IJsselmunde is an island of about 16,000 ha, located in the Netherlands in the delta of the Rhine and Meuse rivers. Following the construction of drainage works some 1000 years ago, the peat soil started to shrink and oxidize, expensive dykes and drainage works became necessary, and conditions for agriculture deteriorated. The island was flooded severely in the late twelfth and in the fourteenth century. In the following centuries sedimentation took place, resulting in higher and more fertile soils. Step-by-step, the land was reclaimed, resulting in a patchwork of 50 polders. The water management infrastructure in the new land was maintained by the land users and owners in the different polders but regulated and supervised by 25 local jurisdictions. In addition, some supra-local arrangements were made, such as joint supervision of dykes and the joint establishment of polder mills and later pumping stations. According to the theory of polycentric governance, this system should have many advantages over more centralized management systems, and indeed there is some evidence of this. Yet, there is also evidence of a potential disadvantage that is not mentioned in the literature on polycentric governance: petrification. Institutional arrangements that had made sense when the first polders were created often were not modified when new land was reclaimed. Future research could focus on the evolution of the water management system and its adaptation to changing conditions.

INTRODUCTION: ORGANIZING WATER MANAGEMENT

Water management can be organized in many different ways. One option is to organize everything at the central level, such as at the level of complete river basins. This reduces the risk of upstream-downstream conflicts and other geographical externalities and facilitates the hiring of specialists. Moreover, cost reductions may be possible because of economies of scale. However, centralized management has potential disadvantages as well. Centralized management may be very bureaucratic and inflexible. Involvement of the local beneficiaries is usually limited and consequently local knowledge and needs may be overlooked. In addition, more staff may have to be hired, which increases costs. And finally, there may be more opportunities for corruption and for shirking and there is a bigger risk of politically motivated projects that do not constitute the best use of resources (Ostrom et al., 1993).

Because of the potential disadvantages of centralized management, ‘polycentric governance’ has been advocated as an alternative. The term polycentric was coined in 1961 and refers to the existence of ‘many centres of decision-making which are formally independent of each other.’ (Ostrom et al., 1961). Polycentric governance would allow for a better fit of the scale of management and the scales of the different management tasks than if there is only one decision-making centre. Moreover, polycentric governance may be less vulnerable than centralized systems because, if one decision-making centre fails, the others may take over. In addition, there may be more possibilities for experimentation, learning and adaptation.

Yet, polycentric governance has potential disadvantages too. Decision-making and
conflict resolution can be quite difficult and time-consuming. Moreover, the individual centres themselves may not function democratically and may be dominated by specific interests. And finally, corruption may be an issue (e.g. Hooghe and Marks, 2003; Skelcher, 2005; Andersson and Ostrom, 2008; Blomquist, 2009; Pahl-Wostl, 2009).

Water management on the Dutch Island of IJsselmonde provides excellent opportunities for finding out more about the practice of polycentric governance. IJsselmonde is located in the delta of the Rhine and Meuse rivers near the city of Rotterdam and currently has a surface area of some 16,000 ha. Before 1795, water management on the island was the responsibility of no fewer than 25 local jurisdictions and 50 polders. Currently, their tasks are executed by only one organization: water board Hollandse Delta.

This paper discusses the evolution of water management on IJsselmonde between the year 1000, when the area is first mentioned in the sources, and 1953, when large-scale flooding took place, which triggered major reorganization of water management. It discusses the development of the island itself and its government, the evolution of local water management, centralization in dyke maintenance until 1953, and upscaling in drainage management. The paper concludes with some critical reflections on the theory of polycentric governance. Throughout the paper, the geographical names ‘Holland’ and ‘the Netherlands’ are used. To prevent confusion, it is important to note that the two are not synonymous: the Netherlands is the name of the present country, and Holland is the western part of the country.

THE DEVELOPMENT OF IJSSELMONDE

IJsselmonde originally was a sparsely populated area of fens and peat bogs. From the 11th century onwards, the area was drained (Henderikx, 2001). At first, this resulted in very fertile agricultural lands for growing grain, but as soon as the land was drained, the peat started to shrink and oxidize and land subsided. To keep the water out, dykes had to be constructed and drainage had to be improved. Eventually, conditions became wetter, grain had to be replaced by less profitable crops. Maintenance of the water management infrastructure deteriorated, more flooding took place, and in the end the land was lost to the water. After some time, however, the rivers and sea had deposited a meter of more of fertile clay on the remaining peat soils and the area was suitable for reclamation (Dam, 2003; Leenders, 2004).

In different parts of IJsselmonde this process of land loss and land reclamation took place at different times. In the western part, major flooding occurred in 1164 and reclamation started soon after 1180 (Hoek, 1973). In the Riederwaard, the central part of IJsselmonde, supra-local supervision of the dykes was introduced in 1288, which may have postponed permanent flooding, but in the 1370s major flooding occurred. From around 1400 onwards the land was reclaimed bit by bit (Dam, 2003). The Zwijndrechtse Waard, the south-eastern part of IJsselmonde, was flooded in 1321 and reclamation started already in 1332 and was completed in 1336 (Duinker, s.d.; Jorissen, 1955).

At the time of the first drainage works, IJsselmonde was contested between the Count of Holland, the Bishop of Utrecht and other feudal lords, but from around 1200 onwards it formed an undisputed part of Holland (Henderikx, 2001). The western part of the area, however, was part of the domain of Putten. Although the Lord of Putten was a vassal of the Count of Holland, the domain of Putten had its own law and did not have to pay taxes to the count. In the 15th century, the Count of Holland became Lord of Putten, but Putten remained a separate district in Holland until 1795 (Dekker and Kort, 2004).

Drainage of fens and peat bogs originally required the consent of the sovereign, the King of Germany, who held the rights over all wilderness, but from around the year 1000 the Count of Holland and other feudal lords started to exercise these rights instead of the King. The first drainage works may have been undertaken by these lords, but in later centuries they transferred their rights on parcels of fens and peat bogs to their vassals. These could then develop the land themselves or transfer the right to groups of farmers or medieval project developers (Linden,
1955; Dam, 2004).

As the land was drained, it became populated and the area had to be integrated in the government system of the time. At the local level, the Count of Holland or the Lord of Putten was represented by the reeve (‘schout’), who maintained order and presided the local council. This council consisted of five or seven councillors, who represented the local population but appointed by the reeve. The local councils were essentially courts of law that – in these days before the separation of powers was introduced - could also issue byelaws. Penal cases were originally handled by the Count or the Lord of Putten himself and his vassals, and from the 13th century onwards by the bailiff, a regional officer of the Count or the Lord of Putten, and his council. The bailiff and his council could also impose higher fines than the local councils and moreover acted as a court of appeal (Ree-Scholtens and Spijkerman, 1990). The highest legal authority in Holland was the Count’s Council and later the Court of Holland (Bailly, 2008).

In most local jurisdictions on IJsselmonde, the Count of Holland had transferred the right to appoint the reeve as a fief to his vassals, and some of these had in turn transferred this right to one of their vassals. These vassals then became the local lord (or lady). In two local jurisdictions (Albrantswaard and Rhoon) the local lord possessed the right to appoint the bailiff as well.

If after a flood the land owners were not willing to repair a dyke, the local lord could reclaim all rights concerning the land. If there was no local lord or the local lord was not willing to undertake the repairs, the Count or the Lord of Putten could reclaim the rights (for details: Beekman, 1905-1907, Vol. 1, pp 29-31). He could then give, or rather sell, the right to reclaim the land to someone else. Part of the deal was often that the main organizer of the reclamation works became the new local lord. Most of the capital for reclamation came from high officials, such as stewards and bailiffs, and patricians form the upcoming cities, most notably Dordrecht and Delft.

The reclamation works on IJsselmonde continued well into the 19th century. From the late 19th century onwards, polders in the North of the island were turned into harbours and new neighbourhoods of Rotterdam. Presently, IJsselmonde is a highly urbanized area with only some agriculture land remaining.

LOCAL WATER MANAGEMENT

The task of the local jurisdictions on IJsselmonde included water management. They regulated and oversaw the maintenance of water management infrastructure such as dykes and sluices, as well as roads. The key instrument for this was the regular inspection (‘schouw’) by the reeve and the local councilors. Early in the year a byelaw would be promulgated, describing the state that the different infrastructural works should be in, and twice or three times later in the year the works were checked. If the works were not in a correct state, the reeve could, with the consent of the councillors, contract the work to others and reclaim double the costs from the defecting person or persons (Oudenhoven, 1654; Alkemade and Schelling, s.d. a; Henderikx, 2001).

Maintenance of the infrastructure was the responsibility of the land users. Originally, tracts of dyke were allotted to individual plots of land, but gradually maintenance was made ‘common.’ This involved the replacement of maintenance obligations by payment of polder levies to finance maintenance at the polder level. The change towards common maintenance took place at very different dates. In the polder Dirk Smeetsland en mr. Arend van der Woude, for instance, dyke maintenance was made common in 1462 (Alkemade and Schelling, s.d. b), but in the Zwijndrechtse Waard, individual dyke maintenance still existed in 1811, when no fewer than 850 individuals were responsible for this, and was abolished only in 1862.¹ In newer polders, such as the Binnenpolder, dating from 1483, common maintenance was the rule from the start (Oudenhoven, 1654). Common maintenance was also the rule for more complex

¹ Archive Hoogheemraadschap van de Zwijndrechtse Waard (Erfgoedcentrum DIEP in Dordrecht), inv.nr. 11, minutes of the meeting of 30 October 1812; Duinker (s.d.).
infrastructure, such as polder mills, which were introduced on IJsselmonde in the late 15th
century (Wouda, 2009). Exceptional expenses, e.g. the replacement of a sluice, had to be paid
for by the land owners in the different polders (Alkemade and Schelling, s.d. a, pp. 105-106;
Hordijk, 1983). From the mid 19th century onwards, the land owners had to pay for the regular
expenses as well.

During land reclamation, it often was not economic to dyke in complete jurisdictions all
at once or to stick to jurisdictional boundaries. Consequently, many local jurisdictions contained
more than one polder and many polders were located in more than one jurisdiction. In these
cases, the land users and owners had to pay for the works in their own polder only, but
regulation and supervision usually remained at the level of the local jurisdiction or jurisdictions.
This resulted in two types of local water management entities: the local councils, presided by
the appointed reeve, and communities of land users and owners in the individuals polders. The
local councils usually consulted the land owners and users in the polder or polders concerned
before they prescribed major new works and in some cases they merely approved the plans
made by the land owners and users (Wouda, 2009). The polders usually had their own treasurer,
elected by the land users (in the polder Oost-IJsselmonde) or the local lord (e.g. the Zegenpolder
and the Molenpolder).

To complicate the picture, in several local jurisdictions separate reeves (‘dijkgraven’) and
councillors for public works were appointed, either for all polders within a local jurisdiction (e.g.
in Ridderkerk) or for individual polders (e.g. in West-IJsselmonde). Maintenance of the
infrastructure, however, remained the responsibility of the land owners and users, individually
or collectively.

This water management system remained virtually unchanged until 1795. On 17 January
1795, however, the Batavian revolution was proclaimed with the support of the French army.
All ‘feudal rights’ were abolished, including the rights of the local lords (e.g. Schama, 1977).
Already on 6 March 1795 the ‘provisional representatives of the people of Holland’ decided that,
for the time being, the different local water management organizations had to remain in place,
but on 7 October they decided that individual board members could be replaced and that from
now on they should be elected by those who had to pay the polder levies or maintain the water
management infrastructure (Röell, 1866). Subsequently, the land owners and users in some
polders (e.g. in Barendrecht and Charlois) decided to elect their own polder board. These then
took over the water management tasks from the local jurisdictions. By 1811 the Netherlands had
become a part of France and municipalities according to French law were introduced. In those
areas where local water management had not yet been taken over completely by new polder
boards, the old local jurisdictions continued to exist as water management organizations only.

In 1813 the Netherlands became independent again. The rights of the local lords were
temporarily restored, including the right to appoint local officers such as dyke reeves, but in
1848 the Netherlands got a liberal constitution and all feudal rights were abolished for good.
Moreover, the judicial powers of water management organizations were abolished because they
conflicted with the notion of the separation of powers. According to some, the judicial powers
had already been abolished under French rule in 1811, when independent courts had been
established, but according to others this did not affect the competence of the water management
organizations (e.g. Anonymous, 1839; Donker Curtius, 1834; Outeren, 1835; Stuurman, 1992).
To remove any legal uncertainty, the judicial powers were abolished explicitly by law in 1841
(Honert Thz, 1842).

Already in 1814 the provinces had gotten the right to change the statutes of the different
water management organizations. Originally, it was not clear how far this right extended and
whether the provinces could also merge these organizations (Thorbecke, 1843; Korf, 1977). The
constitution of 1848 brought some more clarity on this point, and the constitution of 1887 (art.
198) stated explicitly that the provinces could establish and abolish local water management
organizations. Nonetheless, until 1953 the province of Zuid-Holland, in which IJsselmonde is
located, has always been very reluctant to impose reorganization. Yet, already in 1850s Zuid-
Holland did make a general byelaw on polder management and statutes for individual polders
and water boards. As in the other Dutch provinces, they were to be run exclusively by the land owners under the supervision of the province. Not only local lords, but also land users renting land did not play a role anymore. The remaining old local jurisdictions with water management tasks were turned into ordinary polder boards (cf. Blécourt, 1912).

**CENTRALIZATION IN FLOOD PROTECTION**

While for centuries most water management on IJsselmonde was organized locally, in some parts supra-local dyke management had been introduced. Concerning the Riederwaard, the Count of Holland declared in 1288 that, if a dyke had been assessed positively and still broke, the repairs would be done by the whole of the Riederwaard, irrespective of the local jurisdiction in which the dyke was located. This introduced risk sharing among the local jurisdictions in the Riederwaard. Moreover, it introduced regional dyke inspection, on top of the local dyke inspections (Henderikx, 2001, p. 196). Regional dyke inspections were initially conducted by representatives of the different local jurisdictions under the direction of the count’s bailiff, but later a separate bailiff for dykes was appointed (Oudenhoven, 1654; Dam, 2003). With the loss of the Riederwaard in the 1370s, regional dyke inspection disappeared as well and was not revived when the Riederwaard was reclaimed from 1400 onwards. The only exception was the joint inspection of the dykes in the jurisdictions of Ridderkerk and Oost-IJsselmonde, based on an agreement of 21 May 1446 between the two jurisdictions (Oudenhoven, 1654).

Concerning the Zwijndrechtse Waard, the Count decided in 1332 that persons participating in the reclamation works for 1/16th part or more would become local lord for their part. All local lords together would appoint a dyke bailiff, who would inspect the dykes together with his councillors (Oudenhoven, 1654; Jorissen, 1955).

In the western part of IJsselmonde, mention is made of a dyke bailiff of Portugaal in 1379 (Gouw, 1980). In later centuries, the water board ‘The Common land of Portugaal’ covered the territory of three local jurisdictions, but not completely. The newer polders in front of the old land had not been brought under the jurisdiction of the water board, which consequently had no competence concerning the dykes of these polders.

After 1795 several attempts were made to centralize dyke management. On 31 January 1810 the dyke act was adopted (Maas, 1963). Based on this act, the different polders in the Netherlands were combined into seventeen dyke ring areas, one being IJsselmonde. For each dyke ring area, a small commission was appointed that would inspect the dykes twice a year and could give binding orders to the different bodies responsible for dyke management. Individual dyke maintenance was to be replaced by financial contributions. If the costs for dyke management in a polder exceeded a certain maximum, a levy would have to be imposed on all land in the polder, including the lands that under ordinary circumstances were exempted. If this levy did not yield enough, a dyke ring levy would have to be imposed on all land in the dyke ring area, up to 1/3 of the total rental value of the land (including the ordinary and the extraordinary polder levies). If this still did not yield enough, state subsidies could be given. According to Minister De Mist, the purpose of the dyke act was to improve dyke maintenance without changing the distribution of costs too much, and to reduce the need for state subsidies (Maas, 1963).

The ring commission for IJsselmonde was very active. On 6 June 1811, it ordered the raising several dykes, especially in the western part of the island. To finance the works, a dyke ring levy would be necessary. This was not appreciated in the Zwijndrechtse Waard, where the

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2 Archive Ambacht en Gemeente Pernis (Municipal archive Rotterdam), inv.nr. 93; Archive Hoogheemraadschap van de Zwijndrechtse Waard (Erfgoedcentrum DIEP), inv.nr. 11, minutes of the meeting of 11 June 1811.

3 Archive Ambacht en Gemeente Pernis (Municipal archive Rotterdam), inv.nr. 93.
dykes had been raised in 1808 and no new works were necessary. But also in the western part of IJsselmonde, the activities of the ring commission were not appreciated. According to Hendrik Johsz. Vermaat, a local farmer, the whole affair was ‘the most unnatural thing that ever occurred in our country. A ring commission came from the city of Dordrecht and the farmers were ordered to raise the dykes, whether it was necessary or not. And these were gentlemen that did not have to pay a farthing because they did not own a square inch of land. But there was no arguing against them.’ (Vermaat and Vermaat, 1997; translation by the author; cf. Anonymous, 1839).

For financial reasons and because of the difficult economic situation, raising of several dykes was cancelled in 1812, and in 1814 the ring commissions stopped functioning all together. New attempts to centralize dyke management were made in 1851. In reaction to the draft statutes for the polder Nieuw-Reijerwaard, a number of land owners in that polder sent a letter to the provincial executive asking whether it would not be better to establish regional dyke management. The provincial executive consulted the polder boards on the island about this issue, but they were all against because they saw the plans as an infringement on their rights and a threat to their independence. The province tried again in 1860, but with the same result (NN1, s.d.).

Some degree of centralization was introduced following the storm surge of 23 December 1894. The dykes of two polders in the western part of the island had been damaged, and it was not considered fair that only these two polders would bear the costs of the repairs: the other polders protected by these dykes would have to contribute as well. Subsequently, in 1897 two new water boards were established dealing exclusively with flood protection: ‘Water board the west dykes of IJsselmonde’ and ‘Water board the old and new dykes in front of Rhoon’.

Following the flooding of the Zuidpolder in 1928, the province used the opportunity to propose the establishment of one water board for the management of all dykes of IJsselmonde. The Water board the old and new dykes in front of Rhoon was against. They had lost a lot of territory to the expanding harbour of Rotterdam and therefore proposed a merger with the adjacent Water board the west dykes of IJsselmonde. Dyke management on the remainder of the island could be done by two water boards. According to Water board the old and new dykes, one water board for all dykes on the island would be more expensive because more and higher qualified officials would have to be hired (NN1, s.d.).

One water board for all the dykes was made possible only after the largest flood in the Netherlands in living memory, the storm surge of February 1953. On 1 January 1955, water board Dyke ring IJsselmonde was established, but not without much discussion. In 1973, this water board merged with the different polders in IJsselmonde, and was renamed Water board IJsselmonde. Finally, on 1 January 2005, this Water board merged with three adjacent water boards and a water purification board to form Water board Hollandse Delta.

**UPSCALING OF DRAINAGE**

While flood protection was the main issue triggering centralization, some upscaling in drainage management took place as well. When a new polder was created in front of an old one that had drained directly onto the river, these two polders had to reach agreement on the construction and maintenance of a drainage canal through the new polder and a sluice in the new dyke. The resulting arrangements could become very complex (e.g. Teixeira de Mattos, 1920).

In the case of the Koedood, the arrangements for drainage concerned an area of some 2,300 ha. The Koedood was a sea arm that was formed after the loss of the Riederwaard in the 1370s. When the Koedood was closed off in 1580, a solution had to be found for the drainage of

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4 Archive Hoogheemraadschap van de Zwijndrechtse Waard (Erfgoedcentrum DIEP), inv.nr. 11, minutes of the meeting of 12 October 1811.

5 Archive Hoogheemraadschap van de Zwijndrechtse Waard (Erfgoedcentrum DIEP), inv.nr. 33.
eight old and new polders. This solution involved the construction of the Robbenoordse vliet (a new drainage canal) and two sluices.

The Koedood and the connected works were managed by a committee with representatives of the different polder boards on the basis of contracts between the polders. However, this proved to be an insufficient basis. In 1842 the polder Binnenland van Barendrecht had raised its embankment along the Koedood. Consequently, it could continue pumping water onto the Koedood when the agreed upon maximum water level in the Koedood had been reached. This gave problems for the other polders that had not raised their embankments. There was nothing in the existing contracts requiring the polder Binnenland to observe the maximum water level. A solution could only be found in 1870, when a new agreement was necessary for a steam pumping station that would serve all eight polders. Nine years later, in 1879, the committee for managing the Koedood was changed into a regular water board with the power to make binding regulations (NN2, s.d.).

Individual polders also cooperated on the establishment of a wind mill or a pumping stations. For small polders it often was not economical to have their own wind mill and especially their own pumping station, but also larger polders could sometimes save money, for instance when they had over-capacity. Cooperation could take different forms: a contract between the polders concerned, the establishment of a new water board exclusively for the operation of the pumping station, or a merger of the polders concerned (see Teixeira de Mattos, 1920).

Each form had advantages and disadvantages. Contracts could be concluded without involving any higher authority, but the resulting arrangements lacked any public power and any change required difficult renegotiations. New water boards could result in competency problems with the old polders and complicate management (Hordijk, 1983). Merging polders often was problematic because the financial situation of polders and hence the polder levy often differed a lot. For instance, some polders had relatively much dyke to maintain, while other polders owned a lot of real estate generating income (see Wouda, 2004). A solution for this problem was to keep different accounts for the different polders and for the common works, and to differentiate the polder levy. Other problems for merging polders included attachment to independence and personal considerations. Obviously, when two polders merge, one of the two dyke reeves becomes superfluous. This may have been behind the opposition of the polder Ziedewij against a merger with the polder Binnenland van Barendrecht. In 1948 the two polders had the same dyke reeve and could be merged (Hordijk, 1983).

AND WHAT ABOUT POLYCENTRISM?

The history of water management on IJsselmonde offers several illustrations of the potential advantages and disadvantages of polycentric governance. The polycentric water management system on IJsselmonde made it possible to match the management scale with the scale of the management issue concerned, if necessary by establishing a new organization, and to involve local beneficiaries in decision-making and financing, thus reducing costs and limiting the risk of wasteful projects. Yet, regional issues and especially dyke management were not always handled at the regional level. Where regional organizations existed, as in the west of IJsselmonde, their boundaries were not always extended when new polders were created. Consequently, management did not always involve all beneficiaries. This may have resulted in underinvestment and unnecessary flooding. Moreover, for most of the period covered in this paper management cannot really be called democratic because most officials were appointed and not elected.

Polycentric governance is often posited as facilitating adaptation to changing conditions and new insights (e.g. Folke and Hahn, 2005; Pahl-Wostl, 2009). However, little has been written about the issue how adaptive polycentric governance systems themselves are. What stands out in the case of IJsselmonde, is the importance of the broader political and legal context.
The system before 1795 clearly bears the imprint of the mediaeval feudal system and the changes taking place in the period 1795-1860, such as the separation between local government and local water management, have everything to do with the modernization of the Netherlands and the development of the liberal state. Technological innovation and economic factors played a role as well, but mitigated by social factors. The introduction of steam power, for instance, did result in some mergers of polders, but only if the polder boards did not attach too much importance to their independence and their own position.

The water management system on IJsselmonde has generally been very slow to adapt to changing conditions. Sometimes, it became ‘petrified’ and reflected past conditions more than current ones (cf. the regional water board ‘The Common land of Portugaal’, which did not include the newer polders). Petrification may in fact be a problem for many more polycentric systems. Fundamental change of the system may be virtually impossible because of vested interests, unless there is a higher authority that is both capable and willing to take the lead. Yet, if this higher authority imposes its solutions, many of the advantages of polycentric governance may be lost (cf. Ostrom et al., 1961). Alternatively, one of the local units may take up a leadership role, but without support from higher authorities it will be very hard to realize fundamental change. Fundamental change in the absence of higher authorities, as in many international issues, involves difficult and complex negotiations and may have to involve compensation schemes for specific vested interests.

Future research on polycentric governance could focus on the issue of petrification and its reverse, adaptation to changing conditions. These changing conditions could be social, political, economic, environmental or technological. Important factors to be considered that might help to explain adaptation include the current institutional setup (e.g. ownership rights, decision-making powers, and conflict resolution procedures), informal actor networks, and the presence of formal or informal leaders (cf. Olsson et al., 2006; Meijerink and Huitema, 2009). Water management on IJsselmonde provides several possibilities for this type of research.

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