Polder mania or marsh fever? Risk and risk management in early modern drainage projects: the case of Kallopolder, Flanders, 1649 to 1662*

by Tim Soens and Pieter De Graef

Abstract

Coastal marshlands are landscapes of risk: risk-taking is central to capitalist farming. The two seem to merge in the large-scale drainage projects of coastal and inland marshlands that proliferated all over Europe during the early modern period. Drainage projects mobilized huge amounts of mainly non-agricultural capital but also relied on advanced financial tools borrowed from merchant capitalism. Drawing on the extraordinary evidence regarding the financial flows and strategies involved in one such drainage project in Flanders, this article argues that risk was indeed a central concept in the funding as well as in the success or failure of drainage projects. Such projects were at the same time examples of financial speculation in pursuit of easy profit and of sophisticated risk-mitigation using all the legal and semi-legal instruments available. Finally the article shows how the risk assessment of a particular project by the major investors often had a profound impact on the further development of the region.

Risk has always been a central element in the history of the coastal lowlands surrounding the North Sea. Over the past few years environmental historians like Petra van Dam, Franz Mauelshagen and most recently Greg Bankoff have analysed how the permanent threat of flooding and disaster in these regions has generated institutions, technologies and coping mechanisms that are often broadly similar from one part of the North Sea area to another.[1] Not only did the inhabitants of coastal wetlands live in the constant fear of dyke breaches and storm

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[1] G. Bankoff, 'The "English Lowlands" and the North Sea Basin system: a history of shared risk', *Environment and History* 19 (2013), pp. 3–37; E. Thoen, 'Clio defeating Neptune: a pyrrhic victory? Men and their influence on the evolution of coastal landscapes in the North Sea area, especially during the Middle Ages and the Old Regime', in: E. Thoen *et al.* (eds), *Landscapes or seascapes? The history of coastal environment in the North Sea area reconsidered* (2013), pp. 397–428; P. J. E. M. van Dam, 'Denken over natuurrampen, overstromingen en de amfibische cultuur', *Tijdschrift voor waterstaatsgeschiedenis* 21 (2012), pp. 1–10; F. Mauelshagen, 'Flood disasters and political culture at the German North Sea coast: A long-term historical perspective', *Historical Social Research* 32 (2007) 3, pp. 133–44.

flooding by the sea, these lands also bordered rivers and river estuaries and suffered frequent episodes of river flooding. Furthermore, the intentional inundation of coastal wetlands for military defence in wartime was increasingly practised from the later Middle Ages onwards.[2] According to Bankoff the coastal lowlands can therefore be labelled 'risk societies' because their inhabitants, in one way or another, have had to accept the risk of flooding as a 'frequent life experience' and continuously tried to adapt both landscape and society to accommodate this risk as well as possible.[3] From an unpredictable hazard, flooding gradually turned into a 'manageable' risk, although the manner of managing this risk varied greatly. In economic and agricultural history, the attitude towards risk is often singled out as a major element distinguishing peasant societies from capitalist societies. Following the 1976 article of D. McCloskey on the inherent risk aversion of peasants in open-field agriculture, there has been much debate on the extent to which peasant smallholders, in order to ensure the survival of the family, tried to reduce risk as much possible, by diversifying income, crops and plots, and by preferring a stable but low income to higher but less certain profit.[4] Risk also remains a central issue in debates on the transition from peasant to capitalist agriculture. Whether forced by competition for land (the view of Brenner and others) or responding to market opportunities (as argued by De Vries *et al.*), capitalist farmers were increasingly tempted to specialize, innovate, experiment and take risks in order to maximize the profitability of their farm.[5]

So far, the debates on the variable role of risk in agricultural history are difficult to square with the 'permanence' of risk as advanced by environmental historians of the coastal lowlands. By stressing the physical origins of the flood risks, environmental historians tend to downplay fundamental differences in the way environmental risk was constructed by different social groups in different social contexts.[6] On the other hand, for agricultural historians, the specific physical environment of the coastal lowlands, including the occurrence of flooding, is mostly analysed as an exogenous factor which impacts on land use and productivity, but the risk itself is not singled out as an integral element that distinguishes coastal farming systems from inland farming systems.[7] In this article, an attempt is made to integrate both perspectives on the role of risk in coastal societies, by focusing on the highly innovative ways of managing risk that characterized the centralized drainage projects undertaken across the North Sea area in the early modern period. As we will argue, centralized drainage introduced a profoundly different way of dealing with risk, as drainers no longer tried to adapt to risk but used technology, institutions and power to control and manipulate it. Drawing on centuries-old experiences of coping with risk in international trade, drainers turned risk into a commodity, the cost of

[2] A. de Kraker, 'Flood events in the southwestern Netherlands and coastal Belgium, 1400–1953', *Hydrological Sciences* 51 (2006), pp. 913–29.

[3] Bankoff, '"English Lowlands"', p. 19.

[4] D. McCloskey, 'English open fields as behavior towards risk', *Research in Economic Hist.* 1 (1976), pp. 124–70 and id., 'The prudent peasant: new findings on open fields', *EcHR* 51 (1991), pp. 343–55. A more recent assessment may be found in G. Richardson, 'The prudent village: risk pooling institutions in medieval English agriculture', *JEcH* (2005), pp. 386–413.

[5] R. Brenner, 'The agrarian roots of European capitalism', *Past and Present* 97 (1982), pp. 16–113; P. Hoppenbrouwers and J.-L. van Zanden (eds), *Peasants into farmers? The Netherlands and the Brenner Debate* (2001).

[6] Bankoff, '"English Lowlands"', p. 34.

[7] For an overview, see the forthcoming volume on *Land Use and Productivity* in the series Rural Economy and Society, to be published by Brepols (Turnhout).

which could be externalized for other groups or for future generations. It is no coincidence that the early modern consortia or companies of investors active in drainage resembled shipping partnerships, with investors taking shares in several consortia, as Piet van Cruyningen has argued for Zeeland-Flanders.[8] Drainage introduced modern risk management methods into coastal societies, combining inherently high risks with maximised efforts to contain it.

I

In the course of the seventeenth and eighteenth centuries, enormous amounts of money were expended on large-scale drainage and embankment projects in the vast coastal marshlands of England, France, northern Germany and the Low Countries.[9] In many of these projects, both the incentive and the capital came from high status investors, many of them belonging to merchant or government elites, who were experienced in the funding of risky trade and shipping operations. Like these, investment in drainage projects was a risky undertaking in many ways. The constant environmental risk of flooding that is inherent to the nature of coastal wetlands has already been mentioned. Whereas the local population was both bodily and materially endangered by flooding, the absentee investors/landowners mainly suffered in terms of the size of their wallets. They saw their prospects of decent profits and high returns on investment diminish while costs for dyke repairs escalated. In addition to, and intertwined with, flood risks, free-loading landowners unwilling to pay their rates to the water management organization could endanger the quality of the water control system and cause a financial headache for the other landowners (since the latter often had to pay more than required to fill the gap). The problems of erratic tax collection sometimes ended in deficient maintenance and hence increased flood risks.[10] Third, every drainage project entailed a redistribution of property rights, often to the disadvantage of the local population. As a consequence, local resistance to drainage was often very high and a constant danger to projects, especially when intertwined with other causes of political discontent.[11] In the reign of Charles I of England (1625–49) for instance, the massive drainage projects in the Fens, some of them coordinated by the Dutch engineer Cornelius Vermuyden as well as (partly) financed by Dutch capital, became profoundly entangled in the violent political conflicts of the English Civil War.[12] Lastly, the

[8] P. van Cruyningen, 'Profits and risks in drainage projects in Staats-Vlaanderen', *Jaarboek voor Ecologische Geschiedenis*, 2005/06 (2006), p. 131. For the shipping partnerships, see O. Gelderblom and J. Jonker, 'Completing a financial revolution: the finance of the Dutch East India trade and the rise of the Amsterdam capital market, 1595–1612', *JEcH* 64 (2004), pp. 641–72.

[9] A general overview is given by S. Ciriacono, *Building on water. Venice, Holland and the construction of the European landscape in early modern times* (2006), esp. pp. 194–250.

[10] On deficient water tax payment, see M. A. Knittl, 'The design for the initial drainage of the Great Level of the Fens: an historical whodunit in three parts', *AgHR* 55 (2007), pp. 48–9; P. J. van Cruyningen, 'State, property rights and sustainability of drained areas along the North Sea coast, sixteenth–eighteenth centuries', in B. van Bavel and E. Thoen (eds.), *Rural societies and environments at risk. Ecology, property rights and social organization in fragile areas (Middle Ages–twentieth century)* (2013), pp. 195–202.

[11] T. Soens, 'Capitalisme, institutions et conflits hydrauliques autour de la Mer du Nord (XIIIe–XVIIIe siècle)', in P. Fournier and S. Lavaud (eds), *Eaux et conflits dans l'Europe médiévale et moderne*, (2012) pp. 149–71.

[12] K. Lindley, *Fenland riots and the English Revolution* (1982); M. E. Kennedy, 'Charles I and local

actual pay-off for the drainers only occurred after the drainage or embankment project was completed. The return on investment primarily depended on the agricultural output and, at the very start of the drainage project, the future yields of the newly reclaimed lands were highly uncertain.[13] As such every drainage project had to deal with significant degrees of financial, environmental, political and agricultural risk. Both the high amount of capital input and the high degree of risk involved in land reclamation have been considered important elements in the further agricultural evolution of the coastal wetlands as well. As Salvatore Ciriacono puts it, it cannot be a coincidence that 'the capitalist surge in English agriculture came in precisely the same decades as the major fen drainage projects'. Drainage usually brought a new way of organizing agriculture, one based on the collaboration of absentee landowners and large tenant farmers, which often proved an ideal breeding ground for the development of agrarian capitalism in which risk taking, competition and capital intensification was rewarded by a gradual increase in agricultural productivity.[14]

Risk and the management of risk turns out to be a central element in the history of wetland reclamation in general, and the 'grand' drainage projects of the early modern period in particular. However, the existing literature concerned with drainage projects has paid only limited attention to the funding of these projects. Most recent research on drainage concentrates on landscape formation or the technological, agricultural or socio-political impact of drainage.[15] The focus on the outline of the entrepreneurial and rectilinear 'renaissance-style' polders, the technology of the windmill and sluice drainage, land improvement and changing property relations, as well as conflicts between drainers and the inhabitants of the area, or amongst the drainers themselves, has paradoxically eclipsed the main purpose of drainage projects: to make investors' money work in these risky settings.

Despite a rich historiography for drainage and coastal water management, financial analyses of individual drainage projects remain scarce, especially outside the Netherlands.[16] Moreover, much of the investigation tends to concentrate only on the major undertakings of famous engineers and great adventurers, such as the notorious Vermuyden in the English Fens, Jan Adriaanszoon Leeghwater in the marsh regions of Schleswig-Holstein in northern Germany

Note 12 continued
government: the draining of the East and West Fens', *Albion* 15 (1983), p. 26; a more nuanced analysis of the resistance to fen drainage may be found in H. Falvey, 'Custom, resistance and politics: local experiences of improvement in early modern England' (unpublished PhD thesis, University of Warwick, 2012).

[13] H. van Zwet, *Lofwaerdighe dijckagies en miserabele polders. Een financiële analyse van landaanwinningsprojecten in Hollands Noorderkwartier, 1597–1643* (2009), pp. 331–89 on the highly divergent returns in several polders in northern Holland.

[14] Ciriacono, *Building*, pp. 7, 236–43, citation p. 243. Whether or not land drainage invariably led to an increase in agricultural output still remains subject to a great deal of debate, e.g. A. Gritt, 'Making good land from bad: the drainage of West Lancashire, *c.*1650–1850', *Rural Hist.* 19 (2008), pp. 1–27.

[15] On landscape formation, Bankoff, '"English Lowlands"', p. 5; W. Reh, C. Steenbergen and D. Aten, *Sea of land. The polder as an experimental atlas of Dutch landscape architecture* (2007); on drainage technology, Gritt, 'Good land'; Ciriacono, *Building*, pp. 246–47; on agricultural benefits, J. Thirsk, 'The Isle of Axholme before Vermuyden', *AgHR* 1 (1953), p. 28; on conflicts, Soens, 'Capitalisme'; R. Morera, *L'assèchement des marrais en France au XVIIe siècle* (2011), Gritt, 'Good land', pp. 9–10.

[16] Few attempts for Holland by van Zwet, *Landaanwinningsprojecten* and S. Zeischka, *Minerva in de polder. Waterstaat en techniek in het hoogheemraadschap van Rijnland, 1500–1856* (2008). For Zeeland, the most important study is van Cruyningen, 'Profits and risks'.

or Jan van Ens and Jean Hoeufft in the Poitou and Charente region in France. The bulk of wetland drainage remained in the background, completed by lesser known consortia of engineers and investors. Their motives and the success or failure of their investment remains relatively hypothetical: only few attempts have been made to quantitatively assess the degree of risk taken by the investors, the investment strategies of individual stakeholders or the actual returns on investment. These investment strategies might have been very diverse, as the recent literature on drainage emphasizes the multiplicity of interests and stakeholders involved in drainage and the necessity of a firm embedding in local society, which in turn implied the involvement of quite a number of local ruling elites as well.[17]

Precisely this need for a broader participation acts as a trigger for considering the risk profile of investments in drainage projects. A multitude of actors and hence financial strategies were involved and the strength of these projects depended in the end on the ability to raise a great deal of capital from many different participants. The capital of the leading investors was often wrapped up in a larger initiative involving lots of smaller participants. Spreading the risks and risk management were of crucial importance for the success of the investment. In this article, we argue that projects of land reclamation were examples of clever risk assessment: a mixture of speculation – inherent to this kind of investments, given the uncontrollable contextual factors and the high degree of fluctuation in results – and risk limitation, that is, attempts to transform an essentially speculative undertaking into a (more) secure investment. In order to pursue the apparently mutually exclusive goals of speculation and security of return on investment, the larger investors in particular did not hesitate to transfer part of the risk to smaller proprietors and investors. As we will see, they managed to do so thanks to an institutional setting which favoured their interests. This permanent balancing and sharing of risks might have had important consequences for the subsequent agricultural development of the newly reclaimed lands. On the one hand, the many possibilities of risk insurance might have favoured further investment in wetland agriculture, but, on the other hand, too much risk-aversion on the part of the larger landowners might have stimulated rent-seeking behaviour, with landowners trying to regain their initial investment as quickly as possible. If rents were to rise too high, they might have obstructed further productive investment by the farming population, hence impeding, instead of accelerating, agricultural development in the newly drained areas.

An in-depth analysis of the risk profile of early modern drainage projects, depends on the availability of detailed data for the capital flows involved, the social profile of the investors, their returns on investment and the length of their engagement (i.e. short-term speculation or long-term investment). In the rest of this article we will therefore concentrate on one representative drainage project in the Flemish coastal wetlands: Kallopolder on the left bank of the river Scheldt near Antwerp, which was undertaken between 1649 and 1653 (Figure 1).

Almost the entire archive of this drainage project, including accounts and correspondence, has been preserved. We can retrace the financing of the whole drainage scheme through the levying of water taxes – called *geschoten* – and loans, and therefore reconstruct at least part

[17] For England see Knittl, 'Great Level'; Germany, M. L. Allemeyer, *'Kein Land ohne Deich…!'. Lebenswelten einer Küstengesellschaft in der Frühen Neuzeit* (2006); France, Morera, *L'assèchement*; northern Holland, van Zwet, *Landaanwinningsprojecten*.

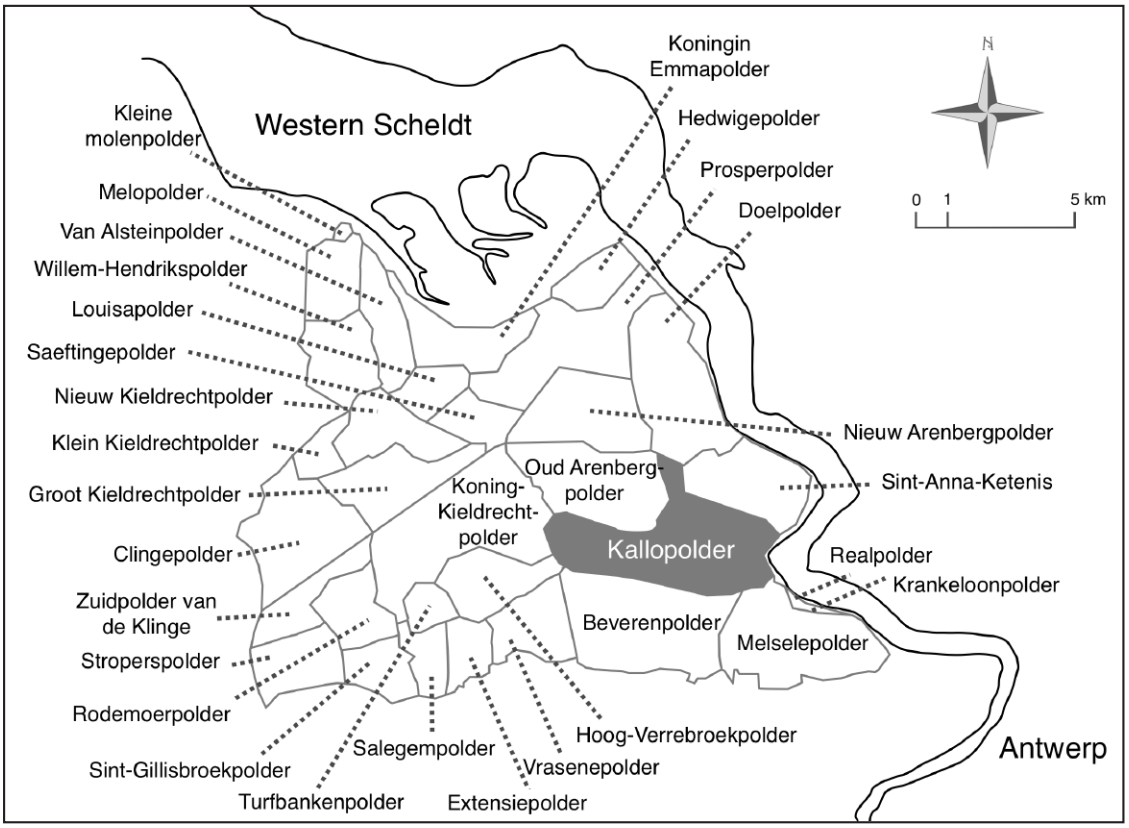

FIGURE 1. Location of Kallopolder on the left bank of the Scheldt Estuary near Antwerp.

Source: I. Jongepier and T. Soens (GIStorical Antwerp).

of the decision-making process that preceded every major stage in the project. What is really exceptional, however, is the opportunity of gaining insight into the crop yields just after reclamation, because the newly drained polder was initially directly exploited by proprietors and land claimants. This provides us with accounting documents in which crop yields and values as well as the costs of ploughing and sowing seed, were recorded.[18] As regards the assessment of risk management in early modern wetland drainage, Kallopolder is also an excellent case study because the odds were against the success of the enterprise. As we will see below, the newly constructed sea defences broke soon after their completion, leading to renewed flooding of the polder and high extra costs. Furthermore, whereas the project was planned during a period of bountiful harvests, the first harvests from the newly drained polder were particularly poor. Even so, the enterprise became a financial success for its initiators, demonstrating their extreme ability to manage risk.

[18] State Archives Beveren (henceforth SAB), P27 (Polder archive Kallo).

II

In the high and later Middle Ages economic activity in this area was dominated by large-scale commercial peat digging, stimulated by the local lords of Beveren, and from 1334 onwards, by the counts of Flanders, who took over the local *seigneurie* and integrated it into their domain. As elsewhere in the North Sea area, intensive peat cutting brought about the undesirable side-effect of lowering soil levels and increasing drainage problems.[19] As a result the area became subject to regular flooding, and part of it was covered by estuarine sediments from the river Scheldt. In 1431 the marshes were sold by the then duke of Burgundy and count of Flanders, Philip the Good, who was motivated by a growing need for cash to fund his campaigns. The sale of the marshes cleared the way for the embankment of the *polders* Haendorp, Sint-Niklaas and Sint-Anna, which together formed the future area of Kallopolder. Renewed flooding followed in the sixteenth century. Right at the start of the Siege of Antwerp by the Spanish army of Alexander Farnese in 1583, the three polders were inundated by the defendants of Antwerp and they remained flooded for many decades until the Peace Treaty of Münster (1648) which officially ended the war between the Spanish Habsburg empire and the newly created Dutch Republic. Kallo remained in the Spanish part of the Low Countries and on 2 September 1649, Philip IV of Spain issued an *octrooi* (licence or patent) granting a company of investors, headed by the Jan Baptiste Cachiopin de Laredo, lord of Kallo, the legal permission to re-embank and drain the flooded lands (Figure 2).[20] The reclamation was finished in 1652, and, in 1653 and 1654, the landowners and claimants began harvesting the crops.[21]

By the middle of the seventeenth century, the granting of a royal licence at the start of a drainage project was a well-established practice all over the North Sea area. Its precise history is yet to be determined, but in the Low Countries the first *octrooien* appeared in the course of the fifteenth century, with precedents dating back to the late fourteenth century. The licence was based on the royal claim to waste or vacant land. When a coastal wetland was flooded, it was deemed abandoned by its former owners, and its ownership was transferred to the sovereign who subsequently granted it to investors.[22] Apart from this transfer of property rights, the *octrooi* also arranged and regulated the future organization of drainage and water

[19] P. van Dam, *Vissen in veenmeren. De sluisvisserij op aal tussen Haarlem en Amsterdam en de ecologische transformatie in Rijnland, 1440–1530* (1998), pp. 58–70; G. J. Borger, 'Draining-digging-dredging: the creation of a new landscape in the peat areas of the Low Countries', in J. T. A. Verhoeven (ed.), *Fens and bogs in the Netherlands: Vegetation, history, nutrient dynamics and conservation* (Geobotany, 18, 1992), pp. 131–71.

[20] Published in G. Wolters, *Recueil de lois, arrêtés, règlements etc. concernant l'administration des eaux et polders de la Flandre orientale*, II, *Polders et wateringues* (1869), pp. 166–74 and also P. De Graef, 'Moeilijke beginjaren van een polder. Indijking en rechtstreekse exploitatie van Kallopolder (1649–1654)', *Land van Beveren* 54 (2012), p. 226.

[21] Ibid., pp. 232–34.

[22] On the medieval origins of the *octrooi*, see Soens, 'Dijkenbouwers of rustverstoorders? De Vlaamse graven en de strijd tegen het water in de laatmiddeleeuwse Vlaamse kustvlakte (veertiende-zestiende eeuw)', *BMGN: the Low Countries' Hist. Rev.* 122 (2007), pp. 334–37 and D. Tys, 'Landscape, settlement and dike building in coastal Flanders in relation to the political strategy of the counts of Flanders, 900–1200', in M. Fansa (ed.), *Kulturlandschaft Marsch – Natur, Geschichte, Gegenwart* (2005), pp. 106–26. P. van Cruyningen is currently preparing an article on the development of the *octrooi* and its contribution to creating an institutional context for land reclamation.

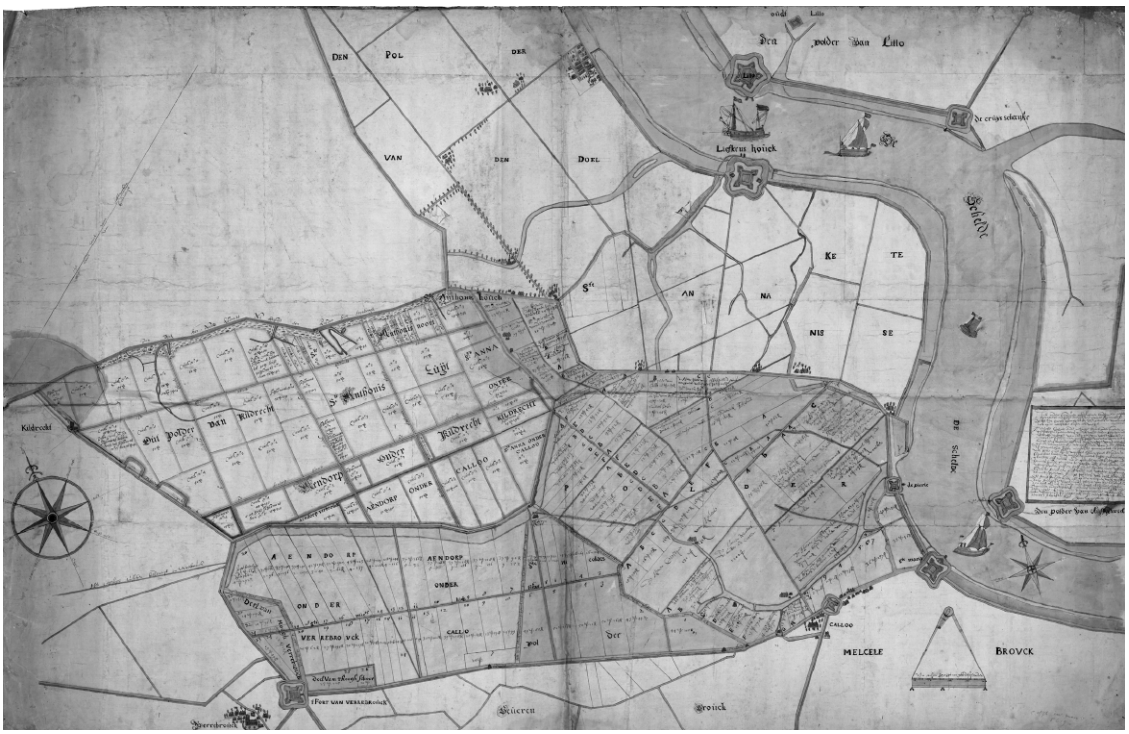

FIGURE 2. Eighteenth-century map of Kallopolder (shaded), on the left bank of the river Scheldt near the city of Antwerp

Source: © National Archives Brussels, *Kaarten en plans*, 2, 8619.

management by establishing a 'polder board' or 'dyke board', which financed its activities through the levy of a water tax or *scot*. From the late fifteenth century onwards the *octrooi* also granted freedom from tax. The *octrooi* of Kallopolder conceded a complete exemption from tax for 36 years, starting from the first harvest. A portion of the ordinary taxes – an indirect tax (excise) of one guilder (fl.) on every vat of beer; and six fl. on every *ame* of wine, were to be transferred to the dyke board to be spent on drainage and dyking. Because these excises were paid by the inhabitants of the newly drained 'polder' as well as by the labourers working in the polder, such a concession of excise duties to the landowners transferred part of the cost of drainage from the landowners to the labourers and inhabitants. Equally important was the threshold of 30 *gemeten* (about 13 ha.) of landed property that an investor needed in order to become involved in the general assembly of landowners. Such restrictions did not exist in the medieval period, but were gradually introduced in the course of the sixteenth and seventeenth centuries, to limit access to the decision-making process – and thus control over the investments – to the larger landowners – the *grote gelanden*.[23]

[23] Soens, 'Threatened by the sea, condemned by man? Flood risk and environmental inequalities along the North Sea Coast (1200–1800 AD)', in G. Massard-Guilbaud and R. Rodger (eds), *Environmental and social inequalities in the city: historical perspectives* (2011), pp. 106–7; G. van de Ven, *Man-made Lowlands. History of water management and land reclamation in the Netherlands* (2004), pp. 116–18.

The 'adventurers' had to gather a large capital sum in order to finance the drainage project. By comparison with the embankment of other polders in Zeeland-Flanders in the same period, the drainage of the polder of Kallo can be considered as one of the more expensive undertakings. In the general polder accounts, the highest *expenditure* was recorded in the years 1650 to 1652 implying that the actual *drainage* works must have been executed in this period. Together with the expenditure for interest and brokerage, the total cost of embanking this area of 1512 ha. ran to 111,668 Flemish pounds (li.) *groten* (or 671,328 fl.). This amounted to 74 li. *groten* (or 444 fl.) per ha. Converted into silver, the directors of the Kallopolder drainage project thus controlled a budget worth the equivalent of 6.6 tons of silver.[24] This undeniably provided them with a great deal of financial responsibility and power. The enormous budgets involved in early modern drainage projects can probably only be compared to state budgets or those of merchant companies engaged in overseas trade.[25]

The drainage of the Zeeland-Flemish Generale Prins Willempolder, the Zaamslagpolder and the Beoostenblij-Benoorden, were all three undertaken between 1650 and 1655. All cost less to complete than the project in Kallo, respectively 204, 245 and 301 guilders per ha, while the Bewestereede only required 112 guilders per hectare (Table 1).[26] Interestingly, the next polder to be embanked in the Waasland polder region, the Oud Arenbergpolder (1685–89) needed a similar investment of about 483 guilders per hectare. Although these Waasland polders were technically comparable with the schemes in Zeeland-Flanders, the cost of drainage resembled the higher expenditure involved in reclaiming the lakes in northern Holland. The reclamation of the Beemster (1612) was the cheapest (260 guilders per ha), but that of the Starnmeer (1643) peaked at 1059 guilders per ha, while the costs of the Purmer (1622), the Wijde Wormer (1626), the Heer Hugowaard (1631) and the Schermer (1635) fell in between these two poles. Lake reclamations were normally more expensive because they necessitated the construction of mills to drain the lakes. This was not necessary, however, when draining most coastal marshes, where gravitation drainage through waterways and sluices was sufficient.[27]

To gather the necessary funds, the adventurers invited those people who claimed rights in the land, whether because their ancestors had lived there or had possessed land before the inundations to participate. Their claims were investigated and if they were not verified, the money the claimants had contributed was refunded. In this way investment in the polder of Kallo was carried by big investors on the one hand – contributing a great deal of capital and in return receiving a large share of the property – and smaller, mainly local, participants on the other. The latter not only provided a substantial part of the capital but also guaranteed at least some local support for the project. Indeed, when analysing the place of residence of the

[24] In 1650 1 guilders (fl.) equalled 9.8 g of silver: J. L. van Zanden, 'The prices of the most important consumer goods, and indices of wages and the cost of living in the western part of the Netherlands, 1450–1800', http://www.iisg.nl/hpw/brenv.php (accessed 24 Jan. 2013).

[25] By comparison, the capital of the first Danish East India Company, at the moment of its foundation in 1616 amounted to 447,498 guilders. See C. van Bochove, *The economic consequences of the Dutch. Economic integration around the North Sea, 1500–1800* (2008), p. 98.

[26] Van Cruyningen, 'Profits', p. 139.

[27] Van Zwet, *Landaanwinningsprojecten*, pp. 245, 305–6; van Cruyningen, 'Profits', p. 128; H. van Damme, 'De Generale Prins Willempolder. Bedijking en bevolking, 1650–55: investeringsmotieven en bevolkingspolitiek', *Tijdschrift voor waterstaatsgeschiedenis* 22 (2013), pp. 6–17.

TABLE 1. Costs of seventeenth-century drainage projects in Flanders and Holland

	Polder	*Year of drainage*	*Total land area (hectares)*	*Costs per hectare (guilders)*
Zeeland-Flanders	Bewestereede	1650	1963	112
	Generale Prins Willempolder	1650–54	3275	204
	Zaamslagpolder	1650	1769	245
	Beoostenblij-Benoorden	1653–55	977	301
Lake reclamation in northern Holland	Beemster	1612	7100	260
	Purmer	1622	2756	334
	Wijde Wormer	1626	1620	351
	Heer Hugowaard	1631	3500	351
	Schermer	1635	4770	534
	Starnmeer	1643	627	1059
Land of Waas	Polder of Kallo	1649–52	1512	444
	Polder of Oud-Arenberg	1685–89	975	483

Source: van Cruyningen, 'Profits', p. 139; van Zwet, *Landaanwinningsprojecten*, 245; Antwerp City Archives, Manual Anthonis Spruyte (Oud-Arenberg)

participants, we notice that 7 out of 16 (or about 44 per cent) of the large participants – acquiring more than 25 hectares of land each – were living in a city (in nearby Antwerp, but also Malines, Ghent, Brussels and Bruges), whereas only 2 out of 16 (or about 13 per cent) were locals. The two principal investors – Jean-Baptiste Cachiopin de Laredo (who received 130 ha.) and Jan Bollaert (91 ha.) – were city dwellers. Cachiopin (d. 1662) offers an interesting example of the type of large investor taking the lead in drainage projects in the early modern period.[28] The Cachiopin family was a merchant family from Spain who had been settled in Antwerp since the middle of the sixteenth century. In the 1650s, however, the Cachiopin became more than just ordinary Antwerp merchants: Jean-Baptiste was knighted and his investment in the Kallopolder project became part of a concentrated effort to acquire land in the Waasland polder region. Their strategy was to buy land already drained in the region, but in addition they purchased the rights to flooded land which might be exploited by drainage. In addition they acquired the seigneurial rights to Kallo in January 1647 at a time when the region was still flooded. The merchant Cachiopin had thus become lord of both water and mud, which he would turn to his advantage through the commencement of the drainage operation. Famous artists like Anthony van Dijck and Pieter Paul Rubens painted portraits of the Cachiopin family, with the one by Rubens hanging in the house of Jean-Baptiste at the moment of his death. Most significantly his post-mortem inventory also listed a large painting portraying the drainage of Kallo.[29]

[28] Most of this information comes from his post mortem inventory. Antwerp, City Archives, WK 968 (1662/05/13).

[29] *In de voorcamer: 'een groote schilderije wesende*

TABLE 2. Place of residence of the investor-landowners, 1649–62

Place of residence	*Property category*					*Total*
	0–5 ha	*5–10 ha*	*10–25 ha*	*25–75 ha*	*>75 ha*	
Large cities (Antwerp, Brussels, Ghent, Malines and Bruges)	3	4	9	5	2	23
Land of Waas	13	4	4	2	0	23
Republic	0	2	0	2	0	4
Rest	0	0	1	1	0	2
Unknown	21	11	2	4	0	38
Total	37	21	16	14	2	90

Source: SAB, P27, no. 731.

The Cachiopins were a merchant family well on their way to integration into the nobility. Amongst the other major investors, we find several families with similar profiles. Many of them made a career in urban administration. Bollaert, for instance, was *groot-aalmoezenier* (director of the urban poor relief) and acquired the seigneuries of Neder and Over-Heembeek near Brussels). Others had entered the service of the Habsburg monarchy – Jean-Antoine Russchen for instance was burgomaster of Malines, but also secretary of the Supreme Court of the Habsburg Low Countries. Apparently, investment in embankment projects perfectly suited this kind of urban elite.[30]

In contrast to the big investors, the majority of the small participants – 17 out of 58 investors, or 29 per cent, receiving less than 10 ha after the embankment was finished – lived in the local region of the Land of Waas. This was probably also true of the many small participants for whom we lack information concerning their place of origin (i.e. 32 unknown cases out of 58, or 55 per cent). More than half of the investors in the 10–25 ha class (9 out of 16, or 56 per cent) also lived in a city (Table 2).

When we consider the total water tax payments over the period 1649–62, the largest share of the capital employed was clearly furnished by urban landowners and city-based noblemen, though the contribution of local, rural participants (either farmers or rural worthies and officials), was somewhat higher than in similar drainage projects elsewhere in the Western Scheldt estuary where it was usual for the urban bourgeoisie from Flanders, Holland, Zeeland and Brabant to obtain 75 per cent or more of the enclosed lands (Figure 3).[31]

Note 29 continued
Callo ingedijckt'. The painting of *Jiacomo de Cachiopin* by Rubens was hanging in the office ('comptoir'). Jacobus (d. 1642) and Thomas Cachiopin were well-known art-lovers (B. Timmermans, *Patronen van patronage in het zeventiende-eeuwse Antwerpen* (2008), p. 43). We have not found any other reference to a portrait of him by Rubens.

[30] Biographical data derived from C. Thomas, *De l'affection, avec laquele je me dispose de la servir toute ma vie. Prospopgraphie des grands commis du gouvernement central des Pays-Bas Espagnols* (1598–1700) (2 vols, 2011).

[31] On the importance of urban capital in early modern drainage projects see C. Dekker and R. Baetens, *Geld in het water: Antwerps en Mechels*

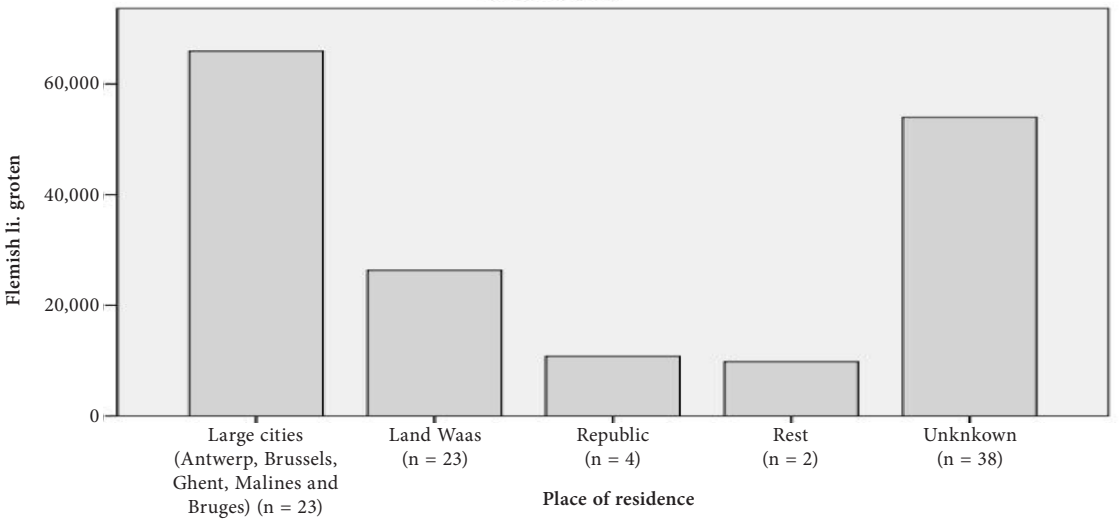

FIGURE 3. Water rates paid according to the place of residence of the investor-landowners, 1649–62

Source: SAB, P27, nos 224 and 731.

The small investors were only admitted when they could provide official titles supporting their claim to the land and, of course, if they proved able to pay the required contributions. In any case, the broad coalition of large and small investors acted as a mechanism for the spreading of risks and, at the same time, enabled the mobilization of the large amount of capital that exceeded the ability of the inner circle of big investors to raise. The fact that those claimants without the necessary capital reserves were excluded from participation, in itself constituted a cover against financial risks.[32] However, this was not enough to prevent financial difficulties during the first years of embankment and exploitation. In these years, the project suffered from the patchy payment of contributions (*scot* taxes). Because participants found it impossible (i.e. smaller ones not having the means to pay) or refused (i.e. wealthy ones deciding to have a free ride) to pay their contribution, the whole enterprise as well as the individual participants ran a considerable financial risk.[33] However, some of the major investors (mostly in the 25–75 ha category) provided a sophisticated answer to this danger, in a way that turned risk into opportunity. They started to contribute higher sums of money than was required by their share in the project. The Antwerp investors George de Nollet and Pieter Melis, as also the lord of Kercken, did so in an almost systematic way. Whereas the required contribution totalled 74 Flemish li. *groten* per hectare (see above), some of them contributed almost 1000 Flemish li. *groten* per hectare (Figure 2). By doing so they solved the project's liquidity problems. They did so however, not because they feared the failure of the project but because these 'excess' payments offered an attractive investment opportunity

Note 31 continued
kapitaal in Zuid-Beveland na de stormvloeden in de 16e eeuw (2010); van Cruyningen, 'Environmental disaster', pp. 1–12; id., *Behoudend maar buigzaam,* p. 104.

[32] This has also been observed in other drainage projects: Soens, 'Capitalisme', p. 162; Kennedy, 'East and West Fens', p. 26; Dekker and Baetens, *Geld*, p. 155.

[33] See Knittl, 'Great Level', pp. 48–9.

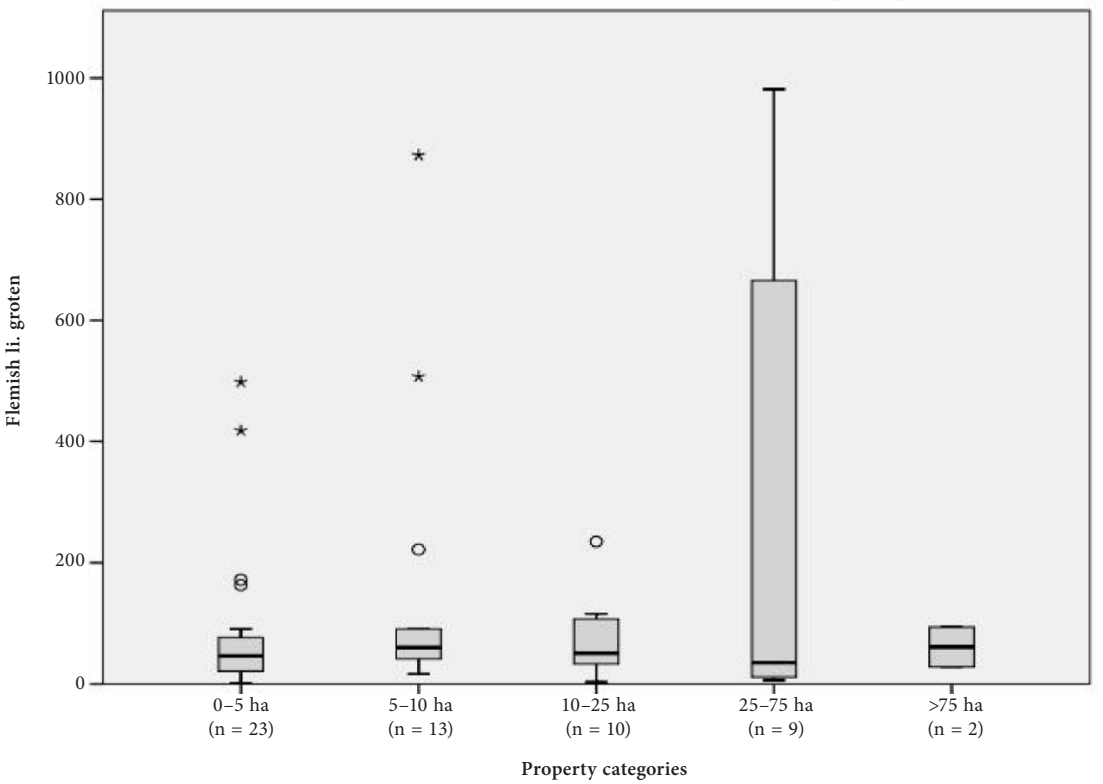

FIGURE 4. Water rates per hectare per property category, 1649–52

Source: SAB, P27, no. 224.

in itself: in fact the 'excess' payments were refunded by the community of landowners at an attractive yearly interest rate of between 6.25 per cent and 8 per cent, considerably above the 4 to 5 per cent rate which, at that time, was normally paid at the Amsterdam money market on both private loans and public ones contracted by the States of Holland.[34] As can be noticed in Figure 4, some of the smaller participants also invested more capital than they were required.

For a minority of landowners, this financial structure offered an attractive additional investment opportunity. The bulk of smaller participants could not profit from this, indeed they saw their contributions increasing because of the interest payments. Theoretically, the latter had to be provided solely by those participants who had failed to pay their share in full, but as many of them ended up renouncing the title to their land, the burden of the repayment fell on the whole community of participants. The repayments are a good example of clever financial risk management: some participants used the project's urgent need for financial

[34] W. Fritschy, 'A "financial revolution" reconsidered: public finance in Holland during the Dutch Revolt, 1568–1648', *EcHR* 56 (2003), p. 64, Table 1; O. Gelderblom and J. Jonker, 'Public finance and economic growth: the case of Holland in the seventeenth century', *JEcH* 71 (2011), pp. 1–39.

means to their own advantage. They initially contributed more than was required but had themselves refunded later using substantial interest payments.[35]

Up until 1652, the participants had contributed 89,335 Flemish li. *groten* in total or 80 per cent of the total of 111,668 li. *groten* needed for the drainage project. Apart from seeking additional advances from benevolent participants, the polder board also had to resort to the capital market. In order to spread the high costs incurred in 1650 and 1651 of more than 50,000 and 40,000 li. *groten* respectively, over a longer period, the polder board contracted loans totalling 76,607 li. *groten*. In the subsequent years – until 1660 – additional loans of 10 to 15,000 li. *groten* per annum were negotiated. Though these official loans were apparently contracted on the Antwerp money market, they were not impersonal loans granted by anonymous bankers, but were negotiated personally by de Nollet and Cachiopin, the leading actors in the embankment project. In total the project's managers obtained more money than necessary for the immediate costs, but we have to take into account the interest and repayments on top of it. Since the extra inputs of big investors can also be considered as loans, the funding of the whole drainage operation relied heavily on credit. This was not, in itself, unusual. However, in Kallo, this happened on much larger scale than elsewhere: contemporary lake drainage projects in northern Holland for instance only involved loans amounting to a few per cent of the total drainage costs.[36] In the polder of Kallo, we can see steps being taken towards creating a consolidated debt, the liability for which fell on the community of participants. By doing this the polder board avoided the immediate imposition of higher contributions, as well the liquidity problems of some of the less fortunate participants. On the other hand, the overall cost of the project increased substantially, and some of the participants clearly saw the credit operations as a further opportunity to increase their private financial gain, either acting as creditors themselves, or negotiating the loans on behalf of the polder board.

III

Part of the financial risk involved in drainage and embankment projects was due to uncertain environmental conditions. In the coastal wetlands, a severe winter storm could easily annihilate all of the participants' work. Many newly reclaimed polders were flooded again quite quickly after their reclamation, probably because their sea defences were not yet settled or compacted enough, or were poorly located. Such misfortune also struck Kallopolder. Shortly after the finalization of the project in November 1651, the polder was struck by a severe storm surge, which broke the newly constructed embankment and flooded the land. The works were redone, with disastrous financial consequences.[37] The renewed flooding also delayed the exploitation

[35] Documents on the water taxes, extra input with the restitutions, loans and interests: SAB, P27, no. 224; regulations concerning restitutions in the resolution books, P27, no. 1, 5 Apr. 1650; registers of those who paid more: SAB, P27, nos 162–6.

[36] Van Zwet, *Landaanwinningsprojecten*, pp. 79, 147–51; M. van Tielhof, 'Financing water management in Rijnland, 1500–1800', in O. Gelderblom (ed.), *The political economy of the Dutch Republic* (2009), pp. 215–18.

[37] Polder accounts on the repair works after the storm surge: SAB, P27, no. 260; recorded for other polders as well: Dekker and Baetens, *Geld*, pp. 54–7; van Cruyningen, 'Profits', p. 126; A. M. J. de Kraker, 'De ontwikkeling van het landschap', in M. Wilssens (ed.), *Singelberg: het kasteel en het land van Beveren* (2007), p. 38.

of the polder, and hence the first return on investment for the participants. The participants responded to this environmental challenge by developing a sophisticated way of directly farming the polder after the completion of the rebuilt embankment 'in order to prevent losses and interests which one would have suffered if refraining from ploughing and sowing'.[38] The problem was that by the time the crops had to be sown, the various plots of land had not been allocated to their final owners due to the many disputes over ownership. The solution was that those owners and claimants who had paid their *geschot* were allowed to begin the cultivation of the land, thus disadvantaging participants whose contributions were in arrears. To avoid yield losses and recover the costs as soon as possible, the polder was ploughed and sown with barley and colza in 1652–53 and with barley, oats, colza and wheat in 1653–54. The costs of the cultivation along with the crop yields and values were meticulously recorded because of the uncertainty concerning the distribution of the land to the different proprietors. As it turned out, some landowners – or the farmers working for them – sowed more than their allocated share. For this reason, and because of the huge variation in observed yields (see below), a complex redistribution mechanism was developed, dividing the profits among the rightful landowners. The farming method has to be situated somewhere halfway between private and collective farming: landowners were cultivating individual plots of land, but their output was added together and divided among the rightful landowners for each part of the polder. Interestingly the administrators used a double-entry style of bookkeeping – technically known as *alla veneziana* – with debits recorded on the left side of the double page and credits on the right side (Figure 5a and 5b). At this time, the adoption of double-entry accounts in public finances had not proceeded very far. It largely remained associated with international trade and merchant families. The decision to use such an advanced bookkeeping system had probably little to do with efficiency, and more with credibility in the circles of wealthy urban investors.[39] For landowners and farmers less familiar with the world of international trade, it might just have complicated their understanding of and control over the accounts.

Newly reclaimed clay polders were reputed to be highly fertile. In Kallopolder, characteristically high amounts of crop produce could be gathered in.[40] Yields of barley reaching more than 35 hl/ha stand comparison with those in the nearby Zeeland polders, where barley yields of 40 hl/ha were not exceptional. Also in the old polders of the Flemish district of Furnes, barley yielded on average 28 hl/ha in the period 1618–44 with peak values of 48 hl/ha in 1638.[41] Oats brought forth 25 hl on average, which is in line with observations of 29 hl/ha in the Furnes polders over the years 1617–43.[42] In 1653, a mean harvest of 18 hl of colza per hectare

[38] SAB, P27, no. 1, resolution May 1652: our translation of 'om te verhueden de schaden en intresten diemen daerdoore bij het naerlaten vande labeure ende besayinghe soude hebben comen te lijden'.

[39] Compare B. S. Yamey, 'The historical significance of double-entry bookkeeping: some non-Sombartian claims', *Accounting, Business and Financial Hist.* 15 (2005), pp. 77–88.

[40] The following data on crop yields in Kallopolder were gathered from SAB, P27, no. 745.

[41] P. Priester, 'Wheat yields in Zeeland from *c.*1585–1995', in B. J. P. van Bavel and E. Thoen (eds), *Land productivity and agro-systems in the North Sea area. Middle Ages – 20th century. Elements for comparison* (1999), p. 312; P. Vandewalle, 'Cereal production in the area of Veurne in the first half of the seventeenth century', in A. Verhulst and C. Vandenbroeke (eds), *Agricultural productivity in Flanders and Brabant, 14th–18th century* (1978), p. 371.

[42] Vandewalle, 'Cereal production', pp. 372–3.

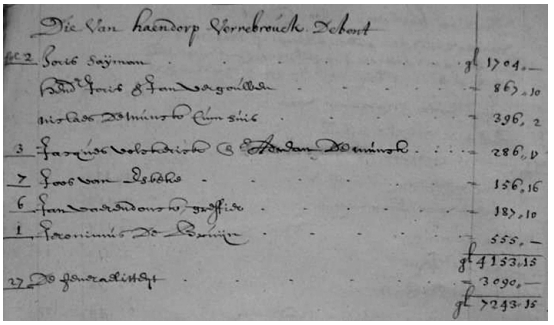

FIGURE 5a. Example of the debit side of the bookkeeping (registering the crop values for each exploitant)

Source: SAB, P27, no. 745.

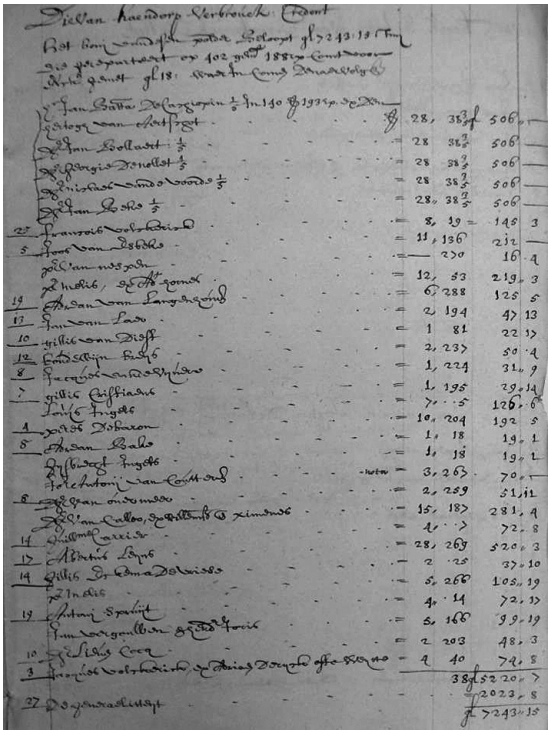

FIGURE 5b. Example of the credit side of the bookkeeping (where the redistribution took place among the rightful landowners)

Source: SAB, P27, no. 745.

is close to the estimations of Lindemans and Priester who argued that colza could produce approximately 20 hl/ha.[43]

Yet, the agricultural enterprise of the first two years after embankment cannot be deemed a total success story since crop yields were highly variable, as Figures 6a and 6b indicate.[44] The box plots of barley especially show a great dispersion around the median value, which indicates yields fluctuating roughly between 10 and 40 hl/ha. An interquartile range (i.e. the difference between the 75 per cent – and 25 per cent level of the data sample, demarcating the edges of the boxes) of more than 12 hl/ha for oats and colza also denotes the high variability of yields in the case of these crops. With 11 hl/ha on average, the harvest of colza for the year 1654 was disappointing and stood in sharp contrast with the good yield of the previous year. The picture is even worse when considering wheat yields. The Zeeland and Zeeland-Flemish polder farms were mostly able to record wheat yields of 15 to 20 hl/ha,[45] while in most of Kallopolder wheat production was below 10 hl/ha, with only a few exceptions. In the case of wheat production, yields in the newly embanked Kallopolder were clearly substandard, whereas the mean yields for barley, oats and, at least for the year 1653, colza were in line with normal harvest data for similar agricultural settings. Yet even these fluctuated greatly in the first two harvest years. The low yields of wheat and the plots of land with barley, oats and colza yielding less than average cannot be attributed to the overall level of cereal production: the years 1653–57 stand out as a

[43] Priester, 'Wheat yields', p. 312; Lindemans, *Geschiedenis,* II, pp. 271–2.

[44] In northern Holland, van Zwet also found varying yields: van Zwet, *Landaanwinningsprojecten*, pp. 331–89.

[45] Priester, 'Wheat yields', pp. 318–20.

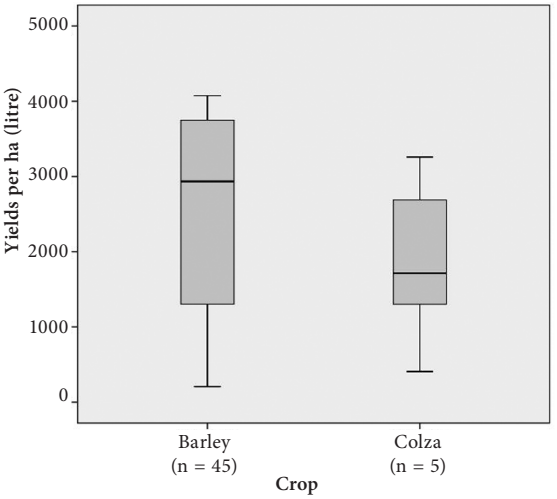

FIGURE 6a. Crop yields per ha, 1653

Source: SAB, P27, no. 745.

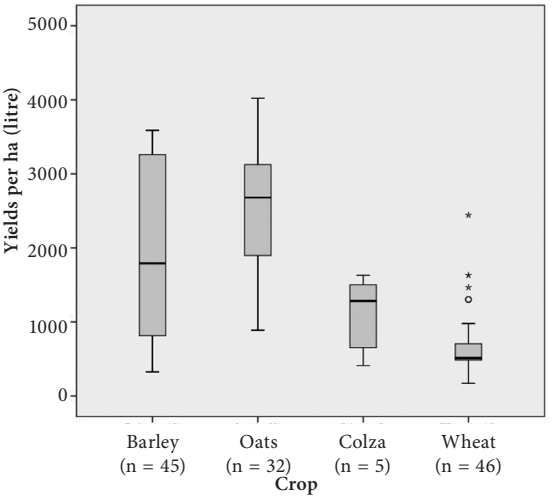

FIGURE 6b. Crop yields per hectare, 1654

Source, SAB, P27, no. 745.

brief period of good weather and relatively abundant harvests – a brief period of climatic calm during one of the most turbulent periods of the Little Ice Age.[46]

So, why were wheat yields in Kallopolder so low and the other yields so variable? No direct reason can be found in the sources, though we can formulate three hypotheses: an extensive method of farming the land, differences in soil composition and structure and beginning the cultivation of the polder too early. From the accounts of 1653 and 1654 it can be calculated that approximately 160 l of barley, 230 l of oats and 300 l of wheat were sown per hectare. This quantity of sowing seed for wheat seems especially high compared with other areas of large-scale commercial 'polder' agriculture, certainly more than the level of 200 l/ha recorded for wheat production in the Zeeland polders.[47] The small farmers in the so-called 'Flemish Husbandry' region of inland Flanders, used as little as 100 l/ha, but they compensated this by a huge labour input, which resulted in extremely high yield ratios (due to the low quantity of sowing seed compared to the high gross yields).[48] Although Zeeland-Flanders was a polder region with large-scale and market-oriented farms, farmers paid a lot of attention to intensive weed control, and hired extra labourers in the spring for that purpose.[49] The landowners of Kallopolder adopted higher seed ratios than the small-scale Flemish husbandry and probably

[46] Both 1648–50 and 1658 count among the worst years of the Maunder Minimum: E. Le Roy-Ladurie, *Histoire humaine et comparée du climat. I, Canicules et glaciers, XIIIe–XVIIIe siècles* (2004), pp. 440–41. Prices of cereal products in seventeenth-century Flanders can be found in A. Verhulst, 'Prijzen van granen, boter en kaas te Brugge volgens de "slag" van het Sint-Donatiaanskapittel (1348–1801)', in C. Verlinden and E. Scholliers (eds), *Dokumenten voor de geschiedenis van prijzen en lonen in Vlaanderen en Brabant* (1959–73), II, pp. 3–70. Local barley prices are not available for this period. We used instead the price series for Groningen by W. Tyms, *Groninger graanprijzen: de prijzen van agrarische producten tussen 1546 en 1990* (2000).

[47] Priester, 'Wheat yields', p. 318.

[48] E. Thoen and T. Soens, 'The Low Countries', in eid., *Land use and productivity* (Rural Economy and Society ser., forthcoming).

[49] Van Cruyningen, *Behoudend maar buigzaam*, pp. 176–7.

even higher ratios than in the polders of Zeeland and Furnes, but farmed their land in such an extensive way that weeds might have been able to grow rampant and overrun the crops on some parcels, hence the lower crop yields.

To cover the cost of ploughing, the preparation of the land for sowing, weed control, harvesting and threshing,[50] landowners received about 337 *stuiver* (17 fl) per hectare. Assessing the price of agricultural labour in the early modern period is very difficult as such labour was seldom paid in daily wages at full market rates.[51] However, even ignoring the actual organization of labour by the landowners, it quickly becomes clear that a labour cost of 337 *stuiver* per hectare is very low. Harvesting one hectare of wheat in the coastal marshlands of Zeeland-Flanders in the eighteenth century already costs about 200 *stuiver* (10 fl.) per hectare.[52] Ploughing and harrowing a hectare of land was valuated at 108 *stuiver* (5.4 fl.) in official manuals of appraisers near Ghent in the 1670s.[53] For another coastal wetland region within the Low Countries – the Guelders River Area – Bas van Bavel has estimated that labour input per hectare oscillated between 50 days on the very large farms to perhaps 225 days on the smallest farms (below four hectares).[54] During the years of direct farming in Kallopolder, the labour input was probably even below 50 days per hectare.[55] The farming of Kallopolder in the first years of its modern existence seems, therefore, to have been undertaken in an extensive fashion and this might explain the great degree of variability in crop yields. Because of this extensive way of farming, most probably with inadequate weed control, weeds had more chance to overgrow crops and thus negatively affect their growing pattern. In northern Holland for instance, some newly reclaimed polders had to deal with the abundant presence of cat's tail grass which was especially harmful to cattle.[56] Without labour-intensive weed control yields could be low.

Differences in the soil composition (from sandy loam to heavy clay and from dry to wet) can also offer an explanation for the big fluctuations in the yields, though not for the generally low level of wheat yields. Taking into account that yields of barley and colza were generally better than those of wheat, the start of wheat cultivation on this newly reclaimed land might have been just too early. Decades of inundations did not only leave a fertile clay layer behind but also salt. Ploughing and sowing in such saline soils might have harmed its structure resulting in disappointing yields. Only colza and barley were better able to cope with salinity. After completing the embankment, it would have been better to postpone cultivation for some years so that rain and snow could wash the salt out of the soil. When the embankment of the

[50] The accounts do not mention which activities were refunded. However, as the full market price for cereals was paid for from the produce of the fields (expressed in liquid measures), the labour must have included all phases of agricultural work, from ploughing to harvesting and threshing.

[51] B. van Bavel, 'Rural wage labour in the sixteenth-century Low Countries: an assessment of the importance and nature of wage labour in the countryside of Holland, Guelders and Flanders', *Continuity and Change* 21 (2006) 1, pp. 37–72.

[52] Van Cruyningen, *Behoudend maar buigzaam*, p. 73.

[53] State Archives Ghent, Varia D, no. 3343; See also Th. Lambrecht, *Een grote hoeve in een klein dorp. Relaties van arbeid en pacht op het Vlaamse platteland tijdens de 18de eeuw* (2002), p. 119.

[54] Van Bavel, 'Rural wage labour', p. 47. Van Bavel uses man-years, which we converted to man-days through multiplication by 250.

[55] Farmers received 337 *stuiver* per ha. for their labour. This represented about 50 days of labour at the very maximum, as 6.75 *stuiver* was more or less the wage a servant would earn on a large farm in this period, though he would live in with the farmer.

[56] Van Zwet, *Landaanwinningsprojecten*.

nearby Nieuw-Arenberg polder was nearing completion in 1784, supervisor Grosfils advised his superior – the Duke of Arenberg – to postpone cultivation until the polder had been properly desalinated, but this advice was ignored.[57] In both Nieuw Arenbergpolder and Kallopolder cultivation started very quickly after the embankment.

Faced with uncertain yields, the choice for an extensive kind of cultivation might have been exactly the right thing to do, given that grain prices in these years were low and labour relatively expensive. In the subsequent decades – in the middle of the famous 'agricultural crisis of the seventeenth century' – the combination of relatively low grain prices and high labour costs caused serious financial trouble for middle-sized farms all over the North Sea area.[58] After all, with a minimum of costs and an extensive type of cultivation, the landowners of Kallopolder still managed to realize profits, as the profits were still (a little) higher than the costs of the cultivation. From the point of view of the landowners, extensification might have been a 'prudent' choice.

As mentioned before, the challenge of highly variable and on average rather low yields was tackled by a distribution mechanism that limited risk. This mechanism provided the fair distribution of the crop values among the different landowners – according to their property share – within each part of the polder (i.e. the former polders of Haendorp and Sint-Niklaas and seven large plots or *kavels* of the old polder of Sint-Anna). The differences between the several constituent parts of the polder remained, therefore, but were rendered equivalent within these parts. Moreover, landowners who had to work the most challenging types of land received an extra sum to compensate for 'harsh labour'. Both the large and the small landowners benefited from this distribution mechanism but the redistribution of profits should likely be seen as an attempt to keep the small and middle class proprietors on board, as the largest proprietors often owned land in different parts of the embankment and hence seldom disposed of land which was entirely of low quality. Buying the produce of the direct cultivation offered additional opportunities for profit for some landowners. The crops were purchased by 65 individuals. Amongst them were 18 landowners, 11 of whom had participated in farming the land. These 18, belonging to all categories of property, cashed in twice. Besides receiving compensation for the cultivation of extra lands and the purchase of the crops of their own estates, they also bought crops to resell on the market. In doing so, risks were mitigated further, at least for those who participated in this system.[59]

Even with low yields and low prices, the investors of Kallopolder were able to realize a satisfactory return on investment, although this varied greatly from investor to investor. When we take into account the water taxes paid from the start of the embanking to 1654 inclusive and balance the sum of the crop values of 1653–54 against these invested sums, we can see that the return on investment was highly variable for the different investors-landowners (Figure 7).

Three landowners managed to earn back their initial investment after two years of cultivation,

[57] On soil salinity see P. Priester, *Geschiedenis van de Zeeuwse landbouw, circa 1600–1910* (1998), pp. 37–41; General State Archives Brussels, Familiefonds Arenberg, S2991.

[58] Especially in the period 1666–95, decades of 'agricultural crisis', in particular for the larger farms and less so for the wage-earning part of the population. For France, see G. Duby and A. Wallon (eds.), *Histoire de la France Rurale,* II, *L'âge classique des paysans, 1340–1789* (1965), pp. 261–75.

[59] On the distribution of the crop values: SAB, P27, no. 745; on crop purchases, SAB, P27, no. 752.

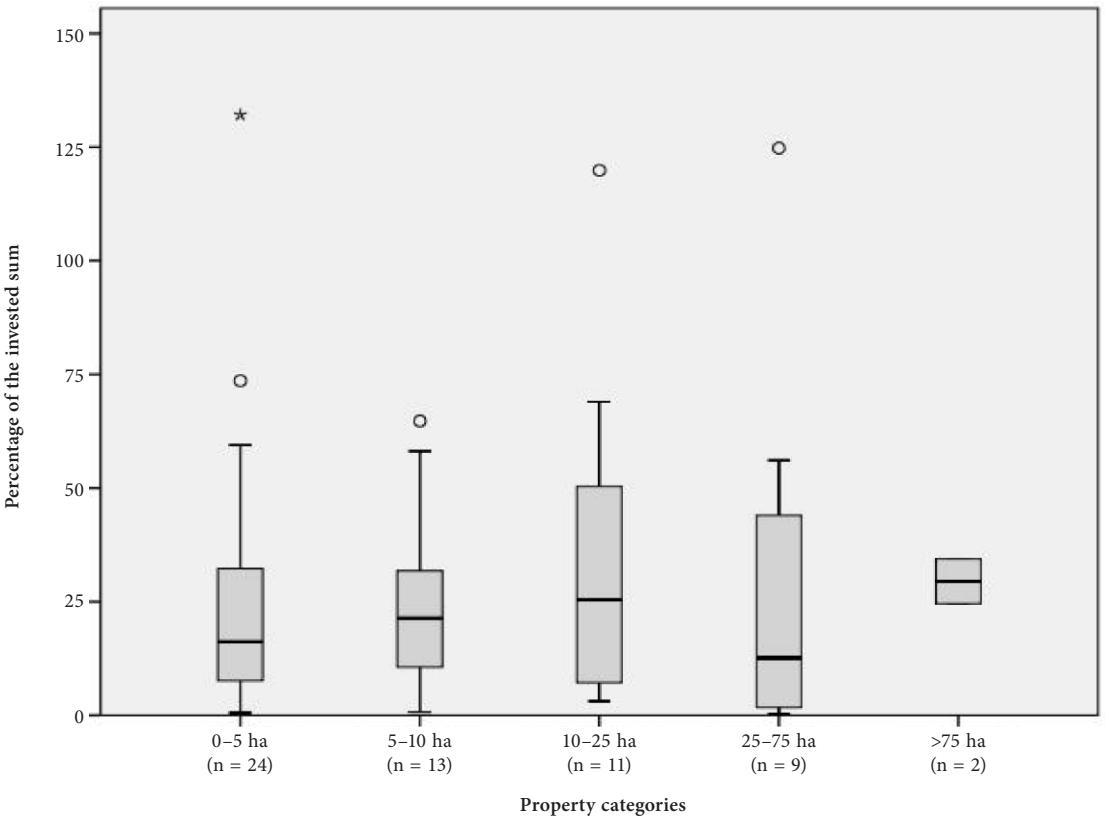

FIGURE 7. Return on investment of the first years' exploitation, 1653–4

Source: SAB, P27, no. 224 and SAB, P27, no. 745.

whereas 18 received less than 10 per cent. On average the investors gained a return of 16 per cent on their investment after two years of cultivation, which is rather high given the variable crop yields. This average return on investment hides huge differences between investors. Principal investor Cachiopin de la Redo – with an allocation of 139.6 ha. of land in 1654 – contributed 29,107 fl. up to 1654. In 1653 and 1654 his share in the profits of the direct cultivation totalled 10,015 fl. or 34 per cent of his investment to date. Nicolas Beke on the other hand, a middle-sized participant with 17.6 hectares, had invested 1991 fl. until 1654, and received 2387 fl., realizing a return on his investment of 120 per cent in two years. In contrast, Pieter Melis (57.5 hectares) was one of those who had invested much more than their actual share in the landed property of the polder. Up to 1654 he had invested 119,764 fl. but received only 2104 fl. as his share in the profits of the direct cultivation (a meagre return on investment of 1.76 per cent). Of course, apart from this return, Melis earned a guaranteed yearly interest of 6.25 to 8 per cent, the rate paid to those landowners who invested more than their actual share of land (see above). The actual return on investment thus allowed for broad differences among the investors. It is clear that some investors (like Beke, but also Cachiopin) had been able to defer a substantial part of their investment – Beke had paid only 113 fl. per hectare, whereas the whole project would

eventually cost 444 fl. per hectare – while still cashing in the full profit of the direct cultivation. In theory, the board of investors had decided that those investors who had not respected their financial commitment would not share in the profits of the direct cultivation, but apparently there was ample room for negotiation. The overall picture nevertheless remains quite positive. In comparison, the return on investment in the lake drainage projects in northern Holland, varied between 1 or 2 per cent up to 11 pr cent a year.[60] In this respect, profits in the polder of Kallo seem rather high. However, we have to take into account the huge debt contracted by the association of landowners, which would only be paid off over the following decades. In this way, short-term profit was made possible by accepting a lower return in the medium to long term.

As mentioned above, some landowners were not going to be able to pay the high initial cost of investment. Drainage law in Flanders prescribed that any landowner unable or unwilling to pay for the upkeep of the dikes could forfeit his land (the so-called *spadesteken* or *spaderecht*). Similar arrangements existed elsewhere in the Low Countries and in northern Germany too.[61] England's marshland customary law also prescribed that 'the Commissioners of Sewers could, as a last resort, sell the land of a person who couldn't or wouldn't pay a sewer rate'.[62] This law was invoked in Kallopolder and resulted in land sales in 1656 and 1659 when the largest proprietors, George de Nollet, Jan Bollaert and Pieter Melis acquired 32, 33 and 72 ha respectively. The register of the (enforced) land sales of deficient contributors recorded land prices of 50 sold properties which varied by and large between 83 and 133 Flemish li. *groten*/ha (i.e. between 500 and 800 guilders/ha). Interestingly, these newly bought lands were exonerated from the outstanding arrears in water taxes, which in part explains the high prices they secured.[63] This way investors could acquire land in the new polder without the uncertainty of the drainage cost.

IV

In the long run, too, this polder area had to deal with a further and even more far-reaching limitation of risks on the part of the absentee landowners. As mentioned before, many coastal wetlands or 'polder' areas in the Low Countries were among the first regions in Europe where proper capitalist social relations – characterized by the triple division of society between (absentee) landowners, leasehold farmers and landless labourers – came into existence.[64] In

[60] Van Zwet, *Landaanwinningsprojecten*, pp. 331–89. For a comparison of the return on investment in lake drainages in France, Morera, *L'assèchement*, p. 214.

[61] T. Soens, 'Flood security in the medieval and early modern North Sea area: a question of entitlement?', *Environment and Hist.* 19 (2013), pp. 227–8.

[62] Knittl, 'Great Level', p. 49.

[63] SAB, P27, no. 733. Compare sale prices of land in the Zeeland polders in van Cruyningen, *Behoudend maar buigzaam,* pp. 400–01 and in inland Flanders in F. De Wever, 'Rents and selling prices of land at Zele, sixteenth–eighteenth century', in H. Van der Wee and E. Van Cauwenberghe (eds), *Productivity of land and agricultural innovation in the Low Countries (1200–1800)* (Belgisch Centrum voor Landelijke Geschiedenis, 55, 1978), pp. 43–63.

[64] See the overview in Bas van Bavel, *Manors and markets: economy and society in the Low Countries, 500–1600* (2010), pp. 242–6; B. van Bavel, P. van Cruyningen and E. Thoen, 'The Low Countries, 1000–1750', in B. van Bavel and R. W. Hoyle (eds), *Social relations: property and power* (2010), pp. 168–97; T. Soens and E. Thoen, 'The origins of leasehold in the former county of Flanders', in Bas J. P. van Bavel and P. Schofield (eds), *The development of leasehold in northwestern Europe, c. 1200–1600* (2009), pp. 31–56.

Kallopolder as well, short-term leasehold became the predominant manner of tenure, and, as we have seen, many landowners were absentee urban or noble landlords. The symbiotic relationship of landlords and farmers in such a system could generate sustained economic growth, with farmers competing for leaseholds, and hence investing in cost-saving farming techniques while landlords offered financial backing to the farmers in case of misfortune.

The type of agrarian capitalism that developed in Kallopolder presents some of the features of this classic model, but not all. Most importantly, not all investor-landlords developed a long-term commitment to the 'polder': they sometimes preferred to cash in rapidly by selling their land shortly after the embankment was completed.[65] Landowners who were not inclined to invest for the long haul sold their properties after a period (mostly after a catastrophic storm surge like the ones occurring in 1661 and 1682 in the polder of Kallo). After profiting from the first years of exploitation – with their returns estimated above at about 8 per cent a year – these landlords quit once they faced new costs. Baars and van Cruyningen found the same distinction between long-term and short-term commitment in other early modern drainage projects in the Low Countries as well.[66]

Those landlords who developed a long-term commitment to Kallopolder, often tried to obtain lease prices that were as high as possible, the equivalent of 4 to 6 hl of wheat per hectare (which is almost twice the average rate of leases in the older Zeeland polders studied by van Cruyningen).[67] On the one hand the high lease prices indicate the eagerness of landlords to recover at least part of their considerable initial investment in a relatively short time, whereas the prospect of high yields on these newly reclaimed lands might have seduced tenant farmers to pay such expensive leases. On the other hand, the high lease prices also include some kind of 'a risk premium' to be paid by the tenant farmers. In the first three decades of the existence of the polder, landlords and tenants faced three major floods (1651, 1661 and 1682), and although the Peace of Westphalia (1648) had ended the hostilities among the Dutch Republic and the southern Habsburg Low Countries, the political situation remained so uncertain that the Dutch Republic continued to maintain fortresses on the very border of Kallopolder. The possession of this polder region itself remained disputed until the end of the eighteenth century. As in many other regions,[68] Flemish leasehold arrangements included an undertaking that the landlord

[65] Morera, *L'assèchement*, pp. 196–97; van Cruyningen, 'Environmental disaster', p. 1.

[66] Cf short- and long-term investment in the Beijerlanden (southern Holland): C. Baars, *De geschiedenis van de landbouw in de Beijerlanden* (1973), p. 109 and in Zeeland-Flanders: van Cruyningen, 'Profits', p. 135.

[67] Sample of 83 lease-prices (1660–1710), with average lease-price of 38.4 guilders per ha.. Based on probate inventories of tenant farmers in Kallopolder, analysed by P. De Graef, 'Polderpioniers in de nieuwe "dyckagie van Calloo". Marktgerichtheid en risicobereidheid van de eerste generatie landbouwers in Kallopolder, *ca.* 1665–*ca.* 1710' (unpublished MA dissertation, University of Antwerp, Belgium, 2010–11). The high lease prices in newly embanked polders are confirmed for other polders in this region as well. For instance, in the 1680s and 1690s, the Antwerp merchant Anthonius Spruyte participated in the drainage of Oud Arenbergpolder adjacent to Kallopolder. Once the drainage was finished, it was leased out at between 27 and 38 guilders per ha. (Antwerp City Archives, Insolvente Boedels 12, Spruyte), compared to 15–22 guilders per ha. in the older Zeeland polders studied by van Cruyningen (*Behoudend maar buigzaam,* p. 402).

[68] A recent analysis in: S. Sonderegger, '… der Zins ist abgelon… Aushandeln von Schadensteilungen zwischen Grundherren und Bauern in schwierigen Zeiten der Landwirtschaft', in: R. Kiessling and W. Scheffknecht (eds), *Umweltgeschichte in der Region* (Forum Suevicum, 9, 2012), pp. 139–57.

FIGURE 8. Monumental polder barn 'Ketelhof' near Kallo (seventeenth-century, demolished 1975)

Source: Private photo collection / Beeldbank Land van Waas.

would share extraordinary costs with the tenants in the event of natural disasters (flooding) or military destruction. Landlords would to pay at least part of the cost of repair works and the tenant farmer would be allowed a reduction in his rent. For many farmers the financial backing of their landlord might have been indispensable in such a high-risk environment, even if this implied paying high lease prices.

As for the landlords, they tried to limit their commitment to investment as far as possible. They did build large, if standardized, wooden barns on their farms (Figure 8) but seldom invested in farm houses, which often had to be built by the tenant farmer himself. Furthermore, landlords often seem to have spread risk further by selling part of their land. Some of the more wealthy tenant farmers were able to buy part of their farm, often starting with the land on which the farmstead was built, and then gradually expanding their landed property. This allowed for the spreading of risk between absentee landlords and local farmers but it also restricted competition on the lease market, a prime characteristic of capitalist farming systems. This is reflected by the gradual rise in the number of smaller and middle-sized properties in Kallopolder between 1653 and the 1690s (Table 3). A new category of owner-occupiers came into being who mostly farmed their own land (from 40 per cent to as much as 70 per cent of their total cultivated acreage).[69] In a similar way successful farmers in the Dutch Beijerlanden or in the Wadden Sea coastal marshes also managed to acquire a lot of landed property in the course of the seventeenth century. In the Zeeland-Flemish polders the *proliferation* of

[69] De Graef, 'Polderpioniers', pp. 7–11.

TABLE 3. Property distribution in the polder of Kallo, 1653–1690s

Year	*Property category*					*Total*
	0–5 ha	*5–10 ha*	*10–25 ha*	*25–75 ha*	*>75 ha*	
1653	13.1	19.8	12.6	21	33.4	100
1655	8.2	10.9	17	35.1	28.9	100
1661	8.7	11.1	21.1	41.2	17.9	100
1690s	18.4	10.1	20.8	29.1	21.5	100

Source: SAB, P27, no. 176, 722, 723, 58–70.

owner-occupied large-holdings did not begin until the eighteenth century.[70] In the high-risk coastal farming system absentee landlords devised strategies to mitigate risk and often quit when risks became too high or profits too depressed. After some decades of farming in the newly embanked polder, successful tenant farmers were willing to accept the full risk of farming in this high-risk environment, albeit in exchange for freehold property rights.

V

Investing in drainage and embankment projects was not the kind of risk-free investment usually associated with landed property. Previous work on large-scale drainage projects in seventeenth- and eighteenth-century England, France, the Low Countries, Germany and the Baltic area has already revealed the huge sums of money and the international financial operations involved in such projects, as well as the considerable degree of risk investors were exposed to, as exemplified by notorious stories of bankruptcies and the failures of drainage projects. However, much of the complexity of the financial transactions and the risk strategies involved in drainage operations remained hidden. Using a micro-perspective focused on one single drainage project in seventeenth century Flanders, we have been able to reveal in detail the strategies of investor-landowners and to demonstrate how they were able to keep the balance between risk-taking (in the environmental, agricultural and financial senses) and the management, assessment and mitigation of risk. In the first place, existing landowners and new investors joined forces in one drainage company, which drained an area formerly consisting of several separate 'polders' and of highly divergent soil qualities. This had the advantage of spreading risk and the possibility of bundling a lot of capital. Second, the agricultural uncertainty with respect to crop yields was overcome through a complex distribution mechanism, effectively allocating the returns of the first year's cultivation among the different landowners according to their share of property in the several constituent parts of the polder. This way differences in soil, drainage quality and desalination between plots were levelled out. Finally, there were – in some respects socially distorted – mechanisms at work

[70] Beijerlanden, Baars, *Beijerlanden*, pp. 106–07; Wadden Sea, O. Knottnerus, 'Yeomen and farmers in the Wadden Sea coastal marshes, *c.* 1500–*c.* 1900', in P. Hoppenbrouwers and B. van Bavel (eds), *Landholding and land transfer in the North Sea Area (late Middle Ages–19th century)* (2004), pp. 149–86; Zeeland-Flanders, van Cruyningen, *Behoudend maar Buigzaam*, pp. 98–108.

for the channelling of risks. The type of funding and the double entry bookkeeping system employed by the company were designed for merchants acquainted with complex financial operations. It must have been very hard for small local proprietors to get a grasp of the financial transactions involved, let alone to detect fraud. Furthermore, upper-tier investors who deliberately contributed more money than required saw their capital refunded with a high guaranteed rate of interest. They were thus able to spread part of the financial risk of their investment. On the other hand, shareholders in arrears would lose their investment if they could not meet calls for money. Their land was then sold by the drainage board without them being compensated for the contributions they had already made. As a result, many smaller participants lost both their land and their investment in the drainage project. In this way the complex financial mechanisms deployed in drainage not only allowed for highly personalized investment strategies, but also for the redistribution of risk from the leading investors to the minor ones.

In the absence of comparative micro-studies on the funding of drainage projects, we are still ignorant of whether the kind of advanced risk management shown with respect to the drainage of Kallopolder was employed in other projects. In any case, our analysis demonstrates the importance of risk management for our understanding of pre-modern coastal agriculture, with financial instruments developed to manage risk in international trade, being transferred to agriculture.[71] In Kallopolder the combination of speculative risk-taking on the one hand and maximum risk-avoidance on the other, seems to have restrained the development of full-blown agrarian capitalist social relations (landlord–capitalist tenant–landless labourer), as landlords in the end shifted part of the risk onto tenant farmers in exchange for property rights. The high level of risk in these coastal areas might be one of the reasons why proper capitalist social relations often did not endure in such regions and why the newly reclaimed land, having started as the property of investors, so often became the property of the people who farmed it. One might even suggest that, during the drainage, there were high risks but the possibility of high profits: in the mature reclaimed landscape, the risk of occasional inundations remained but profits were lower, and the landlords showed themselves to be risk-averse after all.[72]

[71] Compare P. Mathias, 'Strategies for reducing risk by entrepreneurs in the early modern period', in C. Lesger and L. Noordegraaf (eds), *Entrepreneurs and entrepreneurship in early modern times* (1995), pp. 5–24.

[72] Interestingly, environmental problems were often paralleled by the introduction of capitalist social relations. If environmental problems persisted, non-local landowners often gave up and the local population could again regain property rights, although sometimes in a degraded physical environment. On the interaction between agrarian capitalism and environmental problems, see different contributions in Thoen and van Bavel (eds), *Rural societies and environments at risk* and Soens, 'Flood security'.