected hinterland. Furthermore, the historical evidence suggests that a catalyst was necessary to produce support for reforms. A flood that damaged landed property far inland was especially efficient in convincing people that land users in the whole hinterland were stakeholders. It was the conjuncture of these four elements that created the necessary conditions for a successful transition to a regional system of flood protection: a well-developed and highly monetised market economy, state intervention, a well-suited landscape and an exogenous shock such as a major flood.

The first, economic, condition explains why it is so difficult to find successful transitions to regional water management systems in the German territories in the early modern period. Successive sovereigns changed or tried to change the institutional arrangements in many coastal regions, but the effects of their efforts remained limited because of the poor economic conditions in the region. Underdeveloped commodity and labour markets complicated the introduction of monetary levies in the sixteenth and seventeenth centuries. When a well-developed market economy had finally emerged, the monetisation of dike maintenance faced both new and familiar barriers in the sphere of property relations in the eighteenth century. These included limited importance of leasehold, the presence of numerous poor smallholders lacking cash and, sometimes, as in Kehdingen, the right of land owners to wash lands.

The second condition, state intervention, explains why the system of flood protection was scaled up in several places in Flanders and to a certain extent in Jeverland in the sixteenth and seventeenth centuries. The changes in these places were motivated by the ruler's private interests as the owner of large tracts of land on the coast. In other cases state intervention was inspired by fiscal reasons: floods had a direct and negative impact on the income from tolls

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and taxes on land, trade and shipping. Fiscal motives were probably behind most interventions in the provinces of Holland and Friesland. The sea defences here crossed busy shipping routes and often protected relatively large, densely populated and urbanised regions. State intervention also explains why the up-scaling of management systems mostly took place under Habsburg rule, which was a period of intensified state formation. From 1581, under the Dutch Republic, state formation took on a different character, with the provinces emphasising their autonomy and the federal state remaining passive in the field of water management. In these circumstances, uniting the Holland coastal region and the Utrecht hinterland of the Diemerdijk in a new homogeneous maintenance regime proved impossible.

When the third condition, a reasonable relationship between the length of the sea dike and the protected hinterland, was not fulfilled, a successful up-scaling of water management systems was hardly feasible. The landscape in the province of Zeeland with its many isles and long, expensive encircling dikes was thus unsuited and a system of structural state subsidies emerged. The fourth condition was a catalyst in the form of an exogenous shock that made the traditional maintenance system collapse. The role of catastrophic floods as catalysts for the construction of new expensive waterworks is very well known, but their role in stimulating institutional reforms has been highlighted less often. Between 1477 and 1602, several ruinous floods, whether or not accompanied by warfare, created opportunities for change. The inhabitants in the coastal areas, in so far as they had not drowned or migrated, were left destitute and unable to repair the sea defences. This importance of a shock confirms, if confirmation is indeed needed, that in normal circumstances the different stakeholders in the region were utterly unable to solve their disputes about the allocation of costs. Where a more balanced distribution of costs was introduced, this had nothing to do with solidarity as part of a system of norms and values. Reforms were not welcomed by the land users, but forced upon them by a superior power.

Notwithstanding the huge barriers, a number of far-reaching reforms were achieved, placing the high burden of flood protection structurally on the land users of all the lands that profited from them, not just a narrow coastal strip of land. In some cases, the area that had to contribute to the costs of flood protection increased dramatically; for example, from some 5,000 hectares to nearly 60,000 hectares in the case of the Spaarndammerdijk near Amsterdam. In this way, management of the coastal defences developed solid financial foundations. The new arrangements for the Hondsbossche put an end to the prospect of major land losses in the northernmost part of the province of Holland, which had suffered enormous losses in the Middle Ages, and reforms in Flanders also prevented further land loss. Furthermore, the coastline of the Zuider Zee, which had been so unstable in the Middle Ages, was firmly fixed in position during the early modern period. Another positive aspect of all these cases was

the reduction in the time and effort consumed by discussions on cost allocations. Institutionally, most reforms took the form of either an enlargement of an existing water district, a merger of water districts or the creation of a new large water district to include a maximum number of land users to foot the bill. These institutional changes remedied the scale mismatch, itself the result of environmental changes, between local responsibility and a regional interest in flood protection.

#### APPENDIX. SOURCES TABLE 1.

- Hondsbosche: about the reform: Aten 1997, 5. Area after reform is the total area of the contributing districts listed in 1563 (63,330 *morgen*): Kluppel 1857, on 23 April 1563. Measure: 1 *morgen* = 0.93 ha: Verhoeff 1983, 39.
- Zuid-Beveland: about the reform: Dekker 1971, 606. Area after reform is the total surface area of Zuid-Beveland in the first half of the sixteenth century, which is estimated at 76,500 *gemet*; area before reform is this total area minus an estimated 23,000 *gemet* for parishes in the interior. These estimates are based on surface areas listed in fiscal documents from 1531 and 1533 in Dekker and Baetens 2010, 28–30. Apparently, on average, about 15% of lands were free from the land tax but not from water levies. This 15% is accounted for in the surface areas before and after reform. Measure: 1 *gemet* = 0.3942 ha: Dekker and Baetens 2010, 8.
- Cadzand: about the reform: Gottschalk 1958, 168–172, 178. Surface area after reform c. 5,000 *gemet*: Gottschalk 1958, 178. Surface area before reform estimated at 2,000 *gemet*, i.e. 40 % of 5,000 *gemet*, on the basis of the map in Gottschalk 1958, 181. Measure: 1 *gemet* = 0.44 ha: Soens 2009, XVII.
- Zes Everingen: about the reform: De Kraker 1997, 310. Area before reform 6,000 *gemet*; area after reform 14,000 *gemet*: De Kraker 1997, 310. Measure: 1 *roede* = 0.8542 metres, 1 *gemet* = 0.4455 ha: De Kraker 1997, 444.
- Vijf Deelen Dijk: about the reform: Minnema Buma 1853, 84, 132. Area before reform is the area of the Buitendijkers (10,347 ha); area after reform is total area of Binnendijkers (17,601 ha) and Buitendijkers: Mansholt 1939, 172.
- Spaarndammerdijk: about the reform: Van Tielhof and Van Dam 2006a, 150. Area before and after reform: OAR inv.no. 9602 (year account Rijnland 1577/78 with a total of 5,807 *morgen*) and OAR inv.no. 9627 (year account Rijnland 1593 with a total of 68,780 *morgen*). Measure: 1 *morgen* = 0.85 ha: Van Tielhof and Van Dam 2006a, 322.
- Arkemheen polder: about the reform: Hagoort 2006, 20, 30. Area after reform is 4,024 *morgen*, which is the sum of the lands paying the full tariff in 1611 (3305.5 *morgen*) and the lands paying a half tariff in 1611 (717.5 *morgen*): ZA inv.no. 179, fol. 41r.-41v. Area before the reform is estimated at 1800 *morgen*, which was the area that had to contribute to the costs of the polder in 1579: Berends 1935, 483–484 (no. 1332). Measure: 1 *morgen* = 0.87 ha: Hagoort 2006, 19.

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