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The quest for peat in medieval Flanders. Geological and historical arguments compared.

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Abstract

Nowadays it is hard to imagine that peat might have played an important role in the history of the Flemish coastal wetlands. Along the North Sea Coast and the estuary of the River Scheldt, heavy clay soils are sheltered behind a dune ridge or a man-made sea-wall, with no sign of open peatlands or peat bogs. Consequently the importance of peat for the Holocene landscape history of the area was largely ignored until the middle of the 20th century, when historians found ample evidence of medieval peat extraction in the Flemish coastal plain, and geologists also found remnants of peat layers during the geological survey for the Belgian soil maps. A prolonged scientific debate arose with regard to the chronology of peat growth, its former extent, its biological composition and the causes of its disappearance. Basically, two contrasting narratives were developed by both geologists and historians, each using different methodologies and different opinions on what can be called scientific evidence. The ‘minimalist’ position, mainly advocated by geologists, does not accept the historical presence of peat where this is not positively confirmed by soil samples. In a more ‘maximalist’ opinion, circumstantial evidence like toponyms or written data on peat industries was accepted as well. Analyzing the construction of evidence in the different disciplines concerned, this paper will try to revitalise the debate, by shifting the focus from an analysis on the ‘macro-level’ of the Flemish coastal wetlands as a whole to the micro-level of individual subregions. In international literature coastal wetlands are characterized by (A) extreme dynamics over time and (B) important regional variations. As a consequence new interdisciplinary approaches on the micro level might increasingly bridge the gap between both positions.

1. Introduction: the lost peat marshes of the North Sea Area.

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At the beginning of the Middle Ages, a large share of the present-day North Sea coastlands consisted of peatlands, sheltered behind a dune or - less frequently gravel – ridge. The formation of those peat lands started around 5000 BP, when the period of rapid sea-level rise after the end of the last ice age came to an end, and coastal barriers could develop. Behind these barriers conditions became favourable for peat growth. Along the Flemish North Sea Coast and along the estuaries of the rivers Scheldt, Meuse and Rhine peat growth slowed down or stopped either in the first centuries before the beginning of our era or in the Roman and post-Roman period, although the top of the peat is often difficult to date because of (natural) reworking during tidal inundations or human activities (Baeteman 2007: 17). Near the coast and the estuaries the intertidal area was expanding and sediments were deposited on top of the peat. More inland, adjacent to the higher Pleistocene sandlands, peat growth could continue longer on (**XXX aanvullen recente inzichten Kustvlakte-congres**).

2. The ‘peat debate’.

As peat marshes all but completely disappeared in many parts of the North Sea Area, the memory of former peat exploitation also faded away. Renewed attention only took off in the post-WWII period, when intensive geological surveys were carried out in many countries in order to prepare the publication of national soil maps, and the rapid changes of the rural landscape fostered a renewed interest in ‘traditional’ landscapes. However, trying to reconstruct the former extent of peat growth, historians, geographers, archaeologists and geologists often came to different and even contradictory results. Especially in the Low Countries, a real ‘peat debate’ came into existence from the 1950’s onwards, focussing on the following aspects on the nature and extent of medieval peat growth (for a short overview of the debate in the Netherlands, see Borger 2007, pp. 29-32);

1/ First of all, the extent itself of the peat growth was debated. From a geological point of view, important peat growth in the past would undoubtedly have left traces in the present-day soil. Where systematic soil drilling did not reveal traces of peat, its presence was highly doubtful. Historians on the other hand found archival evidence on peat in regions where this was not confirmed by the soil maps. As a consequence, either the locations attributed by the historians were wrong or the peat had been exploited in such a systematic way that no traces were left. Supporters of the latter theory argue that peat remnants would have decomposed when the peat was drained and exposed to the air (oxidation) and/or mingled with the underlying sand or clay grounds when the land was turned into arable.

2/ The second element in the discussions was the nature of the disappeared peatlands.

If the peat layer is rather mince, it's not always possible to distinguish very well between peat and other types of soils with a high content of decomposed plant material (humus, *gyttja* etc.). Apart from that, an important distinction also exists between bogs (*Hochmoore*), predominantly fed by rainwater and nutrient-poor (oligotrophic) and fens, predominantly fed by nutrient rich groundwater (*Niedermoore*). In flat areas, with the right subsoil and abundant rainfall, bogs can accumulate high above the water level (raised bogs, mainly consisting of *Sphagnum* mosses). For the central Holland peatlands, Pons (1992: 48-49) estimates that at the start of the peat reclamations the top of the peat bogs reached 3,5 m above the present-day sea level. A variant, particularly known for the British Isles, is the *Blanket bog*, which starts from depressions in a more undulating area, and gradually covers the higher parts of the area as well. When presuming that in a certain area only groundwater-fed fen occurred, the growth of peat is restricted by the growth of the water-level (and thus, indirectly, the sea-level).

3/ Thirdly, the original thickness of the peat layers poses a lot of problems. Not only the toplayer of the peat might have been excavated, or oxidized due to air-exposure, peat also tends to compact significantly when drained or covered by later deposits of sand and clay sediments. As a result their present thickness as found in soil samples is only a fraction of their original thickness before coverage. Reconstructing the original thickness of the peat remains an important problem.

4/ The disappearance of the top-layer of the peat also caused a fourth problem: it becomes very difficult to date the end of the peat growth. In most parts of the North Sea wetlands, peat growth slowed down around the beginning of our era, when the maritime influence was getting stronger. At the end of the first Millennium AD peat growth had stopped in most regions, but there is evidence of regions where peat continued to grow afterwards.

Three further debates relate to the economic importance of peat:

5/ First of all, there is a strong connection between peat digging and salt production, attested by both archaeologists and historians at least from the Roman period onwards. However, discussion remains whether peat was used only as energy-source for the reduction by evaporation of salt water, or conversely whether peat intruded by salt water was itself and refined in order to produce salt.

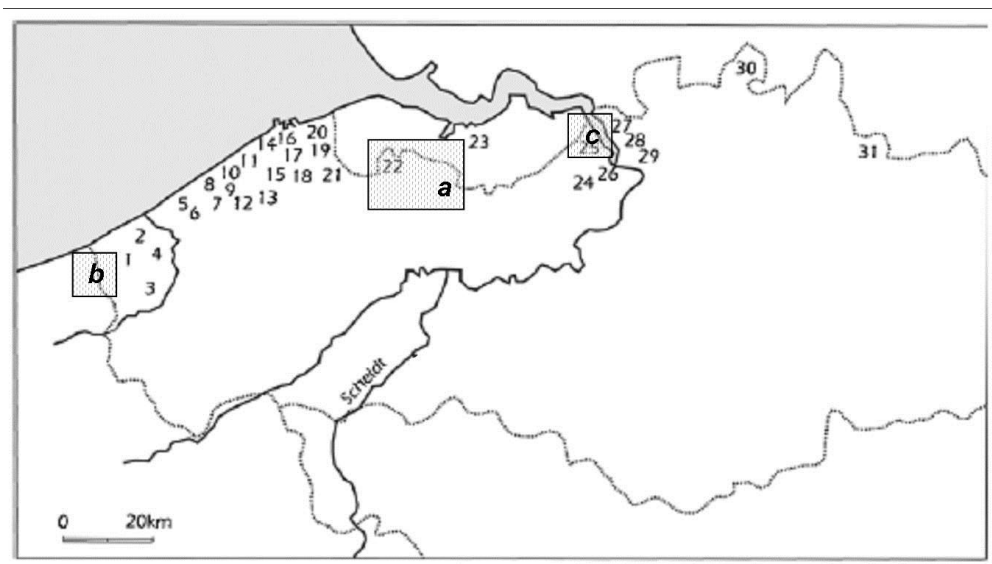
6/ In the 1980's and 1990's mainly Dutch historians tried to determine the importance of local and regional peat trade for the energy supply of the booming urban economies of the Low Countries. The debate concentrated on Holland's Golden Age (the long 17th century) as some scholars argued that this remarkable economic development in a land with little or no

wood would not have been possible without the massive exploitation of peat on an industrial scale (Van Zanden XXX; Cornelisse 2009)

7/ More recently, the importance of peat for the rural economy has been questioned. Both in England and the Low Countries, historians have noticed a remarkable parallel between the decline of peat lands and the end of a so-called ‘peasant’-economy in the coastal wetlands, i.e. an economy of smallholding farmers practising mixed farming and engaged in a lot of proto-industrial and para-agrarian activities (e.g. fishing, weaving, and of course peat digging) (Soens-Thoen; Romney Marsh XXX), in most cases between the 14th and the 16th century AD. As a consequence it can be questioned whether the disappearance of peat lands fostered the structural transition of the peasant economy towards a more commercialised and specialised agriculture, or conversely the decline of the peasant economy brought with it the end of peat exploitation.

3. The geological evidence for peat in coastal Flanders:

In Flanders the presence of peat has been particularly contested, as the Flemish coastal plain is completely devoid of peatlands nowadays. Nevertheless (oligotrophic) peat is available in the subsoil, in many parts of the Flemish coastal plain:



Carte 1 : restes de tourbe oligotrophe dans le sous-sol, retrouvés en Flandre (d’après Deforce, Bastiaens et Ameels, 2007 : 91) avec indication des régions principales mentionnées dans le texte (a= le Meetjesland ; b = les Moères Franco-belges ; c = Doel).

In recent years, peat-growth has been re-examined for a number of regions. The regions were

peat growth has been studied in most detail, is the region of Furnes (Baeteman XXX), and the Waasland Polder region (Crombé et al 2005). In the latter region, the recent construction of several docks for the harbour of Antwerp, has revealed important layers of peat, covered by often several meters of very recent clay and sand sediments deposited after the inundations of the Eighty Years war (1568-1648). In one place, the peat layer reached a thickness of 1,9 meters, even though it had been covered by 2,7 meters of clay and sand (Gelorini e.a. 2006), meaning that the pre-inundation thickness must have been considerably higher (**XXX aanvullen Verrebroek-dok en Baeteman voor Veurne**)⁴.

Even more problematic than the North Sea coast and the Waasland polder region, is the area in the north of Flanders, south of the Flemish-Dutch border. When in the 1950's the soil maps for this region were prepared by a team of geologists directed by R. Tavernier, two soil samples were taken per hectare until a depth of 1,25 metres. The soil classification by Tavernier and his collaborators (including J. Ameryckx and later F. Snacken) makes the basic distinction between two major soil types in the region: the Pleistocene *Sandy Flanders* on the one hand and the Holocene *Polder Region* on the other hand. The border between the two soil types was formed by a large Pleistocene coversand ridge, the so-called Great Ridge of Verrebroek-Gistel, which has a total length of about 80 kilometres and stretches from Gistel near Bruges in the west, to the left-bank of the river Scheldt near Antwerp in the east, more or less in parallel with the present-day Western-Scheldt Estuary. The top of this sand-ridge reaches a height of +7 metres TAW⁵. To the north this sand ridge sinks very smoothly in the coastal plain, the Polder region, where the sandy soils had been covered by very recent marine sediments - mostly clay - deposited in the late medieval or post-medieval period. In the soil classification system of Tavernier et al., the texture of the soil (clay-sand-loam), the quality of drainage (wet to dry) and the formation of surfaces (*podzol* soils et al.) offers the basic criteria for classification. The presence of a substrate underneath a depth of 20 cm is used for further refinement. As for the soil surface, no 'peat soils' were detected in this region (apart from some very local and recent peat formation near former tidal channels in the *polder* region). A *peat substrate* as well, is almost never found, except for some samples in the extreme northern part of the Flemish polders, for instance in the polders north of Boekhoute, where on a depth

⁴ (aanvullen: analyse van veen in Verrebroek: 'eerder landbouw dan turfwinning') en pollenanalyse + gegevens voor regio van de moeren, Baeteman) End of peat growth: Kiden 1989 Oosterweel: 6th century AD; Verrebroek idem (Gelorini et al. 2006).

⁵ TAW = Tweede Algemene Waterpassing (or Second General Levelling), referring to the mean low water level at Ostend, about 2 m below mean sea level and about 2,3 m below the Dutch NAP.

of 135 cm, a small peat layer of 15 cm. was detected. For Ameryckx, the almost total absence of peat in the soil samples and the very clear and sharp border between Holocene clay sediments and the Pleistocene sand, clearly proved that in the Flemish polders peat was absent now and had never developed there in the past. If historians found evidence for peat digging in this region, they must have misinterpreted the use of the word TURF, which probably indicated the cutting of gras sods (Ameryckx cited in De Muynck 1976: 218; 224). Later geologists have delimited a southern border of the present-day extent of a peat substrate in the subsoil of the polder region (de Muynck 1976; Van de Velde 1997). To the south of this peat border, peat layers are so mince that they can not be discerned from other types of organic material. As this peat border is situated very near to the Belgian-Dutch frontier, this implies that peat is unlikely to be detected in soil samples in most parts of northern Flanders, either because it has never been there, or because it has been removed so systematically that no traces are left.

As for the possibility of peat growth on the Pleistocene Sand ridge itself, in 1967 I. Ovaa, who had worked on the soil maps of the Dutch part of this region, had suggested that peat growth on the Pleistocene sand ridge could not be excluded a priori: he found that in the lower depressions between the ridges a loamy substrate at low depth could be found, which was impermeable and hence could have served as a base for peat growth. Ovaa also suggested that in these depressions significantly wetter conditions must have existed in the past as the drainage was much worse. In the 1970's more detailed research on the morphogenesis of this sand ridge was carried out by Cyriel Verbruggen, who also introduced pollen analysis as a tool to unravel the landscape history of this region. Verbruggen also detected a thin layer of peat in the uttermost northern parts of the polder area, underneath the post-medieval clay sediments (Sint-Margriete, Aardenburg-Sint-Kruis), but rejected other findings, for instance near Middelburg because they lacked *pollen of sphagnum* and *ericaceae* typically associated with peat. In a recent article together with A. Verhoeve he summarized his arguments: (Verhoeve and Verbruggen 2006 208-210):

- to enable peat growth the water level cannot be lower than 20 centimetres beneath the soil surface
- the highest point where peat growth has ever been confirmed on a Pleistocene sand cover is situated between +1 and +1,50 metres TAW (near Verrebroek in the Waasland polders).
- peat growth that would have surpassed the water level would have been bog peat (Hochmoor) and this needed a impermeable (clay/loam) substrate and sufficient rain.

The Pleistocene sand ridge in the north of Flanders is both too high, too dry and lacking the necessary impermeable substrate.

Besides the Polder region and the sand ridge, there is a third geographical area where peat growth has been contested: to the south of the Great Sandridge, a number of late-glacial lakes have formed, one of which – the Moervaart-depression - will be discussed extensively below. It has been questioned whether during the Holocene peat growth has occurred in these lakes and in smaller depressions in between the sand ridges. Soil sampling and pollen analysis in several of these depressions revealed no peat, but only *gyttja* – a nutrient-rich organic mud typically deposited at the bottom of lakes. Analysis of one of the *gyttja*-sequences (near Moerbeke) revealed a maximum thickness of 1,90 metres. ¹⁴C dating indicated that this sequence was formed in the Late Glacial period, starting from about 12000 BP (Crombé et al. 2005: 108 ; 128; Verhoeve et Verbruggen 2006 : 209-211).

Finally, geologists also reacted on the hypotheses formulated by some historians that peat exploitation could be derived from a typical field pattern consisting of very small, regular and oblong plots, in a perpendicular or slanted way oriented towards a road or ditch serving as starting point for the reclamations (see below). De Muynck for instance indicated that this field pattern was very common all over the coastal plain – at least in those areas where the field system had not been altered after the inundations and rebankments of the Early Modern period, making the mere presence of such a ‘reclamation landscape’ insufficient to prove the existence of former peat reclamations.

4. The historical evidence on peat in coastal Flanders

The historical data on the presence and exploitation of peat in Flanders are abundant, but difficult to interpret correctly. First of all, there is a problem of terminology : the terms ‘morum’ or ‘morus’ (Lat), ‘moères’ (Fr) and ‘moeren’ (Dutch), pose a lot of difficulties. Historians have used the spread of toponyms with ‘-moer’ to reconstruct the former presence of peat (e.g. Augustyn 1999). Such toponyms are very frequent all over the Flemish coastal plain, but it is not sure that the term ‘moer’ always refers to peatland. Alternatively, ‘moer’ can also refer to mere wetland or marshland. On the micro-level the reliability of toponyms to indicate historical land characteristics is dangerous, as toponyms are subject to change over time and often ‘travel’ through space, making the connection between a place-name with ‘moer’ and the historical presence of peat on that particular spot might be put into question. In other cases however, the link between ‘moer’ and ‘peat’ seems beyond doubt: when at the end

of the 13th century the monks of the Benedictine abbey of Saint Peter in Ghent declare that their ‘moer’ near Kalve (between Wachtebeke and Hulst in the north of Flanders) is sufficient to fuel a ‘perpetual fire’ – *sufficiens ad ignem perpetuo*⁶, they certainly indicate the presence of a vast amount of peat in that area. The same is true when in 1197 the count of Flanders grants a privilege to the abbey of the Dunes to construct a house “*ad custodiendas turvas quas in prefata fodi faciet solitudine*” – to conserve the peatblocks they would dig in that desert, being the ‘Moer’ situated on the French-Belgian border between Furnes (Belgium) and Bergues-Saint-Winnoc (France)⁷.

Especially for the 12th and 13th centuries AD we dispose of a lot of transactions of peatlands, which are granted or sold by the counts of Flanders to abbeys and rich individuals. The count pretended ownership of these peatlands due to his usurped royal rights on ‘wastelands’ or ‘wildernis’ (Tys XXX). This qualification as wasteland was a mere juridical construction and does not mean that these lands were ‘untouched’ by human activities at that moment. A previous use by local communities, either as common pasture-land, for small scale-peatdigging, or even as arable, is quite probable. The usurpation of the Flemish peatlands by the counts of Flanders however opened up the way for an intensive exploitation that was unmatched by any previous human use of the peatlands. Especially in the 13th century, when the Flemish counts were getting into a permanent state of financial shortness, sales of ever smaller plots of peatland are booming, and the prices are gradually becoming exorbitant – another indication that the ‘morum’ in the deeds does not just refer to low-value marshland (see examples in Luykx 1961). Moreover, many transactions make an explicit distinction between the ‘moer’ sold and the ‘treffons’ for which a perpetual rent had to be paid to the count of Flanders⁸. Historians interpret this ‘treffons’ as the – sandy – underground which was revealed after the excavation of the peat (Augustyn 1999 : 22-23).

As for the location of the peat sold, a chronological distinction has to be made between different parts of the Flemish coastal plain: in the western part of the Flemish coastal plain, the number of transactions reached a peak in the 12th century AD, whereas in the northeast of the county, near the Western Scheldt, the sale of peatland was at its height in the second half of the 13th century AD, with almost 170 transactions recorded, having regard on more than 3500 hectares of ‘morum’:

⁶ Gand, Archives de l’Etat, Abbaye Saint-Pierre, I, 10, f°61r : ‘*Morus sufficiens ad ignem perpetuo*’.

⁷ Confirmation des biens de l’abbaye des Dunes par le comte de Flandre (ed. Van de Putte 1864 : 174); en 1160 un privilège similaire était accordé par le comte aux moines de l’abbaye Saint-Nicolas de Furnes : Van de Putte et Carton 1849 : 90-91).

⁸ Often these rents were paid to specific receivers of the count, notably to the receivers of the ‘*brevia*’ [collection offices] of Waas, *Pieter Mazières*, and to the ‘*moermeester*’ and ‘*watergraaf*’

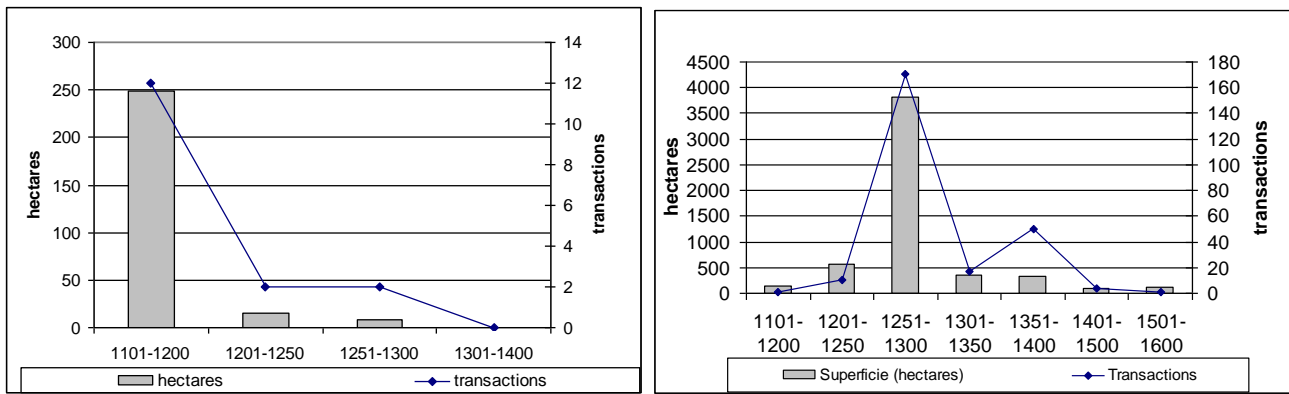


Figure 2 : Sales, gifts and exchanges of ‘moer’ –presumably peatland - in the region of the Moères on the French-Flemish border (left) and in the North-East of Flanders (Waasland-Vier Ambachten), (Soens and Thoen 2008)

This kind of ‘moer’-transactions also existed in the north of Flanders, in regions that were situated south of the ‘peat’-border delimited by the Belgian geologists. In the 13th century the western part of the so-called ‘Meetjesland’ was known as the ‘Moershoofd’ – *caput mori* – of Aardenburg. A unique late 13th century drawing depicts this Moershoofd as an area of approximately 58 square kilometres⁹, which at that moment attracted a lot of new settlers resulting in the almost simultaneous creation of three new parishes: Sint-Laureins, Sint-Jan-in-Eremo and Bentille¹⁰. Although the use of the place-name ‘moer’ is not sufficient to prove that peat reclamation was the actual goal of the massive 13th century land clearances in the area, the willingness of investors to acquire tiny parts of this ‘moer’ at high prices, seems to suggest the presence of peat. In January 1276 for instance, countess Marguerite sold to the dean of the Chapter of Our Lady in Courtrai four *bonniers* de ‘moer’ (ca. 5 hectares) situated in this *Moershoofd* for the total sum of 300 Flemish pound¹¹. Even more convincing is the acquisition by *Godefroy Louchard*, a banker from the Northern French village of Arras, of 100 *bonniers* of *moer* for the total amount of 17000 pound Flemish, which was a huge amount of money (Luykx 1961 : 231). One last example might illustrate the enormous hunger for peat in this period: in 1255 288,3 *bonniers* de ‘moer’ near Bentille-Sint-Margriete are sold to 200 different buyers, good for about 8500 pound Flemish. (Augustyn 1999 : 45 ; Luykx 1961 : 255).

⁹ Lille, Archives Départementales du Nord (ADN), série B, n° 1388, voyez aussi Augustyn (1999 : 43-45).

¹⁰ Ibidem : ‘*Ende daer wonen lieden up sovele dat sire up ebben ghemaect twe kerken bin corten tiden et ebben voracht noch ene te makene here*’

¹¹ Lille, ADN, B 174-184 (‘Inventaire Godefroy’), Tome III, p. 138, n°1890. Pour d’autres ventes dans la même région, également dans le mois de janvier 1276 : Luykx (1961 : 236).

With regard to the ‘peat debate’, the historical data presented above present two big disadvantages: they do not inform us on the precise topographical location of the ‘moer’ nor on the quality or the quantity of the peat to be found there. From the 14th century AD onwards, however, some quantitative data however can be found in accounts of institutional landowners owning peatland in coastal Flanders, either the counts of Flanders themselves are abbeyes and churches. In their ‘moer’-possessions near Beveren in the northeastern part of Flanders, the Flemish counts realised an annual production of about 8000 *last* of peat – i.e. 80.000.000 peatblocks around 1300, declining to 4-5000 *last* in the beginning of the 15th century AD (Augustyn 1999 : 84-85). At that moment this probably was one of the biggest peat-exploitations of Flanders:

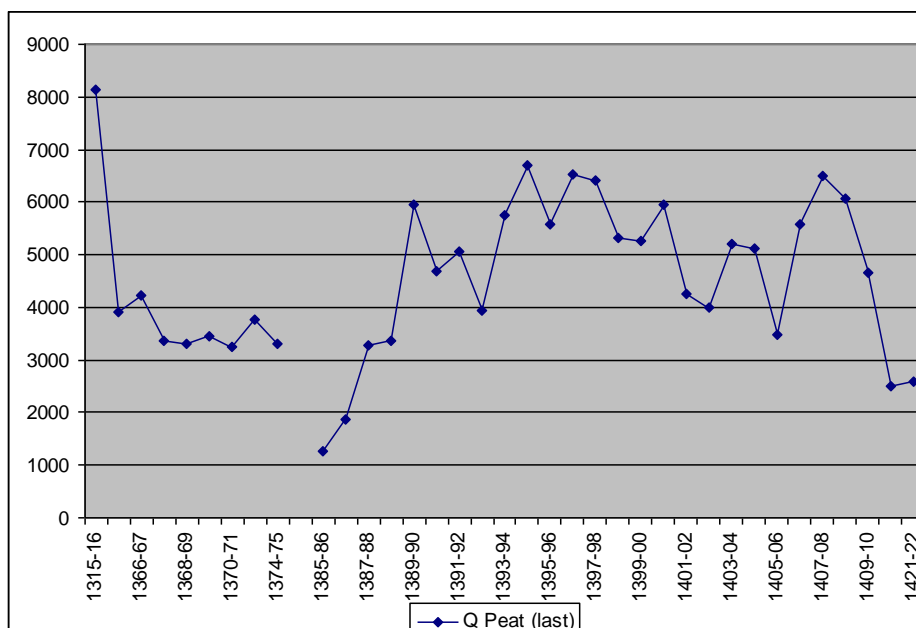


Figure: peat-exploitation of the count of Flanders near Beveren 1315-1422 (Source Augustyn 1999: 85)

Historians also questioned the possibility of a typical ‘field pattern’ associated with peat extraction. According to Gottschalk (1984, p.120-126) peat reclamations in the North East of Flanders presented a so-called *Blockstreifen*-pattern. The basic subdivision was a *bunder* (1,33 hectares) of 100 *roeden* (385,5 m) in length and 9 *roeden* (34,5 m) in width (11 to 1), later subdivided by ditches in small strings. A road or waterway served as starting point - *caput mori* – for the reclamations. For the so-called Meetjesland, near Eeklo and Maldegem, and largely situated on the Great Sand Ridge, Augustyn and Thoen (1987: 101-103) proposed that the basic subdivision of the area in ‘*maten*’ or ‘*blokken*’ served a similar purpose

(although the ‘maten’ or ‘blokken’ are much larger than one ‘bunder’, often up to 33 hectares).

Finally historians pointed at the specific labour organisation of the peat exploitations. In the peat marshes of the Western Scheldt region, peat exploitation in the 14th and 15th century was organised as a seasonal activity, serving as a supplementary source of income for peasant smallholders, who often owned only tiny farmsteads. For Kieldrecht Augustyn could reconstruct the organisation of peat exploitation in 1394:

Table: Turf exploitation near Kieldrecht in 1394: quantities of peat and farm size (based on Augustyn 1999: 118)

<i>Farms</i>	0-1 last	1-15 last	15-30 last	30-60 last	60-110 last	110-150 last	250-280 last	Q peat (total)
0-1 ha	102	32	8	6	2	1		151
1-3 ha	41	23	12	9	3			88
3-10 ha	6	7	5	5	6	2	1	32
10-20 ha		1					1	2
>20 ha						1		1
N farms (total)	149	63	25	20	11	4	2	274

Of the 274 peat diggers, more than half dug less than one *last* of peat, probably meant for their own consumption. A considerable ‘middle’ group dug between one and 30 *last*, much more than they needed to warm their houses. Most of them also had farmsteads smaller than 3 hectares, and the peat probably offered them an attractive by employment. As one person could dig about a quarter of a last a day, 30 last seems the maximum an individual peat-digger could exploit on a year (in winter the peatland is too wet for peat digging). The 37 individuals who dug more than 30 last, without doubt engaged other people to help them (including probably some of the smallholders who dug only minor quantities for their own). These 37 had on average larger farmsteads, and sometimes developed into real peat entrepreneurs contracting for 100 last or more. Both peat digging as commercial activity and peat digging as seasonal by-employment disappeared from after the 16th century. On the hand, population had declined and large commercial farmers had pushed out the peasant smallholders. On the other hand, Flemish peat was no longer attractive to exploit, and Brabant and Holland replaced Flanders as major peat providers.

5. Towards a methodology for surveying medieval peat in the landscape: the Wachtebeke-Moerbeke test-case.

From what precedes, historians and geologists used different proxy-indicators to assess the probability of peat and peat exploitation in regions where peat is no longer visible in the landscape today: A. the soil substrate (either direct evidence on peat or an impermeable loam/clay substrate); B. the height of the Pleistocene subsoil; C. the field pattern (i.c. the presence of a systematic and oblong field pattern); D. concentrations of institutional landownership; E. toponyms related to peat; F. existing historiography. On its own neither of these proxy-indicators is sufficient to affirm or deny the presence of disappeared medieval peat lands in the landscape. However when several of these proxies are affirmative, it becomes worthwhile to start a further enquiry into the former presence of peat in the area. In what follows, we will discuss the validity and risks of each of these proxy-indicators by testing them for a specific test-case: the Moerbeke-Wachtebeke area in the North of Flanders, one of the areas for which the presence and characteristics of medieval peat exploitation has been debated. Furthermore, we will try to develop a general methodology and decision-model in order to come to more conclusive evidence and more precise locations. A GIS is used for the spatial analysis of the available proxy-evidence, to assemble additional historical and geological data and to come to a topographical location of regions of former peat extraction.

We will do so for a test-case in the north of Flanders, just below the Belgian-Dutch border: the villages of Moerbeke and Wachtebeke. Both villages show the typical structure of reclamation villages, and the first written records of these villages also date to the period of the great reclamations: Wachtebeke was first mentioned in 1198; Moerbeke back in 1190 (XXX). Both villages definitely were involved in the great reclamations but the was there peat extraction in this area? Since the major northern part of this area is higher than +2 meter TAW (pre-holocene¹²) the “minimalist” vision implies there were *no* peat lands in the north of the study area. The “maximalist” vision of Gottschalk, Augustyn, Leenders and Thoen implies there *were* excavatable peat lands in the study area.

The study area was occupied as early as the late Paleolithicum, mainly on sandy hights in the “Moervaartdepressie” or surrounding this depression (Van Vlaenderen *et al.*, 2006, p. 20). Occupation lasted (although in different locations) through the Meso- and Neolithicum.

¹² Let op: valt in het studiegebied min of meer samen met het huidige !!!

Recent literature describing the occupation during the Neolithicum and the early Middle Ages is more scarce. It can be assumed that there was a drop in occupation (De Schepper, 2001a; Thoen, 1993, p. 133).

A. The evidence on peat on the soil maps (XXX. Uit te werken Iason)

In the south of these communities lies the “Moervaartdepressie” (Moervaart depression). This depression is part of the “Vlaamse Vallei” (Flemish Valley), formed by the incision of watercourses during the Elster and Saale ice ages (Goossens, 1984, p. 147). During the Eem interglacial, a major part of this valley was flooded and marine and estuary sediments were deposited (Goossens, 1984, p. 148). During the Weichsel ice age löss¹³ and sand were deposited by eolian processes. At the end of this ice age the “Dekzandrug van Maldegem-Stekene”, a sandy ridge, was deposited in the north of the study area. This obstructed the northerly course of the waterways, causing the formation of a swampy area: the “Moervaartdepressie” (Kerrinckx, 1989, p. 11). South of the “Moervaartdepressie” lies the “Ruggencomplex van Zeveneken en Zaffelare”, another sandy ridge. (Kerrinckx, 1989, p. 11). Summarizing, from the south to the north the height of the study area changes from a low depression, a relatively steep ridge, a less steep other side of this ridge and low polders.

XXX Gegevens digitale ondergrond Vlaanderen???

XXX aanwezigheid ondoordringbare ondergrond als voorwaarde voor hoogveenvorming ??

Proxy-indicators on the presence of medieval peat:

B. The Height of the Pleistocene subsoil:

Using Digital Elevation Data, it has become very easy to obtain an accurate picture of the elevation of an area. For Flanders LIDAR-data XXX were used.

¹³ Vertaling naar Engels ?

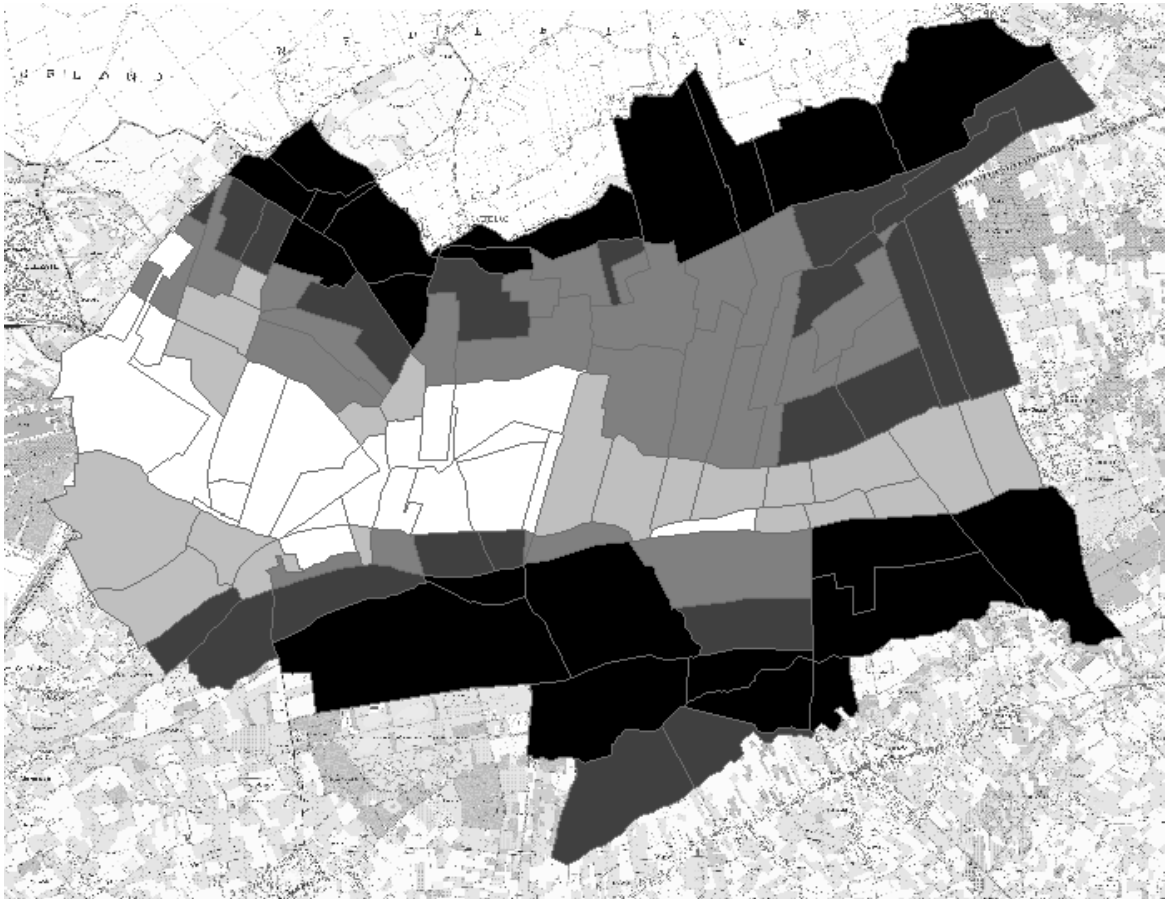


Figure 2: Elevation of the study area

C. Field pattern¹⁴

In order to avoid the large-scale 20th century modifications of the rural landscape, the best starting point for an analysis of the ‘traditional’ field pattern are 19th century ‘cadastral’ maps which are widely available and increasingly digitized. For Belgium, the ‘commercialised’ cadastral maps of P.C. Popp can be used, which date back to the period 1842-1879. For retrogressive landscape reconstructions – ascending in time from the 19th century till the medieval period - these Popp-maps have often proved to be of excellent value. Of course these maps do not mirror the medieval field pattern, as modifications in the field pattern could have occurred between the 16th and the 19th century. Furthermore, being ‘cadastral’ maps they reflect ownership rather than physical plots. A further retrogressive analysis of the field system using so-called ‘pre-cadastral’ maps and land-survey from the 16th to 18th century which are widely available for Flanders (the so-called ‘landboeken’), would be of help but is time-consuming. In the meanwhile, the Popp-maps were georeferenced¹⁵ and fields being

¹⁴ Juiste vertaling ?

¹⁵ Vertaling ?

more stretched than approximately 5:1 length:width-ratio were digitalised as polygons. Secondly, the proportion of these polygons per “beloop”¹⁶ was calculated. The larger this proportion, the greater the probability of former peat extraction within the study area, based on field pattern. The results of this analysis are shown in figure...



Figure 1: Probability of former peat extraction based on field pattern

This figure shows that the areas with the highest probability of peat extraction are located north of the “Dekzandrug Maldegem-Stekene” but certainly within the northern part of the study area. The part of the results pointing to an area with a high probability above the “Dekzandrug Maldegem-Stekene” is in accordance with the findings of Gottschalk (1984), Augustyn (1977), Leenders (1993) and Thoen (2008) who mention a peat border, far more south than the peat border mentioned by Verbruggen (1993).

XXX (Iason) correlatie tussen hoogte en percelering en aanduiden welke zones het hoogst gecorreleerd zijn, maar ook aanduiden dat er zones zijn waar correlatie totaal niet opgaat

¹⁶ Uitleg beloop

D. Concentrations of institutional landownership.

Based on the existing historiography and a survey of published inventories and calendars of charter collections (Gottschalk (1984), Luykx (XXX); Vleeschouwers (1983); Hesters (2009) etc.), the major acquisitions of *morum* by abbeys and other ecclesiastical institutions like urban hospitals in the Wachtebeke-Moerbeke region can be retrieved. The concentration of ecclesiastical property is dense: as can be seen in table 1, at least twelve institutions acquired plots of peatland 1174 and 1375/76, but from the descriptions of the boundaries in these charters, it's clear that many other institutions owned peatland over there as well (e.g. the abbeys of Affligem, Oudenaarde and Zwijveke near Dendermonde). Almost all of these possessions originated either directly or indirectly in grants or sales from the counts of Flanders, who sometimes retained a small *census* on each unit of land. From the second half of the 13th century onwards gifts of *morum* usually indicate whether the peatland is sold with the underground (*treffons*) or not.

Table 1: acquisitions of peat land by abbeys and urban hospitals in the Moerbeke-Wachtebeke region.

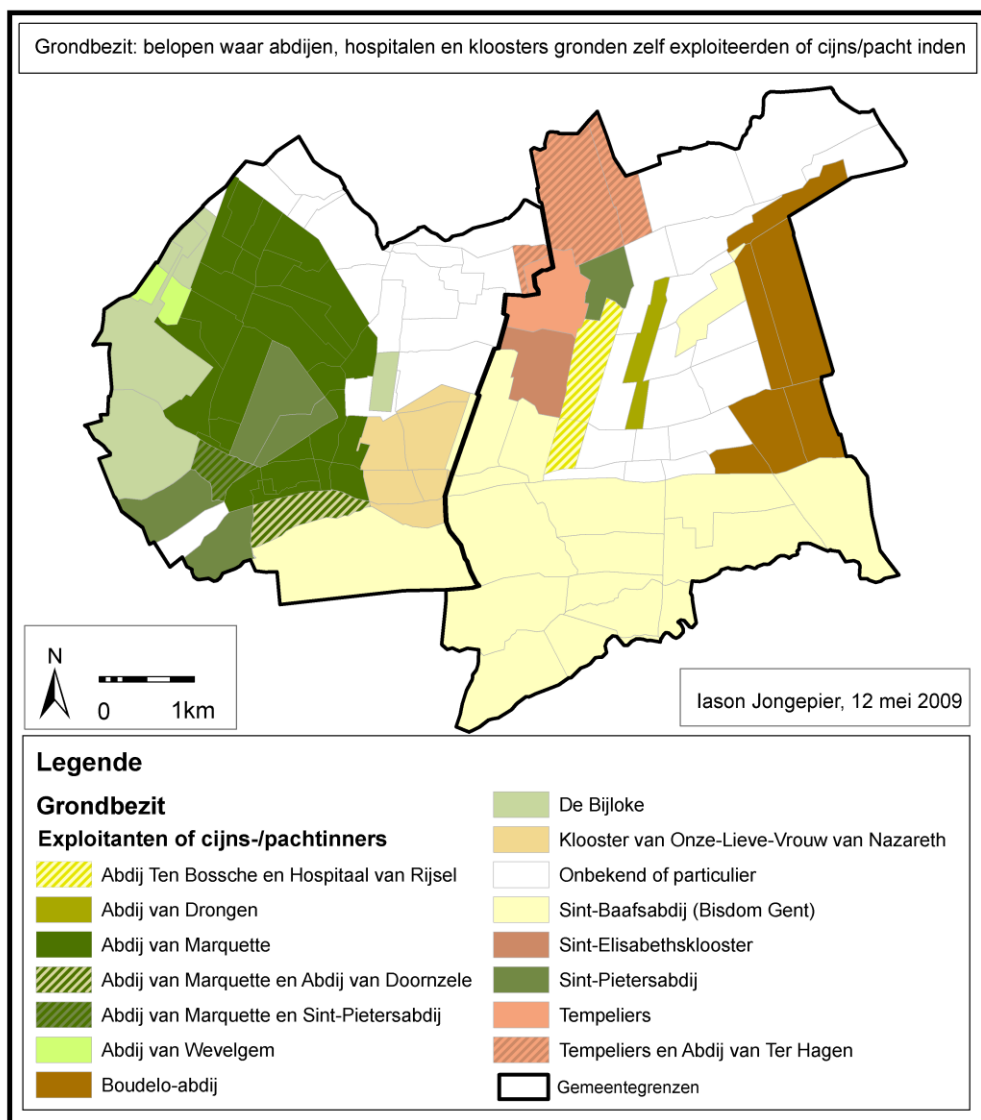
Year	Abbey/Hospital	Place	Size (hectares)	description
1321	Bijloke	Moerbeke (Koudenborn)		7
1200	Boudelo	Koudenborn	unknown	morrum
1297	Boudelo	Moerbeke		18
>1246	Comtesse Hospital (Lill)	Between curtis Ninove and Boudelo		10
1357/58	Doornzele	Wachtebeke		1
1297	Drongen	Moerbeke		11
1356	Drongen	Moerbeke		7
1252	Loos	Mendonk		13
1298	Loos	Wachtebeke		16
1228	Marquette	between (the <i>moor</i> of) Boudelo and Ertvelde		15 moro
1244	Marquette	between (the <i>moor</i> of) Boudelo and Ertvelde		668 moro
1247	Nieuwenbossche	Between Kalve and road to Eksaarde/Moerbeke		33
1298	Nieuwenbossche	Moerbeke		12
1196	Ninove	Mendonk		27 mori
1200	Ninove	Kalve (?)		13 morri
1201	Ninove	Kalve	unknown	morri
1249	Ninove	Kalve		67 tam mori quam terrae
1280	Rijke Gasthuis Ghent	Langelede (?)		18
<1233	Saint Bavo Ghent	Kalve		75 mori
1297	Saint Bavo Ghent	Wachtebeke		21 muer
1275	Saint Bavo Ghent	Kalve		17
1174	Saint Peter Ghent	Kalve-Wolfschoot		134 moro
<1250	Saint Peter Ghent	near curtis Wachtebeke		23
1356	Saint Peter Ghent	Walderdonk		16

Among the largest owners of peatland in the area, we notice the old Benedictine abbeys of Saint Peter's and Saint Bavo's in Ghent (resp. 172 and 113 hectares) situated in the western part of the study area (near Kalve). In march 1240 the latter abbey – Saint-Bavo – was also

granted the huge amount of 1537 hectares of ‘onlende’ (wasteland) in the south of Moerbeke and Wachtebeke. This was the heart of the so-called ‘Moervaart-depression’ – the ‘late glacial’ low-lying marshland we already mentioned above. From the description of this land, it becomes clear that the actual ‘morum’ was situated north of the ‘onlende’, and thus presumably north of the Moervaart-depression, on the Pleistocene sand-ridge¹⁷. The Cistercian Abbey of Boudelo acquired a considerable share of *morum* in the eastern part of the area already in 1200. This *morum* was part of the original foundation-gift of the abbey by the count of Flanders. It lacks precise boundaries but according to the confirmation of the grant in 1247 reaches (‘to the middle of the moor’) (Vleeschouwers 1983: 244). In a further gift of c. 18 hectares of *morum* from 1297 the shape of the plot is mentioned (Vleeschouwers, 1983: 369). With a length of 100 *roeden* and 139 *roeden* at the upper side and 109 *roeden* at the bottom side, this plot had a typical trapezoid size, often associated with peat reclamations. The huge *morum* acquired in 1244 by the Cistercian abbey of Marquette is situated in the western part of the area and remained known as the ‘Marquettermoer’ in later centuries (see below). Each of these abbeys founded a *curia* or *curtis* from which the reclamation of the area was started: Wachtebeke by Saint Peters, Kalve by the abbey of Ninove, Ascotte by Marquette, Koudenborn by Boudelo, Wulfsdonk by Saint Bavos. Most of these *curtes* have been localized on the highest part of the sand ridge, probably at the edge of the medieval *morum*.

Retrieving the exact boundaries of the ‘morum’-possessions of the abbeys is often very hard. The medieval source material often lacks retraceable indications of boundaries (preferring to situate plots in relation to the plots of other landowners). However, by using more recent property inventories of the different abbeys and combining them with 17th and 18th century maps, an approximate localisation becomes possible, on the condition that the landowner has not sold his peatlands after the peat exploitation had come to an end. Nevertheless, even a partial reconstruction of the former ‘morum’-possessions reveals a clear pattern: most of the ecclesiastical possessions are situated next to each other, stretching out from the Pleistocene sand ridge to the north.

¹⁷ Serrure, Carulaire de Saint-Bavon, nr. 226 : “totam illam terram que vulgo dicitur Onlende, que terra sive Onlende, tales habet terminos: versus orientem, Onlende abbatis et conventus de Bodelo, versus occidentem, allodium, sive onlende, sancti Bavonis quod dicitur Licht, et ultra aqueductum qui Nortlende dicitur, Vevorde; versus septentrionem, morom, qui a loco qui vulgo dicitur Calf, extenditur versus Bodelo, versus meridiem terram domini Rassonis de Gavera, que se extendit versus exarde”. In later gifts, Saint-Bavo’s own ‘morum’ is repeatedly situated north of this ‘onlende’ (e.g. the confirmation charter by countess Margaretha in 1263-64).



Even apart from the explicit mentioning of *morum*, the extremely dense concentration of ecclesiastical landownership, already makes it worthwhile to investigate the reclamation history of this area. Such a concentration suggests firstly, that one landowner once owned the whole area and than started to split it up, and secondly that these lands were highly valued and looked after for by financially strong landowners like the abbeys. In the context of 12th and 13th century Flanders, such a competition for land only existed in the coastal saltmarshes and in the peatlands.

E. Toponyms

In order to find other proofs of former peat extraction, a number of historical maps were analysed. These maps range from 1274/1288 to 1879 but it must be mentioned that the first

accurate map dates back to 1576. Two maps contain direct references to former peat lands. Maps of the 17th and 18th century (RAG, Kaarten en plans, nr. 19 and RAG, Kaarten en plans, nr. 686) show “de moere van Marquette” (the peat lands of the Marquette abbey) and a map of 1656 (RAG, Kaarten en plans, br. 434) shows “moerlanden” (peat lands). Although these maps are not geometrically¹⁸ correct, the location of the peat lands in relation to other locations like villages points out that they were at least partially located within the study area. Details of these maps are to be found in de next figure:

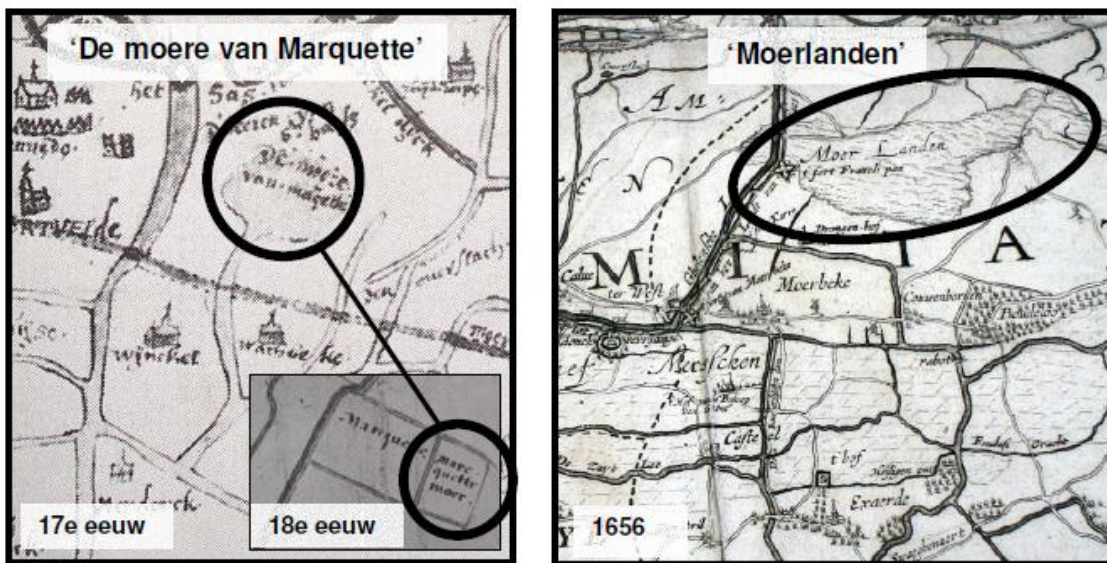


Figure 3: Historical maps

Other historical maps and the work of De Coninck & Martens (1989) provide other toponyms, linked to peat extraction. The following toponyms contain the word “moer” (peat or peat land) but do not directly refer to a well-defined area where peat extraction could have taken place: “Moerstraat” (peat street), “Moermolen” (peat mill), “Moervaart” (peat channel) , “Moerke” (little peat land), “Moerkesbeek” (peat ditch) “Moerhof” (peat farm), “Rode moeren” (red peat lands) and “Moerbeke-Waas (peat rill in the Land of Waas). Other references to former peat extraction are “Kelderputten” (basement pits, linked with holes dug for peat excavation), “Zwarte beek” (black rill, possibly referring to the blackness of the transported peat) and “Turfmeersen” (wet grasslands containing peat, referring to dried peat). These toponyms are located in the next figure.

¹⁸ Vertaling ?

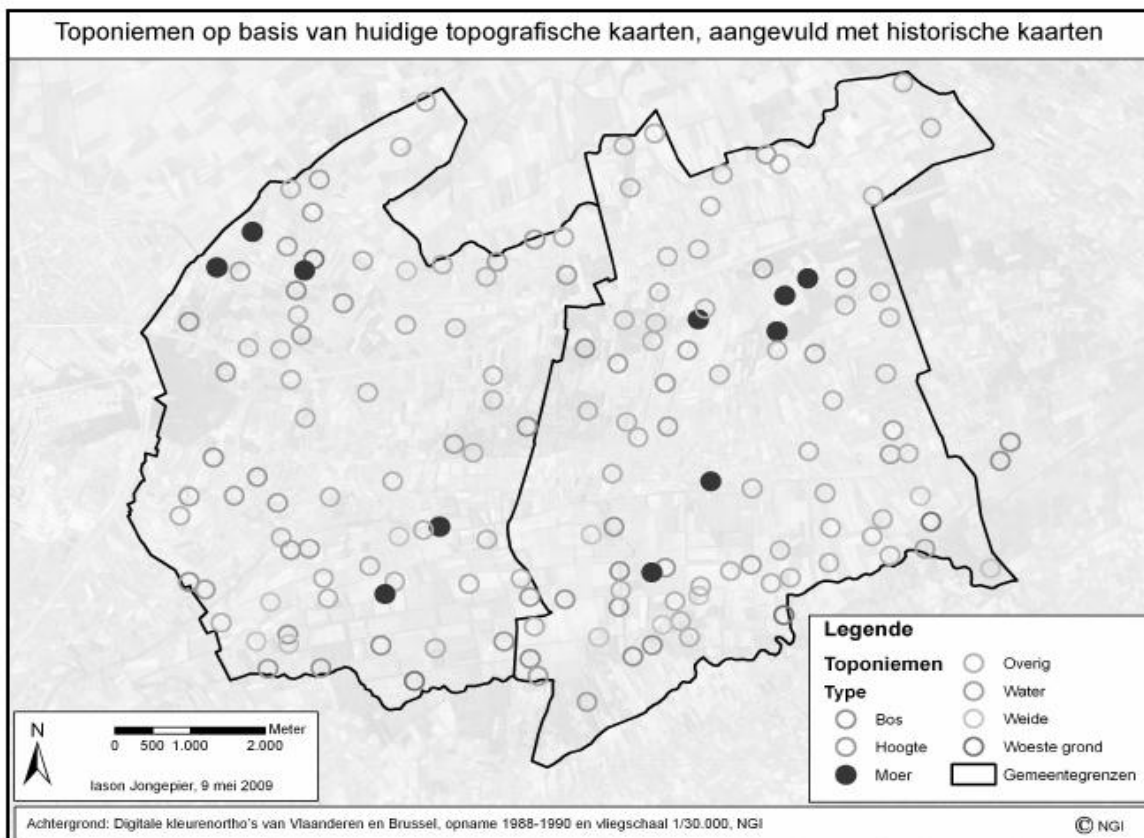


Figure 4: Toponyms

In comparison with the map showing the possibility of former peat extraction the location of the discussed toponyms and the areas with a high possibility are striking. Both are found in the north of the study area and in the north of the “Moervaartdepressie”.

Testing the presence of peat on the micro-level

As several indicators reveal the possibility of peat exploitation, a further analysis is necessary to confirm or deny the presence of peat. In order to do so the archives of the ecclesiastical landowners in the area were scrutinized, in order to reveal data on peat exploitation in the area. For three abbeys adequate sources could be found: the Benedictine abbey of Saint-Bavo in Ghent, the Norbertine abbey of Drongen and the Cistercian abbey of Boudelo. Each of these three abbeys was engaged in peat extraction on their Moerbeke/Wachtebeke possessions from the 14th to the 16th centuries. Among them, Boudelo was obviously the most important peat extractor:

YEAR	Q peat (last)	Q peat (sold)	Outsourcing (pound)	outsourcing (Q peat)	Q peat total (last)
1446	982,0	326,6	3,4	22,4	1004,4
1481	1541,2	?	0,0	0,0	1541,2
1513	753,5	66,0	107,0	1116,5	1870,0
1540	158,0	0,0	0,0	0,0	158,0
1541	200,0	0,0	0,0	0,0	200,0
1542	200,0	0,0	0,0	0,0	200,0
1543	120,0	0,0	0,0	0,0	120,0
1544	132,0	0,0	0,0	0,0	132,0
1545	127,0	0,0	0,0	0,0	127,0

Table : quantities of peat dug at the Boudelo-estate in Moerbeke 1446-1545¹⁹

On the Boudelo-moer, between 1000 and 2000 *last* of peat was dug each year in the course of the 15th century. Part of this was sold – *Bauwelooschen turf* or peat from Boudelo was one of varieties one could buy at the Antwerp market (Prims, *turfdragersambacht*). Another part of the production was distributed to several institutions and secular persons, and the last part was used for the abbey's own consumption. From the second quarter of the 16th century onwards, the amounts of peat dug were much lower, and apparently only meant for own consumption and distribution. In the same period important parts of the peatland itself were alienated as a whole in order to cover the abbey's financial needs, which became very urgent in this period (see de Kraker XXX).

For the year 1481 a detailed account of peat digging on the Boudelo-estate has been preserved²⁰. This source not only mentions the names of the peat diggers and the quantity and quality of the peat dug out, it also gives us a more a less detailed geographical description of where the peat was dug: each peat extraction was situated by referring to one of the three canals that were running through the Boudelo estate: the Arincxlee, the Willebuus- (or Willibrords)lee and the Broeder Lievins Lee. These canals were running south to north, starting on highest part of the sand ridge where the exploitation centre of Koudenborn was situated. As peat was extracted either west or east of each of these canals, it's clear that the peat extraction took place not in the Moervaart-depression but on top of the Pleistocene sand ridge.

¹⁹ Part of the peat extraction by the abbey was 'outsourced' through a specific lease-system, the so-called '*moerpacht*'. Peat diggers bought the licence to dig a certain amount of peat for a fixed price. As exploitation costs were rather high (often more than 50 % of the market price for peat), and a certain margin of profit for the peat digger must be included, we supposed that the leaseprice was half the marketprice. This allowed us to estimate the amount of peat that was dug through the '*moerpacht*' system. For the abbey of Saint Bavo this hypothesis is confirmed for some years where both the sale price and the '*moerpacht*' per last are registered (Denys 1994: 94-95).

²⁰ RAG, Abdij van Boudelo, 1327.

XXX (kaart veenwinning Boudelo toevoegen).

The annual production on the estates of the abbeys of Saint Bavo and Drongen was much lower: respectively 200-300 last and 100-150 last a year. The rather low production by Saint Bavo is surprising as we estimated the abbey's *morum*-possessions at about 113 hectares. The abbey of Drongen however, only owned a rather tiny and easily retraceable plot of peatland, measuring about 17 hectares, acquired in 1297 and 1356 (see above). As can be noticed in the table below, peat extraction on this plot continued at least until 1495-96 and probably somewhat longer, but the 16th century accounts of Drongen abbey have been mostly lost, so the exact ending of the peat exploitation cannot be dated. If 100 last *per annum* would have been dug on this plot and if one *last* of peat measured 22,75 m³ (Augustyn 1999; Stol XXX), this mean that one century of peat extraction would have dug off 1,34 metres of peat on this plot. Consequently, a production period stretching from the early 14th to the early 16th century would have required more than 2,5 metres of peat. In reality, the thickness of the peat varied locally, which means that the peat layer must have been much thicker in some places, and lower in other. That the abbey of Saint Bavo apparently did not produce more peat on its apparently much larger peatlands, might indicate that the peat layer in this part of the *morum* was less thick. Compared to Drongen the possessions of Saint Bavo were situated much closer to the highest point of the sand ridge, which might explain this difference in peat thickness.

Figure: peat exploitation on the estate of the abbey of Saint Bavo near Ghent (based on Denys 1995 : annexes 1-4 ; 14)

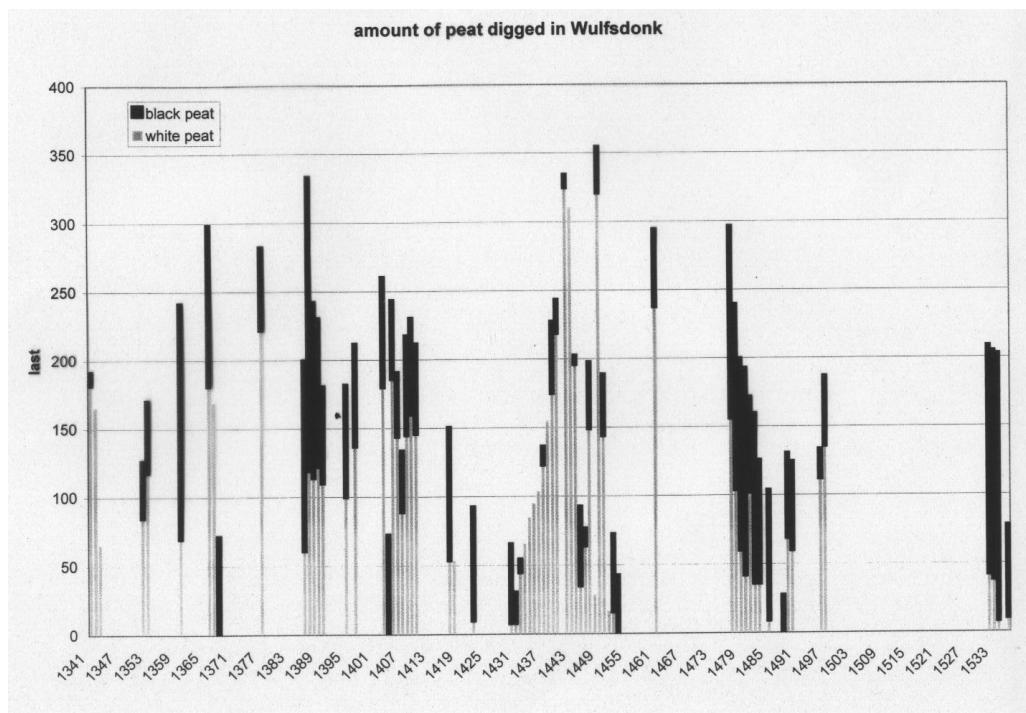


Table: peat exploitation on the estate of the abbey of Drongen in Moerbeke:

		Q peat (last)	Quality
1410/12/24	1411/12/24	34	black
		56,5	white
1417/12/24	1418/12/24	61	white
		20	derdepits'
		21	black
1495/05/02	1496/05/02	125	white
		25	derdepits'

The history of peat exploitation is extremely troubled by the large variety in quality, and hence, in price of the peat extracted. The major distinction was between ‘black’ and ‘white’ peat. The former was the cheapest, both in price and in exploitation cost. It probably was the cover peat. Another popular distinction was between third, fourth and fifth ‘pit’ (*derdepits*, *vierdepits* and *vijfdepits*), presumably referring to the depth of the peat that was extracted. The deeper the ‘pit’, the higher the cost for extraction and the more expensive the peat. When selling part of its peat production in 1448-49, the abbey of Boudelo got 41 Flemish d. (*denarii*) *groten* per last for white peat; 40 to 54 d. for derdepit of a lesser quality and 98 d. for *‘puri derdepits et partim vierdepits’* (pure 3th pit and 4th pit). To dig the peat, the abbey paid 17 to 18 d. for white peat; and 22 to 25 for 3th and 4th pit (excluding transport)²¹. In

²¹ RAG, Abdij van Boudelo, 438 (handbook of peat exploitation 1446-47) and 270 (general accounts 1446-47 and 1447-48).

1390, the abbey of Saint Bavo paid 10,5 d. each last for digging white peat; 13,5 d. for 3th pit and 15 d. for 4th pit. Additional sums of 6 d. for gathering ('*winnen*') the peatblocks; of 12 to 13 d. for transport in wheelbarrows to a nearby canal; and of 22 d. for transport over water to Ghent had to be added per *last*²².

For Boudelo in 1481 we got an insight in the labour organisation of the peat extraction. Compared to the above mentioned data for Kieldrecht in 1394, the number of 'professional' entrepreneurs, digging more than 30 *last* a year is considerably higher (almost 50% of peat extractors), whereas the smallest peat digger still extracted 3,5 *last*, which is more than one household needed as fuel *per annum*.

Table: Number of peat-diggers on the Boudelo-estate in Moerbeke 1481 (source: RAG, Abdij van Boudelo, 1327)

Last	< 1	1 to 15	15 to 30	30-60	60-110	110-150	>150	Total
N peat diggers	0	10	8	6	7	3	0	34
%	0	29	24	18	21	9	0	100

In order to be extracted the peat had to be drained, and just like in any peat-reclamation area an intensive network of major and minor ditches and canals were constructed in Moerbeke and Wachtebeke, each connected to the Moervaart, and by the latter canal to the city of Ghent. As is well known for the Dutch peatlands, drainage of the peat also induced compaction of the peat, and lowering of the soil level, leading to a never-ending process of intensification of drainage, compaction of the peat and increasing water problems. As peatlands were becoming to wet, peat had to be drained below the water level, which happened increasingly in Holland from the 16th century onwards. Historians have questioned whether peat dredging below the water level also existed in late medieval Flanders. In Wachtebeke-Moerbeke more and more references in the 15th century mention '*slachmoer*'. Opinions on the meaning of this '*slachmoer*' are diverging: Leenders (1989: 247) thinks that *slachmoer* does indicate dredged peat, but Gottschalk (1984: 443-444) associates it with the clearing of the peatbanks left over in an area after the peat exploitation had been finished. Augustyn (1999: 98-100) on the other hand thinks of a process known in the Northern Netherlands (Groningen-Drenthe) where dug out peat is mixed with water and than dried and cut in pieces. The sources are indecisive, but seem to suggest that '*slachmoer*' was a

²² RAG, Sint-Baafs and Bisdome, rol 14 (account of Wulfsonk 1390).

geographical entity rather than a production process²³. Perhaps more convincing is the distinction equally introduced in the 15th century between peat that was ‘dug’ (*delven*), usually the white peat, and peat that was ‘made’ (*maken*), usually black peats, including *derde pits*, but also new varieties as ‘smackaerts’ or ‘terdelinck’²⁴. For the latter process the sources also use the verb ‘*maetselen*’ probably meaning that a mould was used²⁵. This peat was apparently too wet to be simply dug out and dried, so a new production process was applied. Whether this implied the use of drag tools, is however not confirmed.

As a final element in the discussion, historians have also questioned whether qualifications as 3th pit, 4th pit and 5th pit inform us on the depth of the peat layer. In Moerbeke-Wachtebeke, the ‘pit’ was used as an exploitation unit, and a variable quantity of peat could be extracted from each pit (often between 3 to 6 last but sometimes as much as 10 last at a time)²⁶. A spade usually used for peat digging measures about 25 centimetres in length. In most peat exploitations, one digs up to three or four spades deep at a time, or about one metre. Would that imply that third pit equalled a peat layer of about three metres, 4th pit of four metres and 5th pit of five metres? In any case, Augustyn found evidence that on the peat exploitation of the abbey of Saint Peter near Wachtebeke 2 last and 2 voeder of peat (i.e. 20800 peat blocks) could be dug at a time on one square *roede* (14,85 square metres). If one last of peat measured 22,75 m³ metres as most studies mention, this would imply that the peat layer there measured at least up to three meters²⁷.

6. Concluding remarks

XXX STROOMSCHEMA:

²³ E.g. RAG, Sint-Pietersabdij, rekening 1739 (1498): “*Van Joosse vanden Saren wonende te Ghendt die over ghestelt was int IIIe capitule vanden uutghevene der voorledene rekeninghe der kerke in resten sculdich wesende vanden jaere XCIII et ante de somme van VIIC LIX lb. XVI s. parisis ter cause ende over de vulle betalinghe vanden V ghemeten IIc XXI roen slachmoers die bij zijnen vadere ghecocht waren wesende de Ie strepe, comt hier als ontfaen de voornoemde somme van: 759 lb. 16 s. parisis*”

²⁴ e.g. RAG, Abdij van Drongen, 92, f°117v (1495-96): ‘*eerst binnen den jaer deser rekeninghe betaelt voor hondert XXV last witte turven te wetene van delvene van ghereene ende te hoepen elck last te XVIII groten f. 9 lb. 7 s. 6 d. groten; Item noch doen maken XXV last turven derdepits elck last te II s. groten f. 2 lb. 10 s. groten*’

²⁵ RAG, Sint-Pietersabdij, rekening 1739 (1498): ‘*Item den zelve Pieeter Lammens voor tmaetsele van IIc XXXIIII last II smackaerts die hij insghelijcx heeft doen maken ende in hoopen ghestelt ten prijse van XXII s. parisis elc last...*’

²⁶ RAG, Sint-Pieterabdij II 1251/2, accounts 1472. Augustyn (1999, pp. 80-81) only mentions three to six last, but in the accounts up to 10 last per pit was found. The evidence cited by Augustyn that the pit would have measured one square *roede* or 14,85 m² is not convincing. The size of a pit probably varied.

²⁷ See Augustyn, op.cit., p. 81, although with a different calculation: ‘item noch ghemaect uit eender roe moers 2 last ende 2 voer smackaerts’ (RAG, Sint-Pietersabdij II, 1251/2 1472-1486).

Acknowledgements

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References

Augustyn, B. (1977) “Bijdrage tot het ontstaan en de vroegste geschiedenis van de Wase Polders van de oudste tijden tot circa 1400”. *Annalen van de Koninklijke oudheidkundige kring van het Land van Waas*. 80, 5-136.

Augustyn, B. (1999) *De veenontginning (12de-16de eeuw)*. Beveren: Gemeente Beveren.

De Coninck, W., Martens, G. (1989) “Langs Wachtebeekse wegen: een heemkundige wandeling, anno 1662”. *Tijdschrift van de heemkundige kring ‘Oud Wachtebeke’*. Jaarboek 1989, 3-239.

De Maesschalck, L. (2004) “De eerste grondverwervingen te Wachtebeke”. *Tijdschrift van de heemkundige kring ‘Oud Wachtebeke’*. 31(2), 12-14.

De Muynck, M. (1976) *Het bedolven kultuurlandschap in de polders: een rekonstruktie uitgaande van luchtfoto's, toegepast op de Oost-Vlaamse en enkele Zeeuws-Vlaamse Polders*. Gent: s.n.

De Potter, F., Broeckaert, J. (1864-1870a) “Moerbeke”. In: De Potter, F., Broeckaert, J. *Geschiedenis van de gemeenten der provincie Oost-Vlaanderen, 1e reeks: Arrondissement Gent, 5: Merelbeke, Merendre, Moerbeke, Moortzele, Munte, Nazareth, Nevele*. Gent: Annot-Braeckman, pp. 1-47.

De Potter, F., Broeckaert, J. (1864-1870b) “Wachtebeke”. In: De Potter, F., Broeckaert, J. *Geschiedenis van de gemeenten der provincie Oost-Vlaanderen. 1e reeks: Arrondissement Gent, 7: Vinkt, Vosselare, Vurste, Waarschoot, Wachtebeke, Winkel, Wondelgem, Wontergem, Zaffelare*. Gent: Annot-Braeckman, pp. 1-36.

De Schepper, G. (2001) “De bossen van Moerbeke: deel 1”. *Tijdschrift van de heemkundige kring van Moerbeke-Waas*. 9(1), 13-18.

De Smet, E. (1975) "Bijdrage tot de toponymie van Wachtebeke". *Tijdschrift van de heemkundige kring 'Oud Wachtebeke'*. Jaarboek 1975, 7-135.

Goossens, D. (1984) *Inleiding tot de geologie en geomorfologie van België*. Enschede: Van de Berg.

Gottschalk, M.K.E. (1984) *De Vier Ambachten en het Land van Saaftinge in de Middeleeuwen: een historisch-geografisch onderzoek betreffende Oost Zeeuws-Vlaanderen c.a.*. Assen: Van Gorcum.

Kerrinckx, H. (1989) *Zaffelare*. Gent: s.n.

Leenders, K.A.H.W. (1989) *Verdwenen venen: een onderzoek naar de ligging en exploitatie van thans verdwenen venen in het gebied tussen Antwerpen, Turnhout, Geertruidenberg en Willemstad 1250-1750*. Brussel: Gemeentekrediet van België.

Leenders, K.A.H.W. (1993) "Venen en moeren: historisch-geografische benadering". In: De Kraker, A.M.J., Van Royen, H., De Smet, M.E.E. (Red.) *Over den Vier Ambachten: 750 jaar Keure, 500 jaar Graaf Jansdijk*. Kloosterzande: Duerinck, pp. 65-70.

Monmonier, M. (1991) *How to lie with maps*. Chicago: University of Chicago press.

Pas, P. (1998) *De Wase en Gentse Boudelo-abdij, van paleis in de moerassen tot eiland in de Waterwijk*. Belsele: Culturele Kring Boudelo.

Soens, T, Thoen, E. (????) *Mais où sont les tourbières d'antan ? Géographie, chronologie et stratégies économiques du tourbage en Flandre Maritime (12^e-16^e siècles)*.²⁸

Thoen, H. (1993) "Romeinen in de Vier Ambachten". In: De Kraker, A.M.J., Van Royen, H., De Smet, M.E.E. (Red.) *Over den Vier Ambachten: 750 jaar Keure, 500 jaar Graaf Jansdijk*. Kloosterzande: Duerinck, pp. 133-136.

²⁸ Officiële referentie en bijbehorend tijdschrift ?

Toen, E. (2008) *Onderzoeksseminarie: geschiedenis van landbouw, milieu en omgeving*. Onuitgegeven cursus, Universiteit Gent, faculteit Letteren en Wijsbegeerte, vakgroep Middeleeuwse geschiedenis.

Van de Velde L. (1997) *Onderzoek naar de verbreiding van het areaal van het verdwenen veen in Noord- en Zeeuws-Vlaanderen*. Onuitgegeven licentiaatsverhandeling, Universiteit Gent, faculteit Wetenschappen, vakgroep Geografie.

Van Vlaanderen, L., Sergant, J., De Bock, H., De Meireleir, M. (2006) *Steentijdvondsten in de Moervaartdepressie (Oost-Vlaanderen, België): inventaris en geografische analyse*. Gent: Archeologische Inventaris Vlaanderen.

Verbruggen, C. (1993) "Venen en moeren: fysisch-geografische benadering". In: De Kraker, A.M.J., Van Royen, H., De Smet, M.E.E. (Red.) *Over den Vier Ambachten: 750 jaar Keure, 500 jaar Graaf Jansdijk*. Kloosterzande: Duerinck, pp. 61-65.

Verhulst, A. (1964) *Het landschap in Vlaanderen in historisch perspectief*. Antwerpen: De Nederlandsche Boekhandel.