10/3/2019

Raised bogs in the Low Countries

A cultural-historical analysis of long-term human uses and impacts

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Abstract

Humans have been interacting with raised bogs in the Low Countries for millennia, in a variety of ways. In prehistoric times, the peat bogs were used to sacrifice a variety of items, and influenced the mobility and settlement of humans. During the Middle Ages peat was used more and more as an energy source, changing the dynamics between raised bogs and humans. The consecutive phases of peat excavation and reclamation after the Middle Ages are described by the "wave of reclamation" model of Leenders (2013). However, the available knowledge on the interaction between humans and raised bogs is spread out over several fields of study, without interdisciplinary long-term overviews for the Low Countries being present. The available cultural-historical literature was examined to determine the regional trajectories for five regions in the Low Countries: Flanders, western Noord-Brabant, northern Netherlands, the Peel, and Hautes Fagnes (Belgium). After the regional literature study, two microregions for three of these regions are chosen. By combining the regional and the local results the trajectories of human and raised bog interactions were determined. These trajectories have validated the "wave of reclamation" model on a national level, but on a local level the results are more nuanced, due to the variation in amount of information between the (micro)regions.

Overall, a general trend of local peat excavation to commercial peat excavation was found for the microregions. In the northern Netherlands the commercial peat excavation started first, followed by the Peel, and later on the Hautes Fagnes. However, differences in the peat excavation trajectories were present within each region. The largest differences are the starting points in time of the intensification, and commercialisation of peat excavation, and the starting point of peat reclamation. These differences could mainly be explained by the availability of capital, infrastructure, the distance to the peat consumer market, and the amount of available peat.

Acknowledgements

This study was performed under the expert guidance of Roy van Beek and Maurice Paulissen, for which many thanks. I would also like to thank Fiona Verhoeven, Artur van Bemmelen van der Plaat, and Moritz Hunsicker for their comments on the work in progress, and their emotional support throughout this study. During the various day-to-day struggles, the people in the thesis room were present, and they would always be willing to lend a hand wherever necessary.

[1] The Figure from the cover page is from https://seniorplaza.nl/nostalgie/turfsteker/

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1 Introduction

1.1 Raised bogs in the Low Countries

For millennia, raised bogs have been an integral part of the landscape in north-western Europe, especially in the Low Countries. The peat coverage in the Low Countries used to be considerably higher than at present (van de Ven, 2003; Vos, 2015). Peatlands in the Low Countries, and in the Netherlands in particular, have been subject to changes due to human influences for thousands of years (van Geel et al., 1996). It took until the Middle Ages before peat excavation and reclamation intensified. The peat reached its greatest extent around the year 1000, after which the intensification of peat exploitation caused the overall extent of peat to decline (de Bont, 2009; van Beek, 2015c). However, the extent of peat was so great for so long (Vos, 2015) that human behaviour was influenced by peat bogs, and vice versa, for millennia in a multitude of ways. Examples of the human peat interactions are the sacrificing of items or people, which we identify nowadays as archaeological finds, the peat trackways which were used to increase mobility through the peatlands, and the way humans build dwellings in peat rich areas. The peat colonies are an example of a settlement type. They were specifically built to accommodate more intensive forms of excavation. As other types of agriculture were unable to be practised on peat bogs due to the wet conditions, the peat bogs themselves were used as pasture where possible (Gerding, 1995). One notable exception is the growing of buckwheat, which was mainly practised in the northern Netherlands. The precise interactions between peat and humans varies per area and has been a topic of research for a long time, with the first article being over 3 centuries old (Schoockius, 1658).

Peat is an accumulation of partly decomposed dead organic material. Two types of peat can be distinguished based on their position relative to the groundwater: fens and raised bogs (Streefkerk, 1987; Jongmans, 2013). The fens are formed in the lower parts of the landscape, where the groundwater can reach the peat layer. This type of peat could mostly be found in the western and northern parts of the Low Countries. The raised bogs do not reach the groundwater but depend on precipitation, thus the name. This type of peat can be formed anywhere, as long as water is able to stagnate, and the precipitation exceeds the evaporation (Renes, 1983; Barends, 1986).

Peat is usually divided in two layers: the upper white peat layer (also called grey peat or “bonkaarde”) and the lower black peat layer. This black peat could be meters thick in certain places (Hollenberg, 1980). The largest difference between these peat layers is the amount of carbon present in the peat. The white peat layer are usually not used for fuel, as it contains a lot of carbon compared to the black peat. Instead of burning up, this results in a lot of ash. Thus, the capacity of black peat as fuel is greater than the white peat layer. The white peat was usually processed into peat turf litter and used in horticulture to improve the structure of the soil (Holtenberg, 1980). In some cases, the white peat was not excavated but instead mixed with the sandy layer beneath the peat bog, resulting in excellent soils (Renes, 1991).

1.2 The wave of reclamation

The intensive excavation of peat and reclamation of peat bogs are the human activities with the largest influence on the peat bog landscape. The intensive excavation of peat bogs is assumed to have started in north-western Flanders during the Middle Ages (van Schaik, 1971). This region extends from Bruges to Antwerp from east to west, and from the West Scheldt and Gendt from north to south (Augustyn, 1987). The start of commercial peat excavation in Flanders was caused by a growing peat consumption in this

region, due to increased population pressures and urbanisation (Leenders, 2013). Over the years, the amount of peat decreased in Flanders, which made it cheaper to import it from further away than to excavate the small pockets of peat remaining. The second region to supposedly be excavated intensively was western Noord-Brabant in the thirteenth to seventeenth centuries (Leenders, 2013). The Gelderse Vallei region is assumed to have followed during the first half of the sixteenth century (Leenders, 2013). This was followed by the northern parts of the Netherlands in the sixteenth century (van de Ven, 2003; Leenders, 2013). Supposedly, it was not until the middle of the nineteenth century that the Peel area in eastern Noord-Brabant and later on the Hautes Fagnes area in eastern Belgium followed suit (Leenders, 2013). Since the Second World War, the excavation of peat has stopped due to a transition of fuel type from peat to coal and oil, nature preservation programs like for instance "Natura 2000" and "Natuurnetwerk Nederland", and the limited amount of quality peat still remaining (de Zeeuw, 1978; Natura 2000, 2019). Currently, some peat turf litter is still being imported from the Baltic for horticultural purposes. The assumed general pattern of peat excavation through the ages is called the wave of reclamation (Figure 1; described by Schaik 1971; Leenders, 2013; van Beek, 2015c).

Peat excavation can be subdivided in three levels of intensity: commercial or intensive excavation, local excavation with export, and local or extensive excavation (e.g. Gerding, 1995).

Commercial or intensive excavation consists of the large-scale, usually industrial, peat excavation meant solely for export. The excavators are comparable to labourers of factories, as they simply get paid for their work and otherwise have no relation with the land. As this form of peat excavation is larger in scope than the other two types of excavation, it stands to reason that reclamation is most likely to occur after commercial excavation. This type of excavation is most easily recognisable on maps, as the excavation tends to occur in regular patterns, and requires an extensive network of canals.

As the name suggests, the local excavation with export consists of the local or extensive excavation, but it is combined with a certain level of exportation of the turf to different regions. It is mainly focussed on the local peat consumption market, but depending on the infrastructure might focus up to a regional level.

The local, or extensive excavation focusses on subsistence peat excavating. The excavator only uses the raised bogs for his own uses. This can take several forms, like the pits in the Peel region (Joosten, 1989), but also the chipping away at the edges.

The reclamation of peat bog areas can differ for each region, as the conditions of the subsoil and the manner of excavation determine which plants can be grown. Examples of the different reclamations are the agricultural reclamations which are prevalent in the northern Netherlands, and the more forest orientated reclamations in the Peel region.

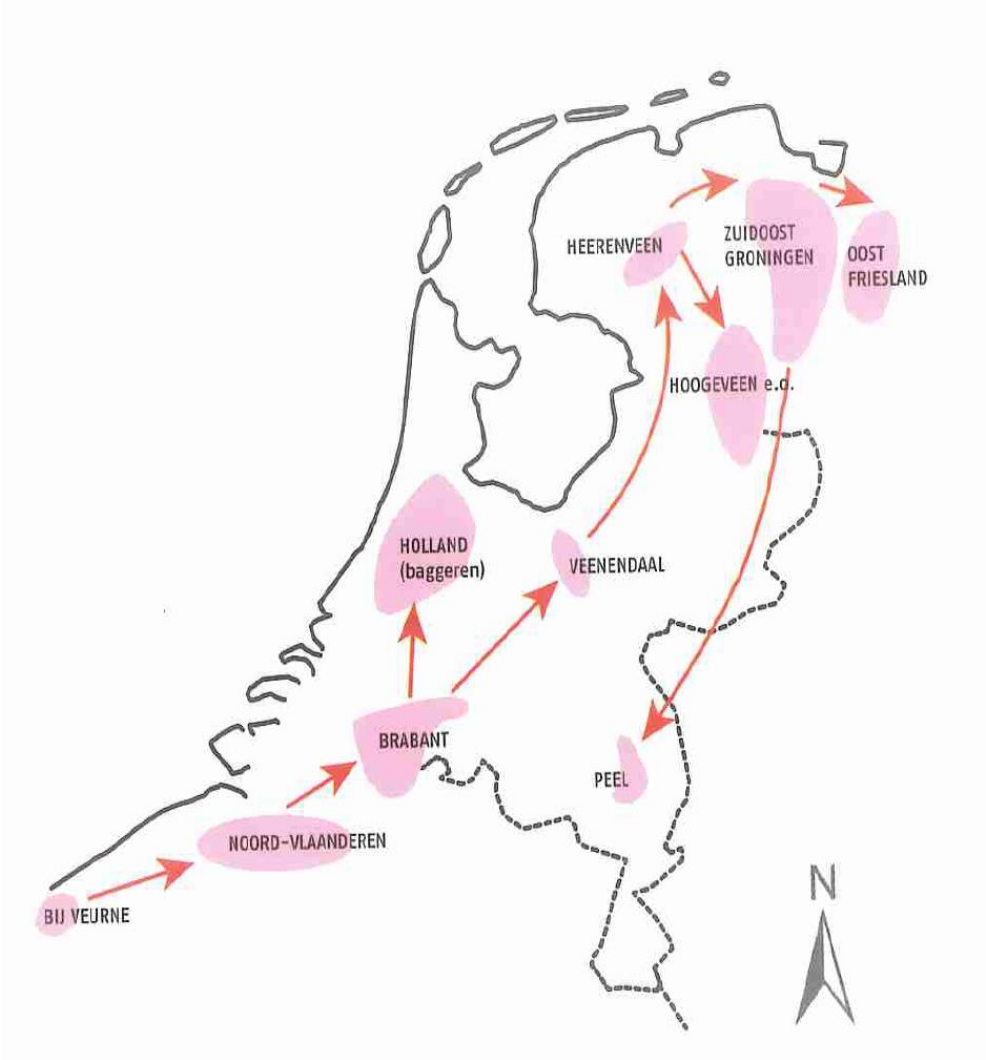

Figure 1: The wave of reclamation (Leenders, 2013).

1.3 History of research on raised bogs

In the last decades research into raised bog peat excavation has been plentiful. However, most of these studies apply a monodisciplinary approach, or focus on a single case study area (or both) instead of a regional interdisciplinary approach (Gearey, 2004). Examples of studies that use a monodisciplinary approach of peat excavation and reclamation are: de Bont (2009) for historical geography, Braadbaart et al. (2017), Groenewoudt and van Doesburg (2018), and Bianucci (2012) for archaeology, van Geel et al. (2014), and Sevink and van Geel (2017) for palaeoecology, and van Schaik (1971), and Bullock et al. (2012) for socio-economy. Examples of the single case study approach are, de Bakker (1982), van Beek et al. (2015b), and Jongepier et al. (2011). These studies consider the Green Heart of Holland, Twente and north-western Flanders respectively. A multidisciplinary overview of raised bog land use development is currently missing, which results in a limited understanding of the way in which we have shaped the peatlands and how the peatlands used to shape us. The studies that are closest to a multidisciplinary overview of raised bogs in the Low Countries are the papers by Stol (1992), Gerding (1995), and Leenders (2013), who focus on the Gelderse Vallei, the northern Netherlands, and western Brabant, respectively. Especially the papers of Gerding (1995) and Leenders (2013) have led to insights in the role raised bogs played in the Low Countries. Leenders (2013) also used a more interdisciplinary approach, as he included both historical geographic and socio-economic sources in his book.

1.4 Research questions

This research consists of three parts: a literature study, an analysis of various types of cultural-historical data and the combining of these two steps to explain the differences between the different study areas. It depends on the scale of the study area which of these types of data are used. To achieve the goals of all parts of this research, four questions have been formulated. The first research question is:

> *How do historical, geographical, archaeological, and socio-economical sources describe the consecutive phases of human land use and excavation of peat bogs in the Low Countries?*

This research question focusses on the available literature and identifies the available knowledge in the different fields of science. It focusses on the large-scale patterns of peat excavation and reclamation. This includes more intensive methods typical of the last millennium and the more extensive methods typical of the centuries or even millennia beforehand.

The second research question is:

> *How do the raised bog areas in the northern Netherlands, the Peel and the Hautes Fagnes (Belgium) compare in their land use development?*

This research question focusses on the regional study areas within the wave of reclamation. These areas were chosen based on the wave of reclamation model as described before (Figure 1), which focusses on the northern Netherlands, the Peel and the Hautes Fagnes, as well as western Noord-Brabant and Flanders. The latter two areas are not used here, as Flanders lacks a large historical dataset, and western Noord-Brabant was already discussed in great detail by Leenders (2013).

The third research question is:

> *What are the variations in land use development of raised bogs within the northern Netherlands, the Peel and the Hautes Fagnes (Belgium)?*

This research question focusses on several microregions within the previously mentioned study areas. Each of these microregions is identified based on the information found in the two previous research questions. This choice is based on the availability of literature and the spatial variability. Temporal trajectories for each of the microregion are.

Finally, the fourth research question is:

> *What are the underlying processes causing the differences in human uses and impacts on raised bogs between and within northern Netherlands, the Peel and the Hautes Fagnes (Belgium)?*

This research question combines the results found in the three previous research questions. These results are then used to explain the underlying processes of the differences found in the previous research questions.

The combination of these research questions leads to insights in both the available knowledge for the different fields of study and the consecutive phases for each of the study regions as well as the microregions. The regional and local overviews of information are used to determine whether any differences in land use development between local areas can be explained. This in turn leads to insights in the causes of the differences between and within the study areas, which may be tested in further research.

1.5 Thesis outline

Chapter 1 contains the theoretical background to this thesis, and chapter 2 the methodology as well as vital definitions. In chapter 3, the large scale pattern of peat excavation in raised bogs in the Low Countries is described, while chapter 4 dives one level deeper and focusses on the northern Netherlands, the Peel and the Hautes Fagnes in particular. Chapter 5 treats individual study cases in each of the regions described in the previous chapter, and chapter 6 treats underlying processes behind the trends found in the three study levels. The research questions presented in section 1.2 are answered in chapter 7, using the information assembled in the preceding chapters to form a conclusion. Finally, the broader context and limitations of this study are discussed in chapter 8.

2 Data and Methods

2.1 Methods

Following the research questions, this study consists of four steps. The first step of this research is to identify the available knowledge between the different fields of study, by determining the consecutive phases of human land use and excavation over the centuries from different angles. The second step is the development trajectories of three of the areas that were mentioned before, namely northern Netherlands, the Peel area and the Hautes Fagnes area, are examined in more detail and compared to each other (Figure 2). The third step consists of the microregions within each study region that are chosen based on a preliminary study and are analysed in great detail. This results in development trajectories of the raised bogs in the microregions. And the fourth step is a comparison between the different development trajectories, which are then compared to the wave of reclamation model. The differences found within and between each area are explained with the help of the available knowledge of the literature and the more detailed examination of the microregions.

The general overview requires the available literature to determine the consecutive phases of excavation and land use development in the Low Countries. This also means that for regions that lack the required literature, it is not possible to determine the consecutive phases of peat excavation. For the regional study areas a more in-depth analysis is made in the cultural-historical literature. This results in an analysis of the available patterns and sequences of peat excavation and reclamation. On top of this, the analysis is used to explain the differences found in the microregions in conjunction with the literature.

For the microregions an even more detailed study is performed. This also requires elevation maps from ArcGIS. The elevation maps are used to determine the location features of the landscape, like drainage patterns, which can then be used to determine which method was used to excavate the peat.

The ArcGIS program (version 10.5) is used to examine the elevation maps. Using this combination of literature, and the digital elevation model, an overview is created in which the temporal trajectories of the microregions are identified. These development trajectories for the microregions can then be compared to each other and the large-scale patterns, and the differences in trajectory between the microregions and the general overview should be explicable.

2.2 Data and Literature

As discussed, the literature study focusses is on three different study levels (Figure 2). For each of these study levels an interdisciplinary approach is used to determine the available knowledge. While the main angle is historical, other angles include socio-economical and physical, and to a lesser extent palaeoecological and archaeological literature. The cultural-historical literature usually originates from the combination of archival and archaeological data.

For the third study level, the microregions, other sources beside the literature are used as well to determine the land use development. These sources include the AHN (Actueel Hoogtebestand Nederland; Actual Height map in the Netherlands) and the MNT (Modéle Numérique de Terrain; Numerical model of the terrain in Wallonie). These are both elevation maps. The most recent version of the AHN is the AHN-3, which is used where possible. However, this digital elevation model still lacks some parts of the Netherlands, in particular in the more elevated parts of the Netherlands. Therefore, the older AHN-2 is used

in the places where AHN-3 is absent. Apart from the AHN-2, AHN-3 and MNT, topography maps from ArcGIS are used.

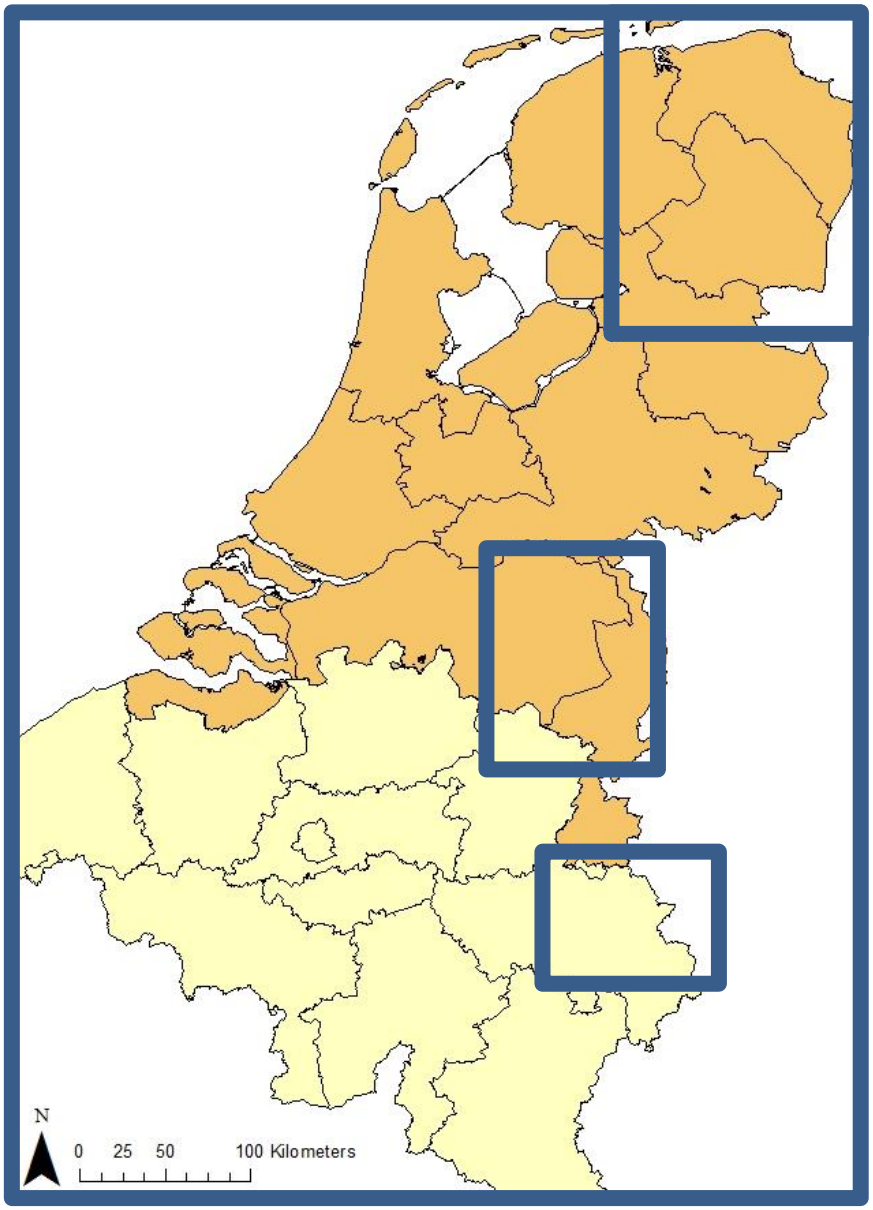

Figure 2: The different study layers. The first study layer encompasses the entire Low Countries. The second study layer consists of three different regions: The northern Netherlands, the Peel and the Hautes Fagnes. The third study layer consists of the microregions within the regions of the second study layer.

2.3 The study area

The Low Countries, or at least the parts of the Low Countries that are relevant in this study, consist of Belgium, which is subdivided in Flanders and Wallonia, and the Netherlands. The Dutch raised bog areas are generally subdivided in four regions: western Noord-Brabant, the Gelderse Vallei, northern Netherlands and the Peel. In Belgium, the raised bogs can be divided in the lowland raised bogs in the west and the upland raised bogs in the east. They are located in Flanders and the Hautes Fagnes respectively. In this study the focus is on the northern Netherlands and the Peel in the Netherlands, and the Hautes Fagnes in Belgium. The northern Netherlands and the Peel regions were chosen, as they are supposed to be part of the wave of reclamation model of Leenders (2013). The Hautes Fagnes region might also be part of the wave of

reclamation, as its geographical location is in line with the overall trend of the wave of reclamation. A more in-depth description of these study regions is given in chapter 3. Throughout the history of the Low Countries, they have sometimes been united under a single ruler, and sometimes they were divided. This might have had an impact on the intensity of the peat excavation, as well as the availability of historical sources for the different time periods. The political history of the region is discussed in more depth in section 3.1.

3 Peat excavation and reclamation in the Low Countries on a national level

3.1 A simplified view of the political history

The Low Countries, or at least the parts of the Low Countries that are relevant in this study, consist of Belgium, which is subdivided in Flanders and Wallonia, and the Netherlands. The Dutch raised bog areas are subdivided in four regions: Western Noord-Brabant, the Gelderse Vallei, northern Netherlands and the Peel. Throughout the history of the Low Countries, they have sometimes been united under a single ruler, and sometimes they were divided. This was already the case in Roman times, as the southern parts of the Low Countries (up to the great rivers) became part of the Roman Empire after the conquest of Gaul by Caesar in the 50s BC. The regions north of the great rivers were sometimes subdued by the Romans during their campaigns into Germania, but they were never completely under their control (Figure 3).

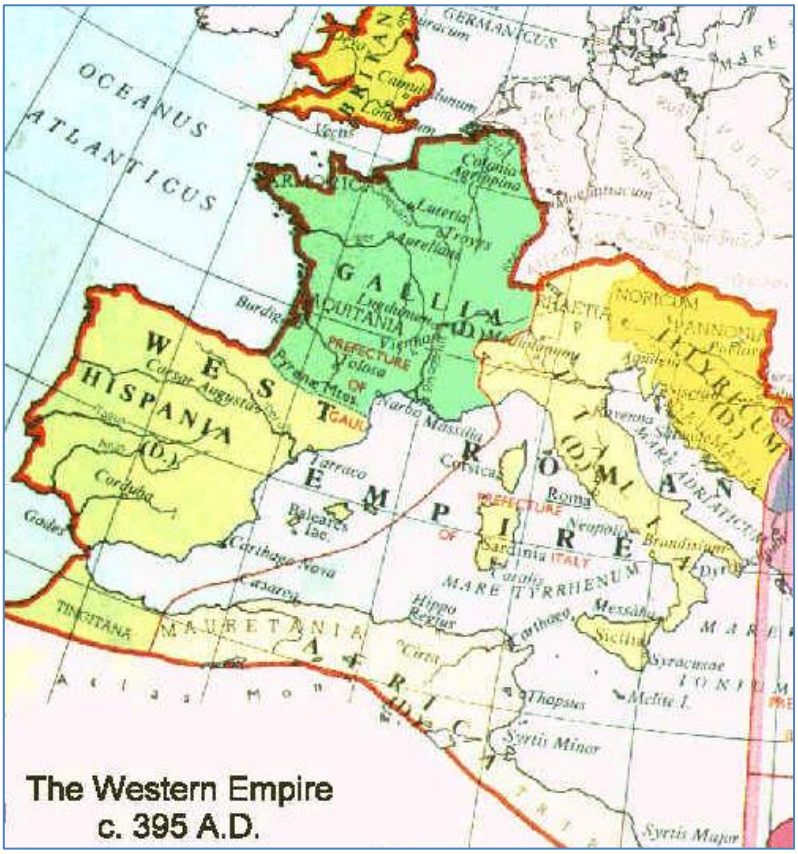

Figure 3: The political situation in and around the Low Countries in 395 AD. Adapted from Muir's Historical Atlas. (1964).

The situation with the Romans remained stable until the fifth century AD, with the crumbling of the Western Roman Empire. This collapse was the result of the relocation of entire populations in Europe. This period is known as the Migration Period. For the Low Countries, this period is an era of flux, of which little is known.

In the centuries after the fall of the Western Roman Empire, the Low Countries were controlled by several German tribes of which the Franks are the most well-known. Eventually, this led to Charlemagne and his successors (Renes, 1999). His reign was one of stability for western Europe. After Charlemagne and his immediate successors, the empire was divided between Charles the Bald and Louis the German (Figure 4),

with the Low Countries being mostly part of the kingdom of Louis. This kingdom would turn into the Holy Roman Empire, which famously consisted of a multitude of smaller states.

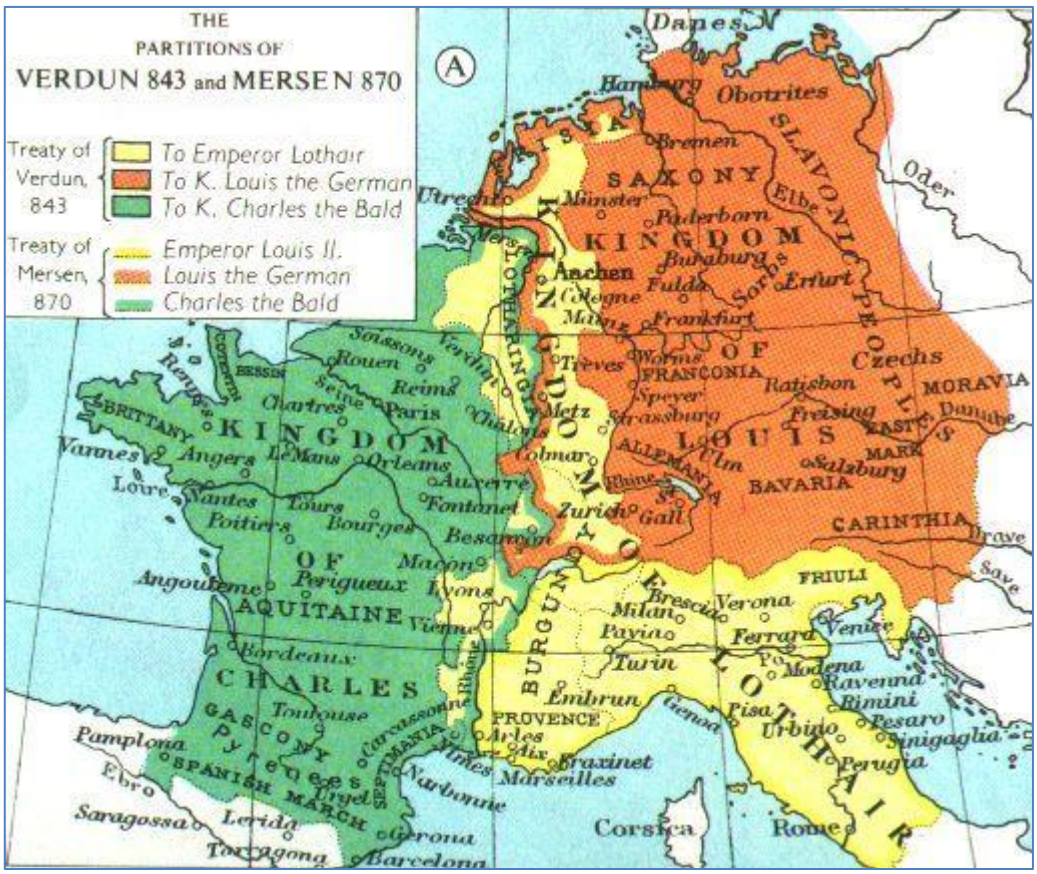

Figure 4: The political situation in and around the Low Countries in 843 and 870. Adapted from Muir's Historical Atlas. (1964)

During the second half of the Middle Ages onward (1000-1500), several smaller fiefs formed in the region due to the fracturing of the Holy Roman Empire. The most important of these fiefs are the diocese of Utrecht, the diocese of Liège, the duchy of Gelre, the duchy of Brabant, the duchy of Luxemburg, the county of Friesland, the county of Holland, and the county of Flanders (Figure 5). These fiefs, combined with several other smaller fiefs, were under the control of the Habsburgs. These fiefs were joined by Philip III (the Good) duke of Burgundy, and Charles V of Spain through conquest and marriages (Sicking, 2013). This meant that in the second half of the sixteenth century the Low Countries were united under one ruler, i.e. Charles V. However, upon his retirement, Charles V gave the Seventeen Provinces to his son Philip II. Philip II failed to connect to the nobles in the Netherlands, and after several attempts at peace failed, the 80-years war commenced in 1568.

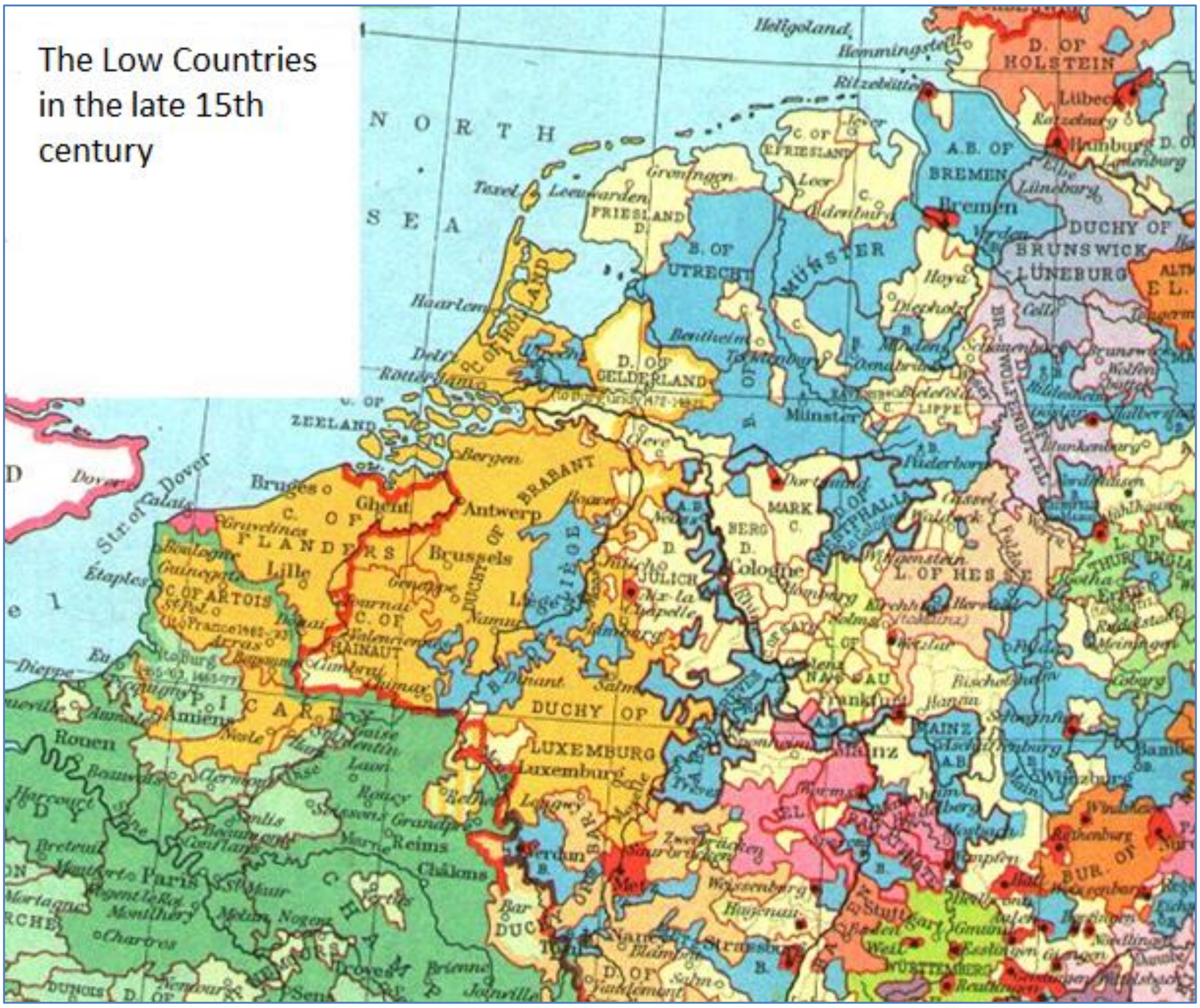

Figure 5: The political situation in the Low Countries in the late 15th century. The current Low Countries consisted of the counties of Flanders, Hainaut, Holland, Artois, the duchies of Luxemburg, Brabant, Gelre, Friesland and the dioceses of Utrecht and Liège. Adapted from Muir's Historical Atlas. (1964)

The 80-years war was a period of instability in the southern and eastern provinces, as war ravaged the countryside (van Nimwegen, 2013b). In the western provinces, this was much less the case, resulting in a booming economy. The 80-years war ended in a stalemate between Spain and the Seven Provinces, with neither able to gain the upper hand. After the peace of Westphalia (1648), the north was officially recognised as an independent republic (the Severn Provinces). The south remained under the control of Spanish kings, and later the dukes of Austria (who were also the Holy Roman emperor at this time; van Nimwegen, 2013a). This was part of the peace of Utrecht in 1715 (Lenders, 1988).

In the eighteenth century, the Netherlands and Belgium were largely at peace. However, the latter half of the eighteenth century was riddled with clashes between republicans and royalists. During this period, Belgium (still under the control of the dukes of Austria) started a revolt, which was backed by Prussia. It is known as the "Brabantse omwenteling", and started in 1789. It would last until the ascension of Leopold II, who made some concessions to the revolutionaries (Defoort, 1965; Lenders, 1988). The classes between republicans and royalists, and the revolution in Belgium, weakened the Seven Provinces. This meant that when war did return to the land in 1795, they were unable to withstand the French. In the period following this conquest, the Low Countries were called the Batavian republic, and their policies were heavily influenced by the French. This would continue throughout the Napoleonic wars (Appendix A). At the peace of Vienna, which concluded the Napoleonic wars, it was decided that the kingdom of the Netherlands would

be established. This kingdom encompassed modern Belgium, Luxembourg and the Netherlands, and would remain until the conclusion of the Belgic revolt of 1839 (Figure 6). After 1839, the modern borders were more or less established, and apart from the World Wars the region remained stable and autonomous.

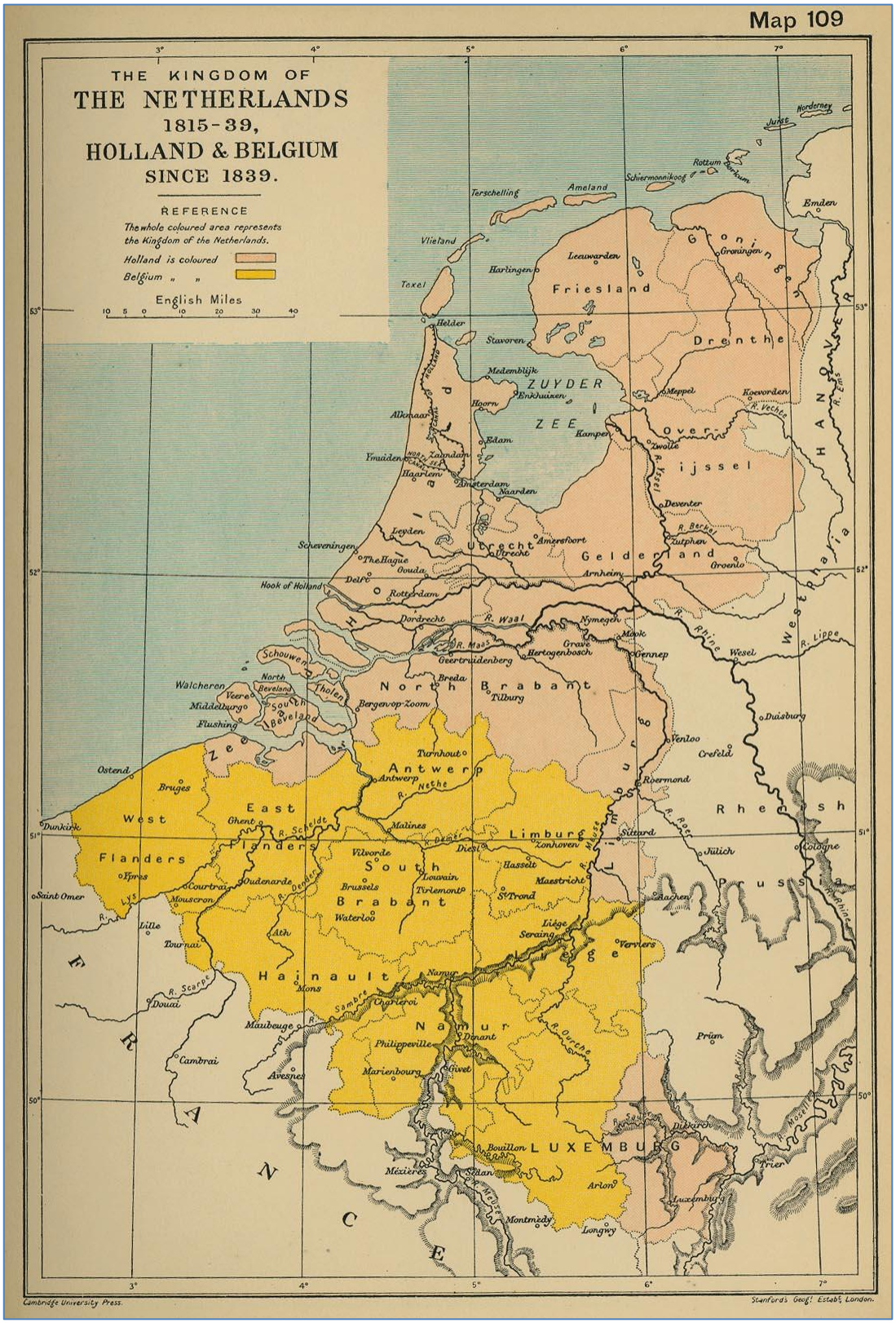

Figure 6: The political situation in the Low Countries between 1815 and 1839. From Ward (1934).

3.2 Geology

At the end of the Younger Dryas (11.000 BC – 9.500 BC; Figure 7), a new era began: the Holocene (9000 BC – 2000 AD). The latter is a warmer period which is currently still ongoing (van de Ven, 2003; Jongmans, 2013). As the ice melted, the sea level rose, which resulted in the coastal plain of the Netherlands. The Holocene sediments that are deposited here are laying directly on the Pleistocene (350.000 BC – 9000 BC) cover sands. In the coastal plain, the lack of relief led to wet spots and swamps where water was able to coalesce. These low-lying Pleistocene valleys and the wet spots in the coastal plain were ideal conditions for the formation of peat bogs (Meijles, 2018). The result of this was the formation of large areas of peat in the coastal regions, especially in Holland and Zeeland (Figure 8; Casparie, 1972; Vos, 2015).

In contrast, we have the areas that were more elevated and where the Holocene sediments were not deposited. These areas are mainly found in the eastern and southern parts of the Netherlands where sedimentation did not occur (Jongmans, 2013). Combined with poor drainage, some of these regions were ideal terrain for the formation of raised peat bogs. These raised bogs are the main focus of this study, and can be found mainly in the parts of the Low Countries that were not affected by the deltas of the Rhine and the Meuse. In general this means that parts of Noord-Brabant and the parts of the northern Netherlands that were not affected by the rivers or the sea were ideally suited for the formation of extended peat bogs.

In the Ardennes, the genesis of the raised bogs was different, as the sea did not play a role. This is due to the genesis of the Ardennes, which formed during the Hercynian orogeny (350 million years ago) and is thus considerably older than parts of the Netherlands (Burg, 1999). A part of the Ardennes is the Hautes Fagnes plateau, which was influenced by the last ice age (Pissart, 2000; Wastiaux, 2003; Demoulin, 2018; van Vliet-Lanoë, 2019). The local depressions in the Hautes Fagnes were formed under the influence of ice during the Younger Dryas. They filled with peat during the early Holocene (around 9.000 BC; Wastiaux, 2003).

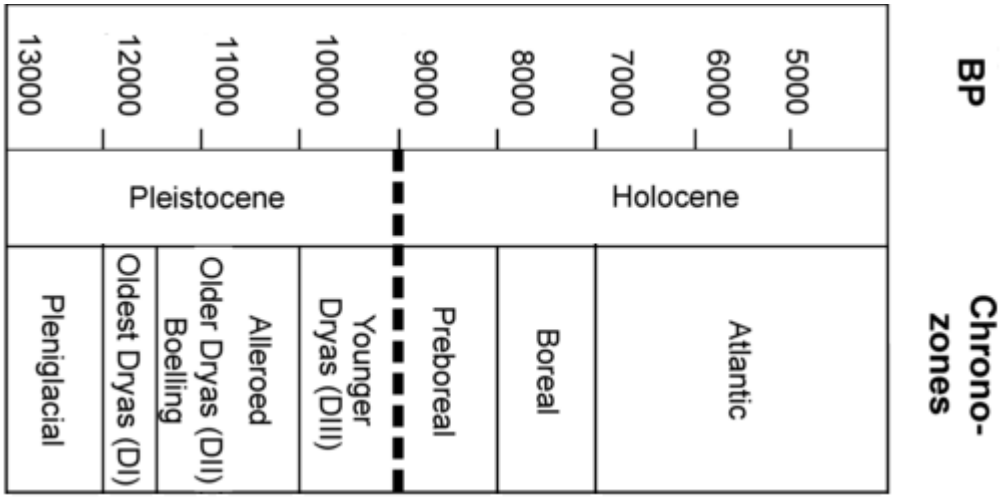

Figure 7: Geological time scale of the last 13.000 years. The years are Before Present (BP). Adapted from Kaiser (2004).

3.3 Archaeology of peat bogs

The archaeology of peat areas consists of several different find types. The most well-known of these finds are the bog bodies, although bog roads and simple artefacts are quite common as well. Furthermore, the best documented cases of peat finds that are relevant for this study are located in the northern Netherlands. This localization can be due to the size of the peat bogs, as well as the timing of its excavation. As the excavation of this region started relatively late, it is likely that the finds would have been mentioned by historical records. It is also more likely that these finds have survived until present day (van der Sanden,

1990). In contrast, while the excavations in the Peel started even later than in the northern Netherlands, hardly any finds have been made.

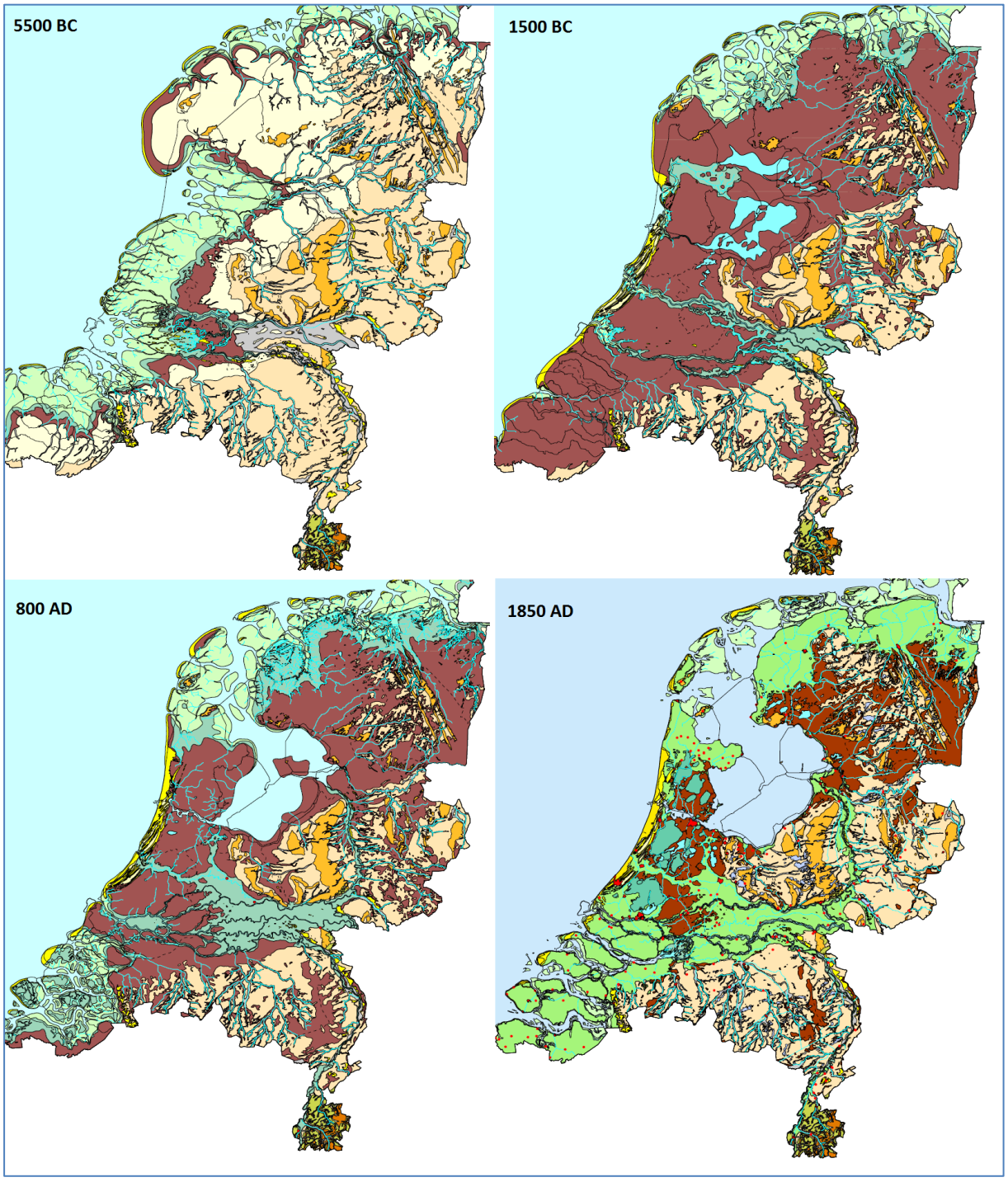

Figure 8: Paleo-geographical maps of the Netherlands, in 5500 BC, 1500 BC, 800 AD, and 1850 AD (Vos, 2013).

3.3.1 Bog bodies

During the Bronze Age (2000 BC - 800 BC), intensive peat excavation and reclamation has been absent, although this does not mean that there were no interactions between humans and bogs. The main excavators are supposedly single farmsteads and small villages who excavated peat for personal use but this has not been proven (de Kok, 1965). The impact of peat bogs on human culture was more pronounced

from the Neolithic until Roman times (4000 BC – 450 AD) compared to the most recent millennium (van der Sanden, 1990).

The first bog body in the Low Countries was discovered in 1791 in Kibbelgaarn (near Veendam, Groningen; van der Sanden, 1990). This was the first of a few dozen known bog bodies in the Low Countries, which were mainly discovered between 1850 and 1950 (van der Sanden, 1990). Beforehand, some bog bodies were mentioned in the newspapers, diaries and the like, but these are not well-documented (van der Sanden, 2013). Two different periods of bog body deposition are distinguished: The first period started in the Bronze Age and lasted until Roman times, while the second period started in the Late Middle Ages (1350-1500) and reached its zenith in the sixteenth and seventeenth century (van der Sanden, 1990). Van der Sanden makes a clear distinction between these two periods. During the latter, bog bodies are supposed to be deposited under different motives (i.e. murder, executions, accidents etc.) than in the former (sacrifice, ritual, etc.). As van der Sanden (1990) mentions, these more recent bog bodies all originate from northern or middle Drenthe and have been dated by their accompanying artefacts. It is interesting to think what might have been the reason for their deposition in the peat bogs, as Christianity had been established for centuries. It might thus be argued that religion did play an important part in their deposition. A counterargument for this reasoning, is that crimes and the peat bogs might have been connected to the devil, leading to the deposition of criminals in the peat bogs. However, this is all conjecture and has not been verified by scientific research as of yet.

The oldest bog body of the Low Countries was discovered in the Emmer-Erfscheiderveen (Drenthe) and is called the “man uit het Emmer-Erfscheiderveen”. It was dated back to in between 1380 BC and 1100 BC. The other bog bodies were all assumed to date back to Roman times, with most of them dating back to around the start of the Christian calendar (van der Sanden, 1990). Most of these bog bodies are assumed to have been deposited in peat through some form of ritual, but this is only speculation (van der Sanden, 2013). The problem with the known bog bodies is that their deposition can be in explained in a variety of different ways. It cannot be excluded that bog bodies may have existed at some point in the Flanders and the Hautes Fagnes peat bogs, although no records remain of them and the bog bodies themselves have been lost to history.

3.3.2 Peat trackways and artefacts

The wooden tracks through the peat bogs are another type of finds in peat bogs. As Casparie (1982, 1987) shows, these tracks can be dated back to at least 2200 BC (the oldest one is the Nieuw-Dordrecht road) and are usually found in the northern parts of the Netherlands. In other regions in the Low Countries, these tracks have not been found as much. Casparie mentions that some indication of a trackway was found between Roodebeek-Sittard. However, this road might have been part of the Roman road and as such does not really deserve to be called a peat trackway. This suggests that there are some tracks through the peat bogs that are quite dubious in their origin, and as such might or might not be peat trackways (Casparie, 1987). According to Casparie (1987) and Ellis (2000), there are also difficulties in the identification of the purpose of wooden planks found in peat bogs. The most common theories suggest that the main usages of the peat trackways are transport and traffic for iron excavation, and for rituals.

Finally, archaeological artefacts have been found in the Low Countries, dating back to the Neolithic at the earliest (van der Sanden, 1990; van der Waals, 2006). These finds indicate that, while the settlements in the Low Countries increased in size and complexity, the number of artefacts increased as well. Examples of the artefacts found are tools, jewellery, and various other items. These artefacts vary greatly in their size and shape, as well as in their age. Therefore, artefacts can be used to determine the age of the layer it was found in and to give an insight in the culture during the corresponding period. The artefacts themselves

also give reason to believe that they were deposited ritually during the Neolithic, the Bronze Age, and Roman times (Fokkens, 2005).

Overall, archaeological studies focus mostly on the northern Netherlands and neglect the other regions. This is due to the number of archaeological finds in the northern Netherlands compared to the Peel and the Hautes Fagnes. As most research has been focussing on the bog bodies and the bog tracks, we do have a relatively clear overview of the knowledge surrounding bog bodies and bog tracks in the northern Netherlands. However, we do lack information about other regions in the Low Countries and other archaeological items.

3.4 Historical peat excavation and reclamation

During the early Middle Ages (between 900 AD and 1100 AD), the reclamations of bogs and fens in the Low Countries were decreasing in elevation due to the exploitation of the land. This was due to the main method of reclamation, which consisted of draining the land to enable cultivation (van de Ven, 2003). The downside of this method is that the peat layer above the water table contracts and oxidises, resulting in a lowered elevation (Erkens, 2015). In the coastal plain, this eventually led to an inability to use the land, as drainage was no longer possible. Another consequence of this method was the increase in floods between 1000 and 1250 AD (Barends, 1986; van de Ven, 2003).

The wave of reclamation model, developed by Leenders (2013; Figure 1), suggests that peat was excavated from different regions during different periods of time. The overall pattern that is suggested by the wave of reclamation model is up for debate in this research, and may also include the Hautes Fagnes (Belgium). Leenders (2013) suggests that up until the High Middle Ages (1250-1400), peat was excavated on a small scale while land reclamation by drainage was prevalent. This is in contrast to the High Middle Ages, when the need for peat increased due to urbanisation and an increase in population (Leenders, 2013). Historical records show that, at the end of the twelfth century, the count of Flanders (Filips van Elzas; Renes, 1983) started an initiative for systematic excavation. Monasteries and hospitals also acquired peat areas for excavation during this period, either for personal use or for the use by local villages (Jongerpier, 2011). In Flanders, the excavation and reclamation of peat bogs led to a decrease in the area covered by peat bogs during the thirteenth century. As the peat coverage decreased, financial inputs were required to be able to keep up the level of peat excavation. With the costs of peat excavation increasing in Flanders, it became financially interesting to look at other regions (van Schaik, 1971; van de Ven, 2003). A second factor that contributed to the shift of peat excavation from the Flanders towards the Netherlands is the urbanisation of the cities in Holland and Utrecht. The rising costs of peat excavation in the Antwerp region led to the excavation of peat in the cheaper western Noord-Brabant area from the 1250s onward. The main reason for this switch was economical and the large amount of easily transportable peat made the initial cost for the infrastructure more acceptable (Schaik, 1971, Leenders, 2013).

After 1600 AD, the western Noord-Brabant area also became more limited in its supply of peat, resulting in an intensification of peat excavation in the Gelderse Vallei region (Stol, 1992). This started in the second half of the sixteenth century (van de Ven, 2003). However, as the Veenendaal area was considerably smaller than the western Noord-Brabant region (Vos et al., 2015), it only took until the middle of the seventeenth century for the Gelderse Vallei region to become mostly exhausted for commercial excavation (Figure 7; Leenders, 2013).

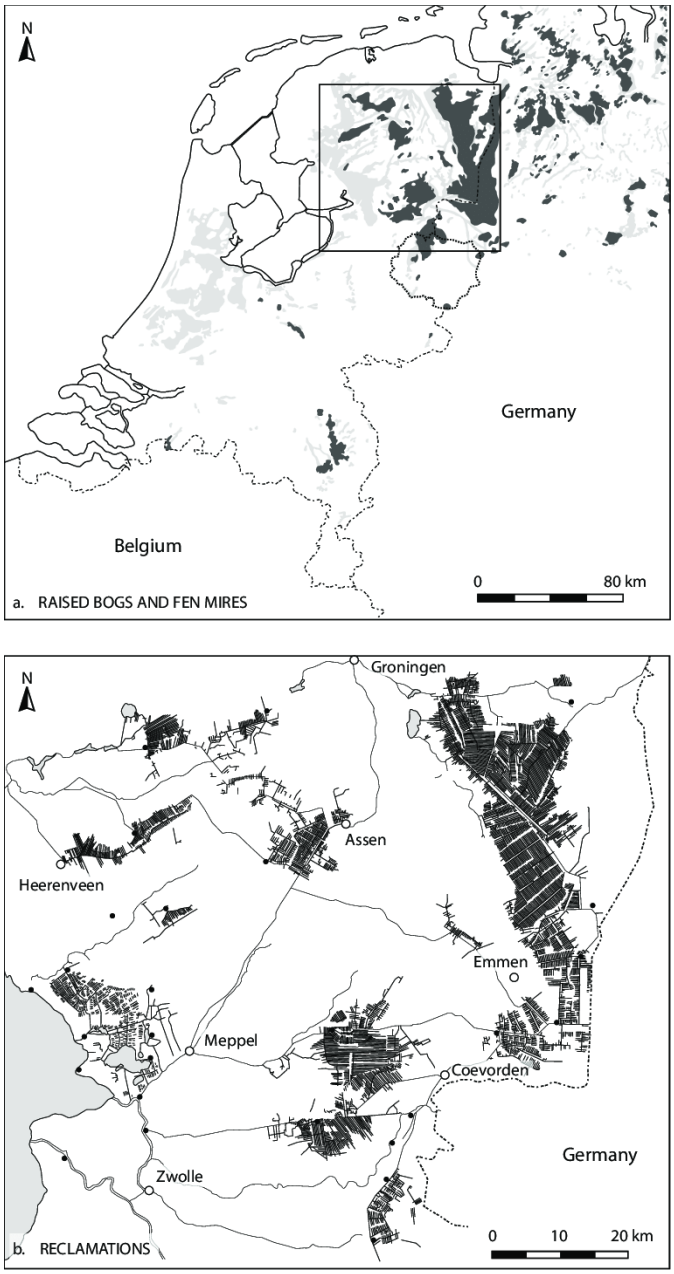

Figure 9: The relict channels of the northern Netherlands. They can be divided in four sections: Frisia, Overijssel, Groningen together with north-eastern Drenthe, and south-eastern Drenthe. The Groningen and north-eastern Drenthe region is located between Groningen and Emmen. The south-eastern Drenthe region is located east of Emmen and Coevorden. (van Beek, 2015c)

From the second half of the seventeenth century onward, the northern Netherlands became more intensively involved in the excavation of peat for the major cities in the western parts (Barends, 1986). The most economically important peat bog in this region is the Bourtanger moor, which used to be the largest continuous ombrotrophic bog in northern Europe (Barkman, 1969). A subdivision of the Bourtanger moor can be made between on one hand north-eastern Drenthe and south-eastern Groningen, and eastern Drenthe on the other hand. (Figure 9; van de Ven, 2003). The main difference between these two regions is the timing of excavation, as north-eastern Drenthe and south-eastern Groningen already underwent intensive excavation in the sixteenth century. In contrast, the eastern Drenthe region was only opened up for excavation in the nineteenth century. As the peat excavation became more mechanised, the amount of peat excavated from the northern Netherlands increased until the twentieth century (Figure 10). On top of the increased excavation in the northern Netherlands, the mechanisation also led to the possible exploitation of the Peel area. This area had always been difficult to excavate as the height and the relief of

the landscape prevented excavated peat to be transported over large distances. It therefore required a dense network of canals before intensive excavation was possible (Gerding, 1995).

Figure 10: The amount of peat excavated in each of the five regions: orange is western Noord-Brabant, grey is Northern Netherlands. Western Noord-Brabant is based on data from Leenders (2013), Northern Netherlands is based on data from Gerding (1995). No comparable data was found for Flanders, the Gelderse Vallei, the Peel, or Hautes Fagnes.

A network of drainage canals was also required for the Hautes Fagnes region, which was partly excavated. As the Hautes Fagnes is located in the Ardennes, the distance to the large cities in the western parts of the Low Countries and the lack of a suitable infrastructure caused the costs of peat excavation to be high (Froment, 1968). Therefore, the level of excavation of these raised bogs has been extensive throughout most of its history. Other reasons for the lack of peat excavation was the small size of the workable population in the Hautes Fagnes, and the abundance of wood. Therefore it wasn't necessary, and even more expensive to excavate peat. It is mentioned in the literature that commercial excavation already occurred in the Hautes Fagnes in the sixteenth century (Froment, 1968), but these excavations were isolated and not comparable to the excavations of western Noord-Brabant. We can only speak of structural excavations in the Hautes Fagnes after the industrial revolution and the resulting industrial development of the Ardennes. However, this ends by the 1960s, as other forms of fuel became preferred. This is comparable to the situation in the Netherlands as the amount of peat excavated decreased drastically after the Second World War. In the Netherlands, the excavation of peat stopped entirely in 1992 (NRC, 2019; Gerding et al., 2015), but some peat moss litter is still being imported from other countries for horticultural purposes.

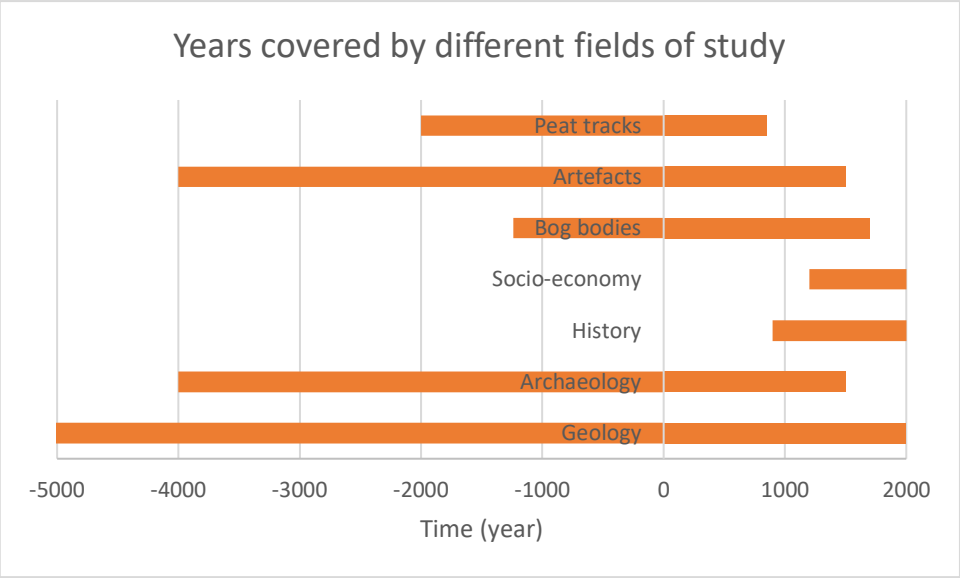

Figure 11: The different phases covered by the different fields of study: Geology, archaeology, history and socio-economy. The three main types of archaeological finds in raised bogs are identified individually, as peat tracks, artefacts and bog bodies.

Overall, the historical sources are abundant for the different regions in the Low Countries. Especially the western Noord-Brabant and the northern Netherlands are quite well covered in the different studies. The amount of peat excavated is not known for Flanders, the Peel and the Hautes Fagnes, but they are available for the western Noord-Brabant and the northern Netherlands (Figure 10). In the same way, the actual advent of intensive peat excavation is not known for certain in the Peel and the Hautes Fagnes. The socio-economic sources are also quite abundant for the more recent times, but they are lacking before the end of the Middle Ages.

The problem with the different cultural-historical sources is that they mostly cover different periods in time. As was shown, the field of archaeology mainly covers a period between 2000 BC and 200 AD. This is in contrast to the historical and socio-economic sources which both cover periods in the most recent millennium (Figure 11). This contrast between the different fields of study ensures that the information of different periods depends on one or two fields of study, while excluding the others. A knowledge gap for all the different fields of studies was also identified. This gap is located in the early Middle Ages. On top of this general gap, there are also gaps for each of the different fields. For archaeology, this gap is found after the Middle Ages. This is surprising as van der Sanden (1990) already mentioned that at least some bog bodies were found that date back to the 16th and 17th centuries. The historical literature starts, depending on the region, in the eighth or ninth century at its earliest. The information on peat bogs that is found at this time is usually very fragmented and focusses on the monasteries. At this point in time, the people of the church were some of the few who were able to read and write. During the middle ages, this information remains fragmented until the establishment of a more centralised government. This establishment occurred at different times in different places. For instance, Flanders was already centralized by the twelfth century, while the Peel would have to wait until the nineteenth century before a semblance of centralized government was established for the Peel as a whole. The same holds for the socio-economical literature, as a centralized government improved the keeping of records. This general trend between the different fields of studies also varies between the different study regions. For instance, Flanders is mentioned considerably earlier in historical and socio-economic sources compared to the Peel or the Hautes Fagnes, which is caused by the intensive (commercial) excavation which started here much earlier than in the Peel (Leenders, 2013) and the Hautes Fagnes (Bouillenne, 1966).

4 The regional view

4.1 Raised bogs in the northern Netherlands

In the northern parts of the Netherlands, one of the greatest raised bogs in north-western Europe once existed. It was called the Bourtanger moor, and was located in the provinces of Groningen and Drenthe. It was used as a natural border between the Netherlands and Germany. In addition to the Bourtanger moor, several other raised bogs could be found in the northern Netherlands. However, since the sixteenth century large swaths of raised bogs have been excavated (Figure 12).

4.1.1 A brief overview of the archaeological finds

Most of the more notable peat finds in the Low Countries were found in the northern Netherlands, with most of them originating from Groningen and Drenthe. These finds consist of bog bodies, peat trackways and archaeological artefacts. The bog bodies are only documented well in Groningen and Drenthe, and are completely missing from the other regions in the Netherlands (van der Sanden, 1990). Even in Groningen and Drenthe, the amount of information available for each bog body is limited. This is mainly caused by the second hand accounts, and in some cases by the lack of actual body. However, there are also a few bog bodies that have been studied intensively and are well-documented. Examples of these bog bodies are the bodies that are now on display in the museum of Drenthe: the girl of Yde, the pair of Weerdinge, the man of Exloërmond, the skeleton of Aschbroeken, and the Juffer of Zweelo.

The trackways in Groningen and Drenthe were already touched upon in Chapter 3. In addition to those trackways, Casparie (1987) also mentions several other trackways in the northern Netherlands. In Overijssel, some proof has been found for the presence for peat trackways. The clearest trackways were found in the eastern parts of Overijssel, in and around the Vriezenveen region (Casparie, 1987). Even these cases have not been identified as peat trackways without a shadow of a doubt. Others may have been found in other parts of Overijssel but these have not been properly documented. The bog trackways in question are located in the north of Overijssel, near the border with Drenthe. The first one is a wooden trackway that runs from the Steenwijksmoer towards Coevorden. The second one is a wooden footpath that runs near Coevorden, and the third one is a footpath in the Zuidwolde area. According to Casparie (1987), the second trackway was built in 1536 to enable Georg Schenck, general of Charles V, in bringing his artillery to Coevorden.

Apart from these three trackways close to the border of Overijssel and Drenthe, two trackways are mentioned by Casparie (1987) that are located near Vriezenveen in the Engbertsdijksveen. The first is a wooden trackway that is located to the north of Vriezenveen. As no remains of this trackway have survived to the present, the actual existence of this trackway is questionable. The second trackway is a wooden one, dating back to 165 ±30 BC. Although there is no certainty, this trackway may have been the continuation of the first trackway.

The archaeological artefacts that were found in the raised bogs of the northern Netherlands can be divided between the Neolithic finds, the Bronze Age finds, Roman finds (Wentink, 2006). In the northern Netherlands, the first two are most prevalent, while finds from the Roman period are much less present. This would be logical, as the Romans never settled in the northern Netherlands. Therefore, the only way in which Roman artefacts could be present in this region is through trade between the Romans and the local population (Frisians, Batavians, and various other tribes). This is in stark contrast to the Neolithic and Bronze Age finds, which were made and deposited in the raised bog (accidental or not) by people who actually lived in the region. No evidence has been put forward as of yet that humans actually settled on the peat, but they most certainly lived on the higher sand-ridges from time to time.

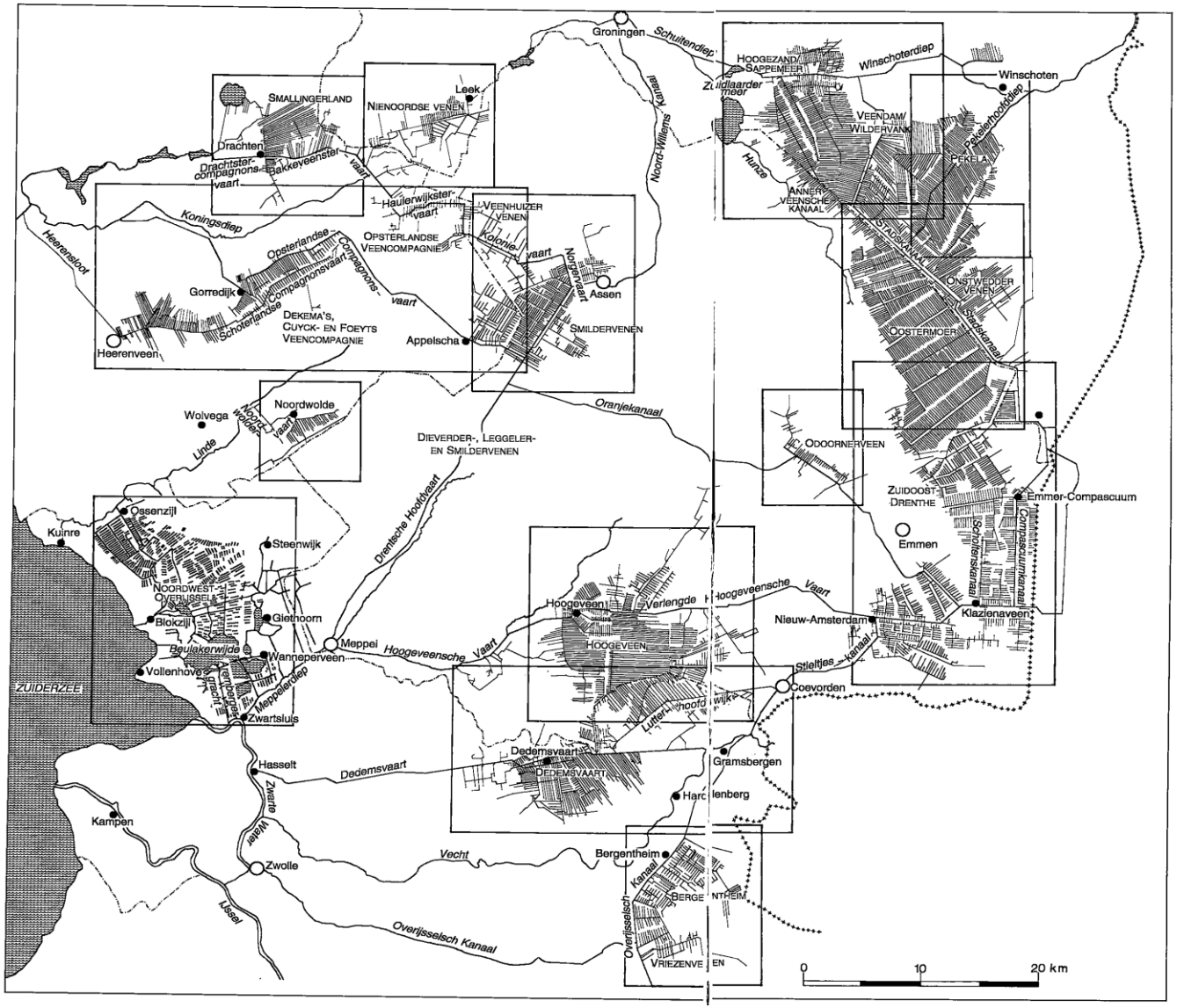

Figure 12: The raised bogs in the northern Netherlands, divided in different subregions. The Vriezenveen and Veendam microregions are located in the northeast and the south, respectively (Gerding 1995).

4.1.2 History

The peat bogs in the northern Netherlands are usually subdivided in four different areas: Overijssel, Groningen and north-eastern Drenthe, south-eastern Drenthe, and Frisia. Each of these regions has had a slightly different history. Therefore, we cannot really speak of the start of the excavation of peat in the northern Netherlands in general. However, several things can be found that are equal for the different areas. After the Romans left the southern half of the Netherlands (±410 AD), writings about the northern Netherlands became noticeably absent from the historical record. It would take until the region was christened in the eighth century before historical records are found again in the northern Netherlands. However, even during the first five centuries of the new millennium, not much is known about the region, and apart from some extensive excavation by the local population no indications for excavation have been found. The first excavations in the raised bogs were near the Hunze, where excavations started in the thirteenth century (Groenewoudt, 2012). The most common way to excavate peat was to use a radiative form of progression. The same method would be used for the reclamation in this region, which occurred alongside the peat excavation. This form of peat excavation and reclamation was also present in the Friesland region, where mounds were used as the centre of these radiative excavations (Gerding, 1995).

During the 80-years war, the Groningse Ommelanden sided with the Republic of the Netherlands from the very start onward. This is in contrast to the city of Groningen itself, which sided initially with the Spanish Crown. This contrast between the city and the countryside was caused by religion as the countryside was dominantly Protestant. In the city, this was more complicated, as the poor were attached to their Catholic believes, while the wealthier citizens were more worried about the economic depression of their city. Due to these complications, it took until 1594 and the conquest of Groningen by Maurits of Orange before the Northern Netherlands were united under the Republican banner (van Nimwegen, 2013a). An immediate consequence of this was that the stability of the region was re-established. Combined with investments from Holland and Utrecht, this lead to an increase in excavated peat. At this point in time, it is not possible to be determined as anything more than local excavation with export, but the signs are present that slowly the excavation of peat becomes more commercialised (Gerding, 1995). This increase would continue until the economic crisis during the latter half of the seventeenth and the first half of the eighteenth century. In the second half of the eighteenth century a second wave of exploring the raised bogs was started, with Drenthe as its main focus (Gerding, 1995; Voerman, 2001).

In Overijssel, the intensive excavations started around the sixteenth century, and with the introduction of the dredging bracket, in 1751, the amount of peat that was excavated by individuals increased (Gerding, 1995). It was now viable for excavators to sell some of their excavated turf.

With commercial peat excavation also came reclamation to the excavated area. The reclamation of soil required either the white peat layer to be mixed with the subsoil or a lot of fertiliser. Until the introduction of other forms of fertiliser, it was a scarce commodity (Coolen, 1877; Voerman, 2001). This forced the area of reclamations to remain limited to what could be fertilised by manure and human waste from the cities. Especially in the northern Netherlands where many plots of land became available, this was a major issue (Schaik, 1969; Gerding, 1995). Most of the excavated area was therefore not reclaimed immediately. While this was mostly the case close to Groningen, as these soils were first to be excavated, the problem extended to the entire northern Netherlands.

After north-eastern Drenthe, Groningen, and Overijssel were all at least partly excavated, the only raised bog that was mostly untouched was the Bourtanger Moor in eastern Drenthe. It was only commercially excavated after the opening of the Eems canal under the guidance of King Willem I (van der Ven, 2003). This intervention by the King was needed as the nine villages in Drenthe who would benefit the most from this canal could not reach an agreement with the province of Groningen. After this agreement was reached

in 1819, the commercial excavation in this region started quickly, and would remain present until the last commercial excavation in 1992 in Klazienaveen. The ending of peat excavation in the other parts of the northern Netherlands varies greatly, but in general the commercial peat excavation stopped completely after the Second World War. This did not come as a surprise as the peat excavation in the northern Netherlands had been on the decline since the second half of the nineteenth century (Schaik, 1969; Gerding, 1995). This decline was caused by several factors, such as the competition with coal, an agricultural crisis between 1878 and 1895, and in 1902 the mines in Limburg started to produce coal at a competitive level. In the end, only a fraction of the original raised bogs remained in 1992. Most of the remaining peat can be found in the Bargerveen, which has become a nature reserve (Gerding, 2015).

4.1.3 Social economics

In general, the northern Netherlands have been used as a peat excavation region for several centuries. With the first mention of peat excavation in raised bogs, in the twelfth century, and the lack of a centralized government, it should come as no surprise that monasteries had a hand in these first excavations. After all, the monasteries had the capital and influence to excavate the raised bogs more effectively than individual excavators. However, already in the thirteenth century, the city of Groningen is mentioned as exploiting the raised bog. These excavations were undertaken by the wealthier population of the city, as they required money up front, but could result in profit (Schaik, 1969).

The urban areas in Overijssel can be divided in the western part including Zwolle, Kampen and Steenwijk, and the eastern part including Almelo, Hengelo and Enschede. These regions have developed in different ways, with the western part already being dominant in the Middle Ages. This was due to the Hanze trade, which connected the towns on the Ijssel with several German cities and even the Baltics. This connectivity also made these cities wealthy, until their trade was taken over by the cities in Holland. These cities in Holland used the capital that they acquired to invest in the peat excavations of the Groningen, Drenthe and eastern Overijssel. This was the next step, after the investors of the city of Groningen had already made the first inroads in the raised bogs. These investors saw the peat excavations as an opportunity for a safe but slow profit. During this period (the sixteenth and seventeenth century), the amount of peat excavated increased rapidly, due to these investments (Schaik, 1969; Gerding, 1995). As the stability of the region returned after the 80-years war, the amount of peat that was excavated in the region around the city of Groningen reached commercial levels. After all the investments, the infrastructure was in place for a rapid colonisation of the raised bogs on the border between Groningen and Drenthe. The “Veenkoloniën” (peat colonies) are characterized by the formation of its villages. These villages are formed alongside a canal and moved periodically, together with the centre of peat excavation. The peat that was excavated was transported over the canal. This is called the Groningen method (Joosten, 1992). During the eighteenth and nineteenth centuries, the “Veenkoloniën” would slowly expand, as the peat excavation in the region expanded. The older and more centrally placed peat colonies such as Veendam would become small centres of themselves, resulting in a network of connected hubs throughout the excavations (Voerman, 2001; Kooij, 2010).

The wealth would grow even more with the introduction of the “baggerbeugel” (dredging bracket). The dredging bracket was introduced in the Groningen and Friesland by peat excavators from Overijssel in 1751. This is considerably later than in the western and southern parts of the Netherlands, and was caused by the prominence of raised bogs in the northern Netherlands, which can be drained and excavated easily (van de Ven, 2003). After the excavation of the peat layer, the Pleistocene sand layer surfaced. These Pleistocene sands could then be used for agriculture.

The commercial excavation in the northern Netherlands would hit a few snags in the nineteenth century, with the increasing competition with coal throughout the century, the opening of the mines in Limburg in

1902 and the agricultural crises between 1878 and 1895 (Schaik, 1969; Wintle, 2000). The effects were compounded by the competition with the newly opened Peel region in the south, and the fast rise of wages in the first decade of the twentieth century. Even though the Great War was a highpoint for peat, as it was no longer possible to import coal, the downward trend was not stopped. The last great year for peat was 1920, after which an economic crisis caused by overproduction destroyed many peat excavation companies (Gerding, 1995).

Even though the peat excavation was having problems in the second half of the nineteenth century, this was also the period in which artificial fertiliser was invented. So while the peat excavation was decreasing, the area of reclaimed land increased drastically (Schaik, 1971).

In the 1920s, the Dutch government decided to subsidise peat, which ensured that it would be financially viable. However, the economic crash of 1929 ensured that the peat excavation companies would rely on the subsidies of the government. So, when in 1950 the ministry of Economic Affairs stopped the subsidies on peat, many excavators stopped or went out of business (Gerding, 1995). In the following decades, 90% of the remaining people that worked in the peat industry focussed on peat litter factories. The end for peat excavations came in 1992 with the closure of the peat excavation company at Klazienaveen (NRC, 1992).

4.2 Raised bogs in the Peel

The Peel region is located on the border between Noord-Brabant and Limburg. Before excavation started, it used to be one of the least accessible regions of the Netherlands. Combined with the natural defence that it gave to the Netherlands, as the region was difficult to traverse, it was one of the last regions to be excavated.

4.2.1 Archaeological finds

Surprisingly, not a lot of finds have been discovered in the Peel, despite intensive excavations in the region as late as the nineteenth century. This is especially striking considering the many archaeological finds northern Netherlands, some of which was already excavated as early as the 1500s (Gerding, 1995). One would assume time would be on our side here. Joosten (1989) mentions that only a quarter of the original peat bog area remained by the time commercial excavation commenced in the nineteenth century. A possible and likely explanation for the few finds in the Peel is any finds hidden in the peat removed by local excavations were lost in the process (Wentink, 2006).

One find does stand out, however, and that is the famous Roman horseman, although it is unclear how he came to be deposited in the peat bog (van der Sanden, 1990). This find consists of a variety of artefacts like a silver helmet, two bronze clocks and four leather shoes. There are also supposed to have been human remains. It was assumed that a Roman officer and his horse drowned here in full regalia. However, the human remains that were found were not mentioned in the original sources, although they appear in a letter from a German named Kholgruber. The problem with this letter consists of various unknowns; the expertise of this person is unknown, it is unknown whether he actually visited the site, and it is unknown whether he had the required experience to identify human remains from peat bogs. As there are many questions surrounding this particular find, van der Sanden (1990) does not include it in his catalogue of bog bodies.

4.2.2 History

In the Peel region, the first mention of peat excavation, although it may have been extensive excavation, dates back to 1427 (Joosten, 1989). This was when Willem, the “graaf van Horne”, gave a Claes Bormans of Baecxem the right to excavate peat in the municipality of Nederweert. In the centuries that followed, no other indications for peat excavation or reclamation were found. However, Joosten (1989) and Schaminée,

(2012) mention that the amount of peat in this region was already diminished by the nineteenth century. The amount of peat remaining might have been as little as a quarter of the original peat bog. While this may have been enough to sustain the living raised bog, the amount of peat remaining was thus severely diminished by the time of commercial excavation in the Peel region. Hollenberg (1980) also mentions an impressive urge for reclamation in the Peel region during the French period (1795-1815). After 1815 the urge for excavation and reclamation would not restart until 1840 (Hollenberg, 1980).

However, it would take until 1853 and the founding of the Helenaveen before we can really speak of intensive or commercial excavation. This late opening of the peat bogs in the Peel was caused by the distance to the large cities in the western parts of the Netherlands as well as the lack of infrastructure. With the opening of the Zuid-Willemsvaart in 1826 and the introduction of industrial equipment, peat could be excavated cheaper and transported easier towards the large cities in the western Netherlands (van de Ven, 2003; Vermeer, 1992).

Compared to the northern Netherlands, the main problem of the Peel region was that this region was relatively poor, and was thus not able to excavate the raised bogs and reclaim some of the soil. This is also why, while in the second half of the eighteenth century the population of Europe grew and the food demand rose, it was impossible for this region to benefit from excavations and reclamations. (Hollenberg, 1980)

The start of the commercial peat excavation in Helenaveen in 1853 was the start sign for a rapid increase in the amount of excavated peat over the next years. This led to the foundation of Griendtsveen (north of Helenaveen) and the start of peat excavation by the municipality of Deurne (located to the west of Helenaveen and Griendtsveen). At first, this was only the black peat, which resulted in the white peat being deposited directly on top of the subsoil. These soils became the only soils that would retain their white peat layer, as from 1883 onward the white peat layer was removed alongside the black peat, and processed into peat litter. It is mentioned by Hollenberg (1980) that in 1918 only 250 ha still retained a substantial white peat layer of 80 to 90 centimetre. These were the soils that were excavated in Helenaveen before 1883 and are among the best in Noord-Brabant. About 3000 ha of the area covered by peat bogs has lost its white peat layer between 1883 and 1912. These soils are nowadays found in national parks. This is partly because they are not suitable for reclamation in any form without copious amounts of fertiliser (Thissen, 1993).

Overall, the history of commercial peat excavation and reclamation in the Peel is brief, as the amount of peat excavated rose quickly through the second half of the nineteenth century, but also dropped quickly. This was the result of several economic crises that hit the peat excavation industry and the peat litter industry hard, like the agricultural economic crises between 1880 and 1900, and the agricultural crisis between 1878 and 1895 (Schaik, 1969; Thissen, 1993; Wintle, 2000).

4.2.3 Socio-economics

The Peel region used to be considered a minor area of peat excavation due to its location (Schaminée, 2012). The location between Noord-Brabant and Limburg caused it to be an area of contention between the Dutch Republic (Batavian republic), France, and the Holy Roman Empire (Figure 4), which is one of the reasons that the Peel has a small population (. The small population did use the peat layers in the area for their own use. This also led to the aforementioned decrease in the overall raised bog area in the Peel. However, the peat areas were not excavated commercially (intensively) until the nineteenth century. The lack of workable population and infrastructure was the main cause behind this lack of excavation. When the Peel was a main source of peat, it excavated most of its white peat layer. This caused problems with the reclamation of the soils after the excavation was complete, as the white peat layer could not be used as improvement for the soil.

During the period of peat excavation, there were also some positive points, namely that the infrastructure of the region was improved drastically. Apart from the Helenavaart, which facilitated the transport of peat, the region was finally connected to the train network. This opened the region up even more, but resulted in several problems between the local population and the outsiders that came to the Peel looking for free, or at least cheap land. This relates to the rule that if a person improved on the land, it came into his possession. Examples of the villages that instated this rule were the villages of Boekel and Bakel, who instated the rule in the 1860s (Hollenberg, 1980). In the end, the different municipalities put a limit on the amount of land per person, and required them to work for a certain period of time on the land before they could call it their own. (Thissen, 1993).

4.3 Raised bogs in the Hautes Fagnes

The Hautes Fagnes is a region in the Ardennes in Belgium. It is located in the southern half of the country, Wallonia, to the east of Liège. The formation of the peat layer in the Hautes Fagnes occurred during the same time as the raised bogs in the Netherlands, i.e. during the Preboreal (Figure 7; between 9400 and 8100 BC; Wastiaux, 2003). Nowadays, the Hautes Fagnes consists of about a dozen larger and smaller raised bogs scattered around the landscape (Figure 13).

4.3.1 Archaeological finds

In the Hautes Fagnes, a couple of peat trackways have been discovered (Nekrassoff, 2018). The first trackway was discovered in 1768 and ran between Eupen and Sourbrodt (Streel, 2007). It was believed to be Roman, until carbon dating brought that date forward to the Merovingian age (between 460 AD and 885 AD). It was supposedly used for the transport of lead-zinc ores from Germany to Trier, which was an important metal working centre during this period (Streel, 2007). Other than this peat trackway and some artefacts from the Neolithicum and the Bronze Age, no archaeological finds have been mentioned in the literature for the Hautes Fagnes.

4.3.2 History

The Hautes Fagnes region is one of the worst regions for agriculture in Belgium due to its climate, the rough terrain, the mediocrity of the soils and the isolation of the region (Froment, 1968). In this region, the amount of peat excavated is fairly limited, seeing as the population was small and peat was not exported to other regions like in the northern Netherlands and the Peel. Another factor that contributed to the lack of peat excavation was the abundance of forests in the higher parts of the Hautes Fagnes (Bouillenne, 1966). As trees are easier to use for fuel compared to peat, it was cheaper to use wood for fuel instead of peat. Thus, the raised bogs in the nineteenth century in the Hautes Fagnes were relatively untouched, compared to the raised bogs in the Netherlands. However, this would end by the last decades of the nineteenth century, as overexploitation and poor management led to a poor state of the forests. The result was a shortage of wood. This was solved by the reclamation of raised bogs, which would then be planted with trees, mostly spruce (Aletsee, 2010).

The decrease of the bogs in the Hautes Fagnes is visualised by the map of Ferraris (for more information, see Vervust, 2016 and De Coene, 2013), which shows that the area covered with peat bogs used to be larger than at present by quite a margin. On the map of Ferraris, the Hautes Fagnes is shown as a continues peat bog, while nowadays only a dozen or so small bogs and fens remain in the valleys of the Hautes Fagnes. However, the problem with this map, is that no distinction has been made between raised bogs and fens.

The first mention of excavation in the Hautes Fagnes dates from the sixteenth century (Bastin, 1939), and Bouillenne (1966) and Robert (1963) for instance, mention the eighteenth century as the start of peat excavations in the Hautes Fagnes. These dates are not really based on archival evidence but on accounts

from locals, and therefore cannot be verified anymore. However, if these statements were to be true, the amount of peat excavated would only reach a significant level (i.e. local excavation with export) in the nineteenth century. Before this point in time, we can see that only extensive peat excavation occurs in the form of pyramids (Bouillenne, 1966). These pyramids are formed of the bricks of peat that are drying in the sun, a method that was still being used in the 1960s. This changed as the Hautes Fagnes became part of the Hautes Fagnes-Eifel Nature Park, in 1966. Between 1800 and 1966, a significant portion of the raised bogs was excavated. However, as the infrastructure in this region is lacking, and the drainage ditches are not of the scale that would suggest commercial peat excavation, it can be suggested that most of the peat was excavated by either extensive, or local excavation with export. Apart from the excavation of the peat bogs, many fens and bogs were drained and reclaimed for forestry (Bouillenne, 1966; Aletsee, 2010).

4.3.3 Socio-economics

The Hautes Fagnes was not hit as hard by the economic crises that impacted the peat excavation in the northern Netherlands and the Peel regions, as the Hautes Fagnes does not appear to have had a form of commercial excavation. Before the start of the nineteenth century, the region was used for wood, and probably peat on a local level. The lack of meaningful infrastructure limited the options of the people that lived here. As more land was reclaimed throughout the nineteenth century, more land was used for forestry. The wood was used for both fuel and the mines in Limburg and Belgium (Thissen, 1993). The forestry is still happening to this day, but on a limited scale.

4.4 The choice of the microregions

After having determined the progression of peat excavation in the three regions, we can now determine which microregions are to be selected for the next research question: *What are the variations in land use development of raised bogs within the northern Netherlands, the Peel and the Hautes Fagnes (Belgium)?*

For the northern Netherlands, the Veendam and Vriezenveen regions were chosen. The Veendam region was chosen due to its importance to the city of Groningen. On top of this connection, the city of Veendam is also one of the oldest peat colonies. The Vriezenveen region was chosen for the amount of available literature as well as its location on the opposite side of the northern Netherlands, compared to Veendam. In the Peel region, we have chosen to look at the Helenaveen and the Bakel regions. The Helenaveen region was the first to be commercially excavated in the Peel region, and the available literature suggests that it was the most accessible of the various regions. The village of Bakel is one of the oldest cities in Noord-Brabant as well as one of the cities that was directly involved in the partitioning of the raised bogs in the region.

The Hautes Fagnes region has, as was mentioned before, not been excavated commercially for any length of time. However, the region has been exploited commercially, especially for forestry. One of the chosen regions is the Fagne de Clefay which is one of the regions to the south-eastern part of the Hautes Fagnes. It is located between two mountains and is one of the better documented raised bogs in the Hautes Fagnes. The other microregion that was chosen is the Brackvenn, which is located in the north-eastern part of the Hautes Fagnes, near the German border. It was also chosen for the availability of relevant literature, but also as a geographical opposition to the Fagne de Clefay. In the next chapter (Chapter 5), these microregions are discussed in detail.

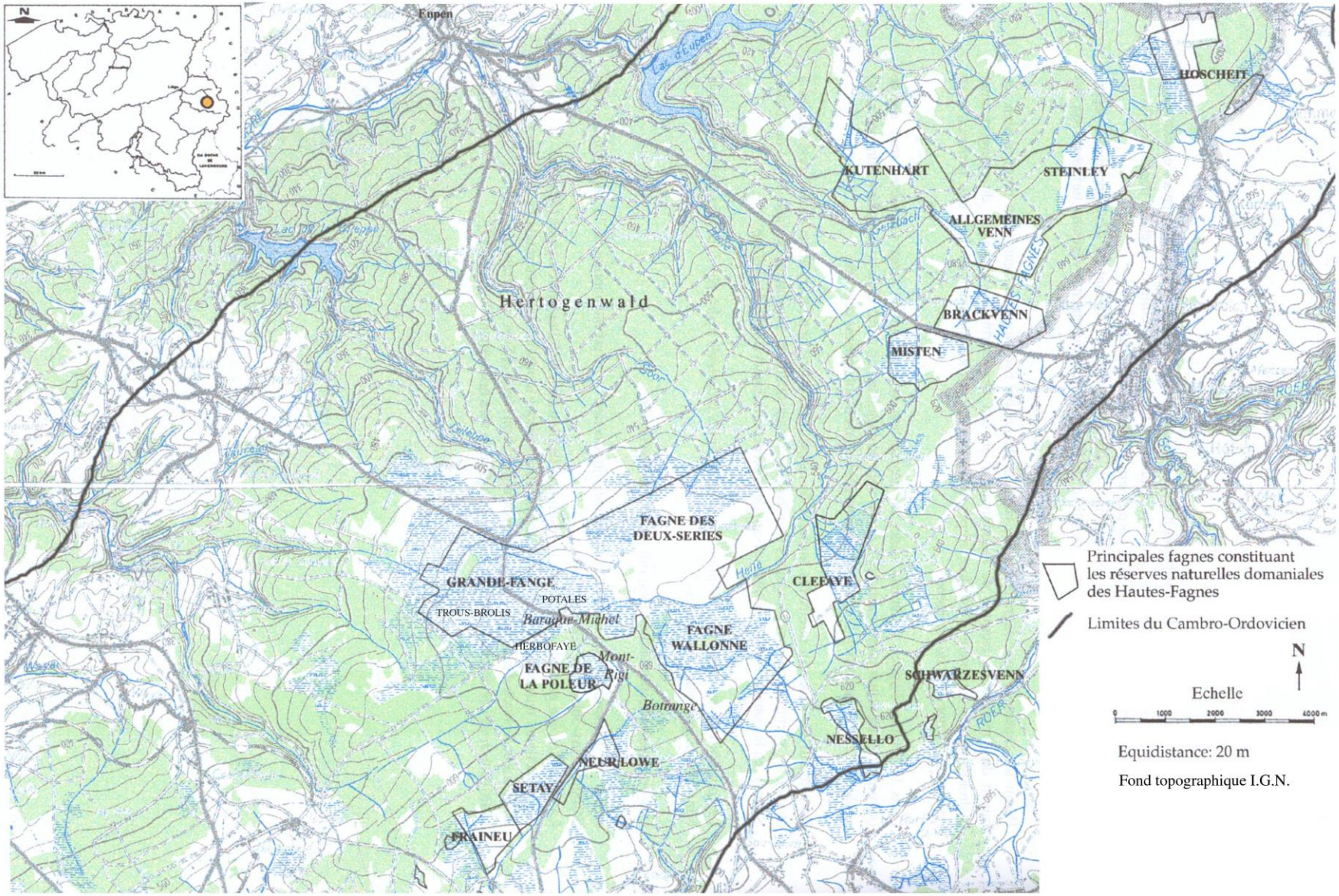

Figure 13: The modern extent of the peat bogs in the Hautes Fagnes (Wastiaux, 2003)

5 The microregions

5.1 The microregions of the northern Netherlands

The chosen microregions are Vriezenveen and Veendam. Vriezenveen is located in the north-eastern corner of the Overijssel province, close to the border with Drenthe. Veendam is located more to the north in the province of Groningen. It is located just south of the city of Groningen and is very close to the border with Drenthe (Figure 12).

5.1.1. Vriezenveen

Reclamation, peat-cutting, building work and archaeological research have produced just over 200 archaeological sites in the Vriezenveen region. This dataset is biased in several ways. Archaeological activity has been limited, partly because relatively little construction work has been carried out in this sparsely populated area. Hardly any large-scale excavations have taken place. Furthermore, the bog reclamation history has affected the composition of the dataset and site distribution patterns (van Beek, 2015b). Even though this means that a bias is present in the available archaeological data, the archaeological finds may still yield valid insights in the relations between the humans and raised bogs. On top of the two trackways that were located north of the town of Vriezenveen (section 4.1.1), quite a large number of both stone/flint and bronze archaeological finds have been discovered. These finds vary greatly in size, shape and date of deposition. It is currently unknown what the motivations behind their actions were, but the current theories range from accidental to ritual sacrifice (van der Sanden, 1990).

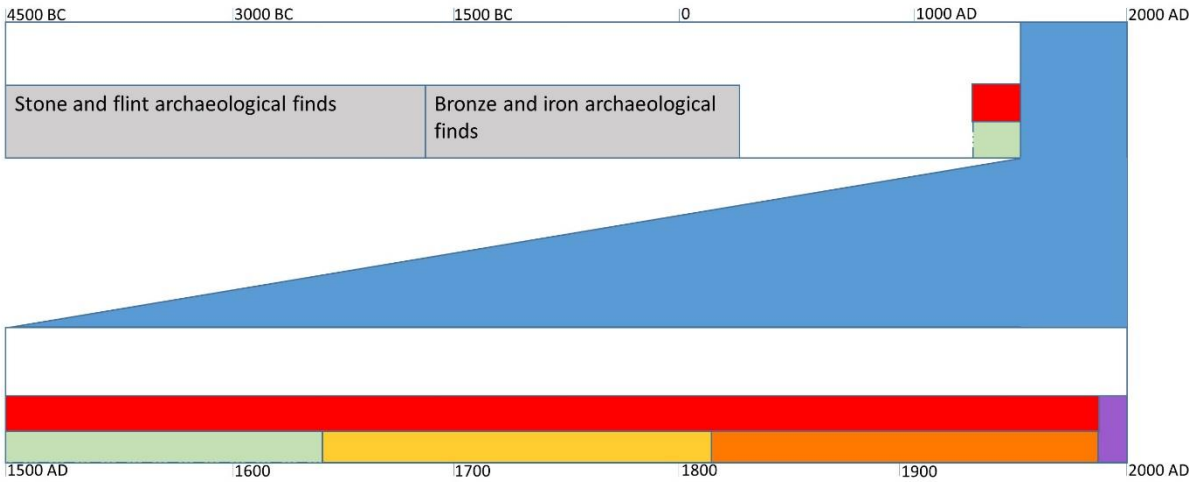

Figure 14: Archaeological finds, peat excavation and reclamation during the last 6500 years around the village of Vriezenveen. The years 1500AD – 2000AD have been zoomed in on. Green is the period of extensive excavation; gold is the period of local excavation with export; orange is the period of intensive excavation; red is the period of reclamation; and purple is the period of the national park.

The reclamation in the Vriezenveen region started in the late twelfth century or the beginning of the thirteenth century under the guidance of the lords of Almelo. The Almelose Aa was the starting point of these first reclamations (van Beek, 2015b). However, it would take until the middle of the seventeenth century before any indication of the export of turf from Vriezenveen is substantiated (Gerding, 1995). The peat was excavated in the area north of Vriezenveen, transported over the Schipsloot towards the northeast and then sold at the so-called Superpluus, which belonged to the lords of Almelo. However, as this is still localised, this is still part of the period with local excavation with export. The commercial peat excavation with export to other regions would not start until 1810 (Figure 14; Gerding, 1995). A noteworthy

fact is the opening of a trade route over land between Vriezenveen and St. Petersburg (Russia) in the early eighteenth century. This trade route mainly focussed on linen, and while this did not affect the peat excavation directly, it would increase the wealth in the region (de Bont, 2004).

An extra impulse for the peat excavation in the region surrounding Vriezenveen was the digging of the "Overijssels kanaal", which opened in 1856. The canal connected the Schipsloot to the Vecht. The opening of the "Overijssels kanaal" also gave Vriezenveen access to the Ijssel, and thus also to the wider world. This improvement of the infrastructure ensured that the raised bogs (of about 16.000 ha in total) could be excavated much faster, and the turf could be transported to a much larger market. As the raised bog north of Vriezenveen was excavated, the distance between the raised bog and the town of Vriezenveen increased. To combat this process, the town of Vriezenveen was relocated at three times between the twelfth and the seventeenth century (van Beek, 2015b; Figure 15). The long but narrow parcels that were the result of the peat excavation in this period can still be seen on maps, as the canals that were dug alongside these parcels are shown in the elevation map of the area around Vriezenveen (Figure 16). The commercial level of peat excavation did not last and started to decline from 1880 onward (van Zanden, 1985). This decrease in peat excavation is due to the financial crises that plagued the last two decades of the nineteenth century (Gerding, 1995). After the peat excavation had ceased in the region around Vriezenveen, the remaining raised bogs were bought by Staatsbosbeheer in 1953, and were eventually declared part of the Natura 2000 program in 1992 (Natura2000, 2019; Figure 14).

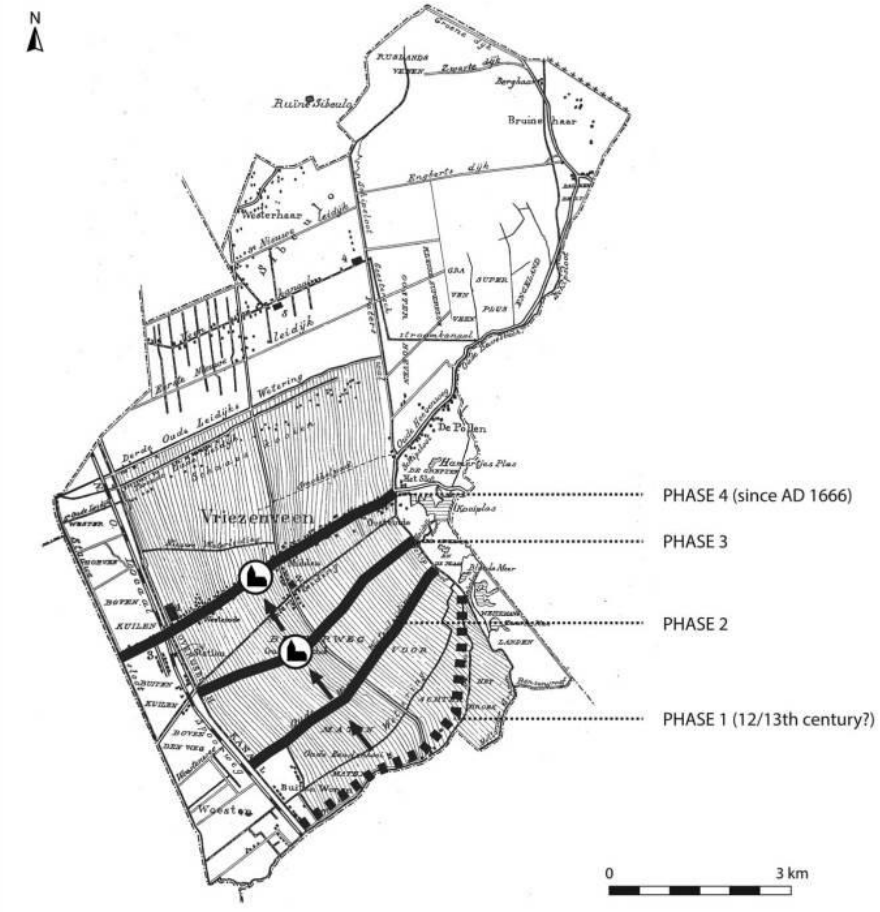

Figure 15: The progression of the centre of Vriezenveen (van Beek, 2015b)

Figure 16: The Vriezenveen microregion. The street map is from the Historical topographical data (1920) and the colours are from the AHN-2.

5.1.2 Veendam

The first local peat excavations with export in the Veendam region started at the end of the sixteenth century (1595), with the start of the investments by the merchants of the Holland province (de Vries, 1996). The peat excavation system around Veendam had the Oude Ae as its main canal. In Veendam, the two most important canals were both connected to the Oude Ae (de Smet, 1969; Molema, 2014). In 1628, the Winschoterdiep, which was partly funded by the investments from Holland, was finished (Voerman, 2001). The Winschoterdiep connected Waterhuizen to Zuidbruik, for the transport of peat from Sappermeer and Veendam to the city of Groningen. The digging of the Winschoterdiep resulted in an immediate uptake of the amount of peat that was excavated and transported to the market of Groningen, which was the main distributor of peat towards the cities in Holland and Utrecht (Gerding, 1995). The area between Hoogezand-Sappemeer and Veendam-Wildervank was excavated in the seventeenth and the eighteenth centuries, and therefore belongs to the oldest peat colonies (Reyes, 1999; Koorn, 2012). In the eighteenth century, several canals were added to this system, which resulted in the in addition of several peat excavation systems, of which Stadskanaal to the south of Veendam was the most important. Most of these canals can still be found today, indicating that the raised bog in this region used to be very large and structured, as the Veendam is completely surrounded by the canals (Figure 17; Bieleman, 2008). As these systems were added to the network of peat excavations the competition between the older peat colonies like Veendam and the newer peat colonies like Stadskanaal became apparent.

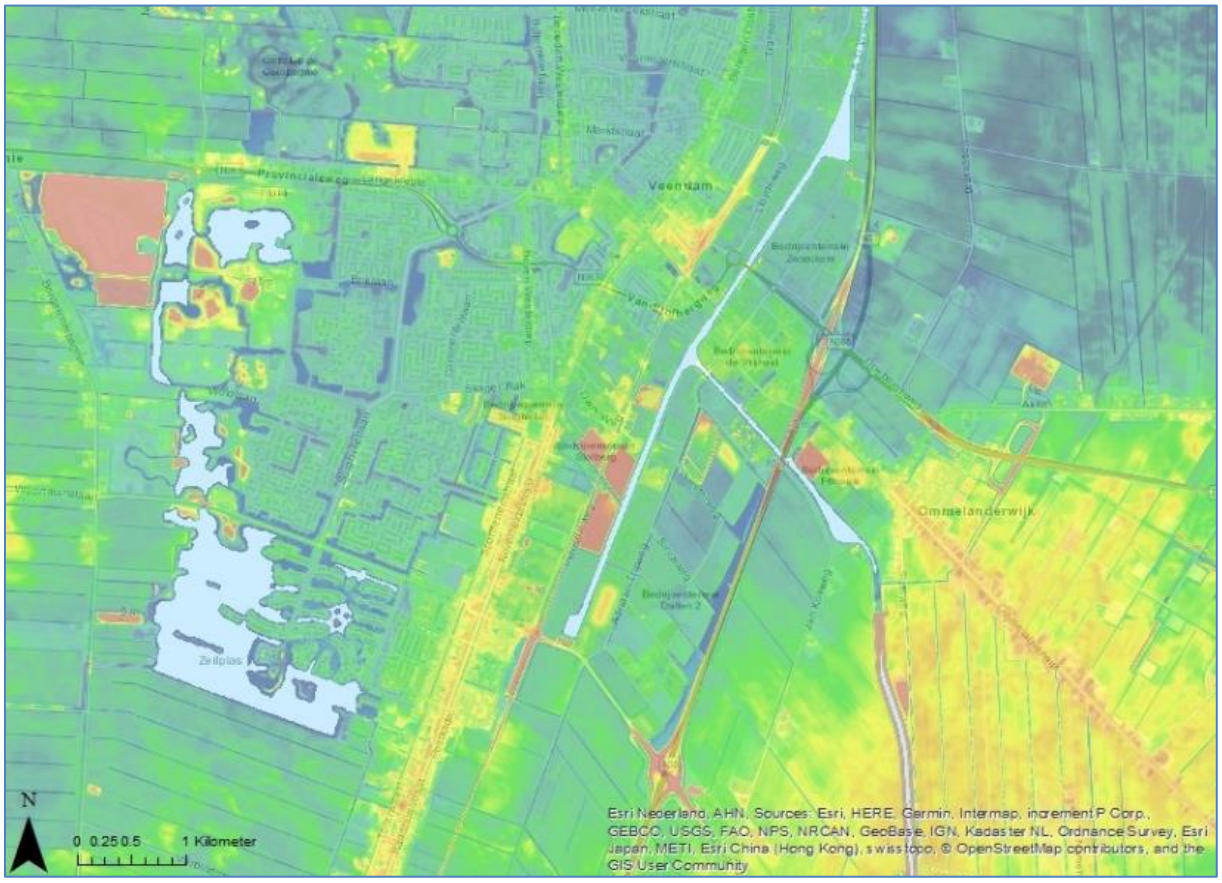

Figure 17: The Veendam microregion. The street map is from the ArcGIS Basemap and the colours are from the AHN-2.

One of the problems with reclamation is that in many cases, especially in the Peel but also in the northern Netherlands, the white peat was removed to be processed and then used as peat litter (Gerding, 2015). However, it shows great insight that the council of the city of Groningen already declared in 1651 that the subsoil of the excavated raised bogs should be mixed with the waste and other types of fertiliser to improve the soil as much as possible (Coolen, 1877; Bieleman, 2008). As the city of Groningen was one of the main possessors of areas covered with raised bogs in this region, this lead initially to several reclamations close to the city itself. Veendam is one of the cities that was affected by this policy, as the soils around Veendam were to some extent colonised by farmers. However, the problem with this policy was that there simply was not enough fertiliser for the vast amounts of land that had potential for reclamation (Schaik, 1969; Gerding, 1995). Especially in the seventeenth century, this lead to a lot of land simply being left unattended (Bieleman, 2008). This would last until the invention of other forms of fertiliser in the nineteenth century. Another common occurrence was that the land remained untouched until the entire raised bog had been excavated. The reason for this was that it would be easier to maintain and protect from any threats from the water (Voerman, 2001). It is therefore safe to say that in most cases excavation was not immediately followed by reclamation in the region surrounding Veendam. However, as the plots were still available, especially after the introduction of artificial fertiliser, reclamation would continue for a much longer period.

In the beginning of the nineteenth century, the amount of peat that was excavated in the region around Veendam was beginning to decrease (Texier, 1983). The amount of peat excavated was even lower than the amounts that had been excavated in the sixteenth and the first half of the seventeenth century. Commercial peat excavation would remain present until 1850, when the excavation stopped entirely (Voerman, 2001; Figure 18). Even the introduction of railroads in 1860 and the industrialisation of the second half of the nineteenth century would not rekindle the peat excavation in the Veendam region. However, due to the availability of the plots for reclamation, the amount of families that focussed on agriculture actually increased in the nineteenth century from 64 to 88. This continued reclamation is also noticeable in the historic names in the region around Veendam: in 1829 several homes alongside the Beneden Oosterdiep (located in the northern part of the modern-day Veendam) were located in the street Oosterdiep-Heideveld. The Westerbrink (north of modern-day Veendam, was also called Heideveld in 1829. These names suggest that at least north of Veendam there were still several areas that were not cultivated, as the meadow was allowed to re-establish itself (Voerman, 2001).

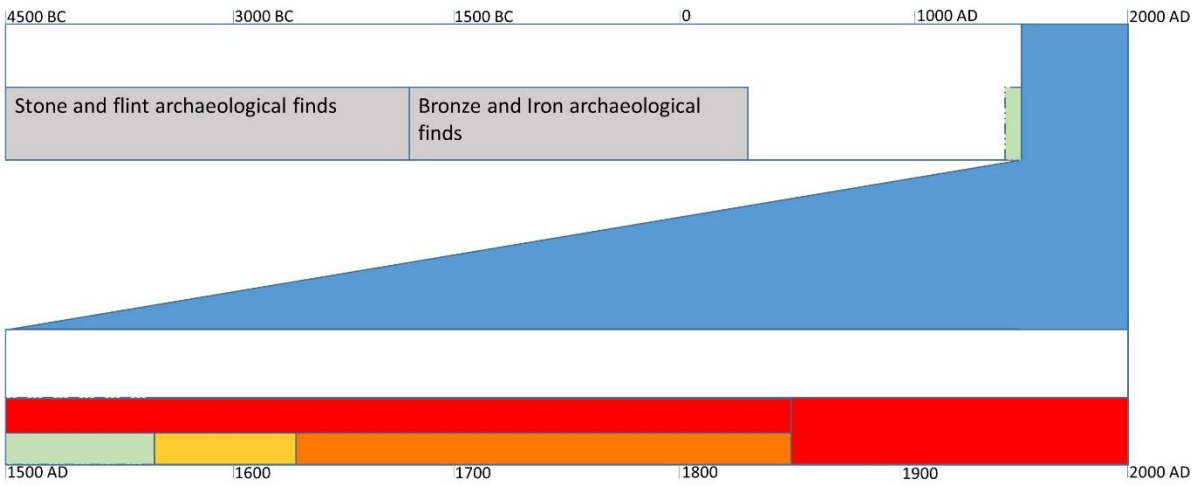

Figure 18: Archaeological finds, peat excavation and reclamation during the last 6500 years around the village of Veendam. The years 1500AD – 2000AD have been zoomed in on. Green is the period of extensive excavation; gold is the period of local excavation with export; orange is the period of intensive excavation; and red is the period of reclamation.

5.2 The microregions of the Peel

The microregions that were chosen for the Peel are Helenaveen and Bakel. These two cities are opposites in multiple regards. Helenaveen is a very recently developed town in the centre of the Peel, founded for the excavation of peat in 1853, whereas Bakel has existed for more than a thousand years much further north.

5.2.1 Helenaveen

The small village of Helenaveen was formed in 1853, although some may say that it was not officially founded until 1857, the year one of the stone buildings became a church for the Roman Catholics (Hollenberg, 1980). It is named after the wife of van de Griendt, who was the investor of the Peelvaart. Unsurprisingly, the Peelvaart has also become known as the Helenavaart, again named after the wife of van der Griendt (Hollenberg, 1980). The reason behind the founding of Helenaveen is the opening of the Zuid-Willemsvaart in 1826. This canal made this region accessible for peat barges, which ensured that the peat excavation in this region intensified. Helenaveen is only the first of the peat colonies in the Peel, followed by Griendtsveen and Deurnse Peel. The almost three decades between the opening of the Zuid-Willemsvaart and the founding of Helenaveen was caused by the fear that intensive peat excavation could lead to floods and other damages caused by water. In these years, there were several engineers that noted that this fear was unfounded, and even in 1853 an article was published in the provincial newspaper to quell some of the fears of politicians by L.A. Reuvens. He was of the opinion that, when the raised bogs were excavated, the amount of water in the region would decrease. This would in turn lead to a decrease in flood risk for the Peel (Hollenberg, 1980).

In the first few decades after the founding of Helenaveen, the town grew rapidly alongside the Helenavaart, and several smaller canals were dug (Figure 19). It was modelled on the peat colonies in the northern Netherlands, which meant that the growth of the city was only alongside the easily accessible canal. Even when other cities like Griendtsveen were founded and started to compete with Helenaveen, the town grew, albeit slower than before. It should be noted that it would take until the 1880s before the Zuid-Willemsvaart was connected to the Meuse or the Waal, which made the transport of peat significantly easier from Helenaveen. Starting in 1881, the amount of peat that was excavated decreased significantly (Figure 20). This was due to the competition with Griendtsveen, which was founded by the same van der Griendt that founded Helenaveen. Griendtsveen had the added advantage that a train station was located in this city, which ensured that the transport of peat would be easier. This train station connected the town to Eindhoven, Helmond and Venlo (Hollenberg, 1980).

Even though the amount of peat excavated decreased in Helenaveen, the population continued to grow in the last two decades of the nineteenth century, from 502 in 1882 to 950 in 1901. This population growth is explained by the sudden appearance of the turf litter industry (Hollenberg, 1980; Thissen, 1993). The reason for this sudden appearance of the turf litter industry is the introduction of machines that were capable of processing the white turf into turf litter. While the introduction of these machines stimulated the local economy in Helenaveen, it would be detrimental for most other parts of the Peel as the white peat layer was completely removed. Due to the fact that the Helenaveen region was excavated before the introduction of the turf litter machines, much of the white peat layer was simply returned on top of the subsoil instead of being processed.

Up until this point, the focus of the peat companies was fully on the excavation of peat. However, as the amount of peat decreased and the white peat layer was exhausted in the region, the focus was put more and more on the reclamation. The problem was that with the white peat layer gone, the soils were rather poor in nutrients. Companies like the “Heidemaatschappij”, moved the focus from peat extraction to

cultivation of the soils. The reclamation itself would not start until 1905 (Hollenberg, 1980). Around Helenaveen, this would turn out to be a period of prosperity, as the soils that were found in this region could be augmented with fertiliser to become some of the best soils in Noord-Brabant (Hollenberg, 1980; Thissen, 1993). This is however in stark contrast to the rest of the region, as even in the Maatschappij Griendtsveen the amount of reclaimed land remained very low.

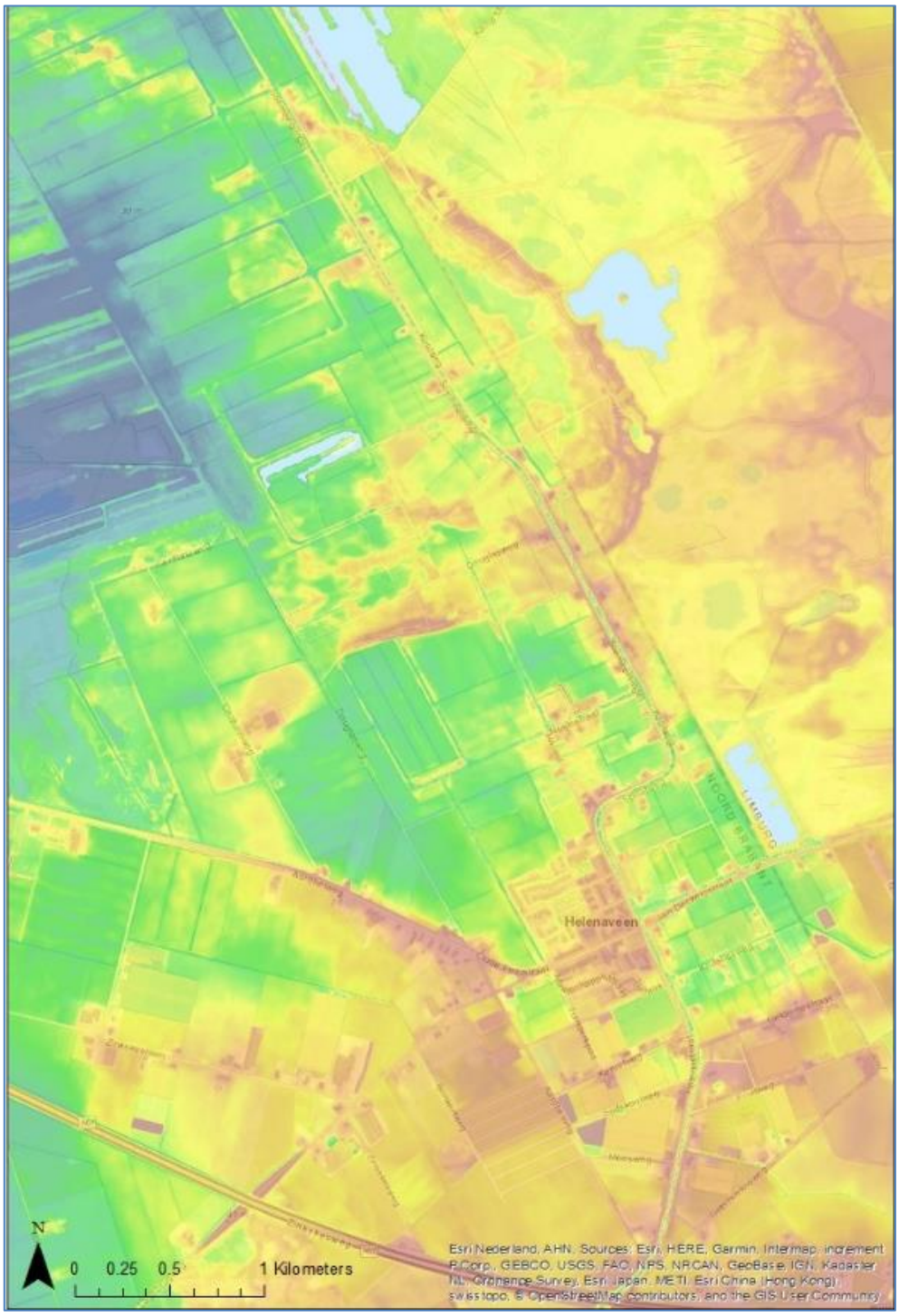

Figure 19: The Helenaveen microregion. The street map is from the ArcGIS Basemap and the colours are from the AHN-2.

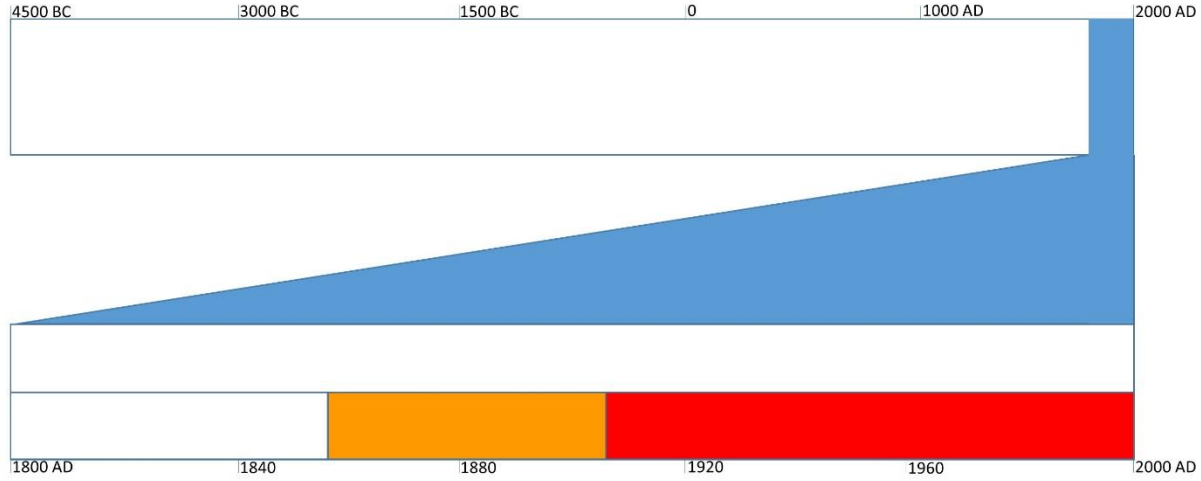

Figure 20: Peat excavation and reclamation during the last 6500 years around the village of Helenaveen. The years 1800-2000 have been zoomed in on. Green is the period of extensive excavation; orange is the period of intensive excavation; and red is the period of reclamation.

5.2.2 Bakel

The municipality of Bakel is located in the province of Noord-Brabant in the Netherlands, and is positioned north of the Deurnse and Mariapeel. The largest part of the Bakelse Peel became the shared possession of the municipalities Bakel, Helmond, Aarle-Rixtel and Beek and Donk. In 1834, they agreed which municipality got which part of the Bakelse Peel: Bakel got half, Helmond one-fourth and Aarle-Rixtel and Beek and Donk one-eighth of the area. This also meant that in 1834, the municipality of Bakel possessed the largest area of the Peel, especially when compared to its limited population. These lands were placed in the highest part of the Peel, which ensured that Bakel became infamous for its reputation of being the highest and most barren village of the Peel. The farmlands surrounding Bakel were also notorious for needing the most sheep manure in the Peel (Thissen, 1993). This related directly to the poverty in the region,

Apart from these problems in the agricultural sector, Bakel was isolated from other populated areas in the Peel. The connections with the outside world and within the vast municipality itself were extremely bad. There were no paved roads until the construction of a road started in 1873, which was completed two years later. The maintenance of this road towards Venray was to be under the supervision of the municipality. As the municipality had financial difficulties throughout the nineteenth century, this was not always done in a sufficient manner. The municipality of Bakel was even fined twice by the province for their lack of maintenance (Hollenberg, 1980).

In the 1840s, the turf from the Peel was a significant export product of Bakel. Halfway the nineteenth century, the trade of turf to other regions would decrease, with the last mention of export of turf in 1862. The end of peat excavation in this region might be connected to the availability of turf of van de Griendt, who started a large-scale excavation in 1853 (Helenaveen). Another possibility is that the peat bogs in the Bakelse Peel that were easy to excavate were exhausted. As the excavation that occurred in this region was done by individuals, the capital for large-scale infrastructure was unavailable. This, in turn, lead to scattered peat excavations which remain visible to this day (Figure 21). A combination of these two possible reasons for the decrease of the export of turf from the Bakel municipality is also possible. There was also a small-scale importation of the fertiliser guano in 1873, which in favour of the agriculture: there is a report from the year 1873 that mentions the import of the fertiliser guano (Thissen, 1993).

Between 1864 and 1891, most of the possessions of the municipality were sold, but Bakel remained one of the seven most financially troubled municipalities in Noord-Brabant. These sales of land started already in 1831, and the last try to sell land was made in 1913, as Bakel tried to relieve some of its debts. Most of these lands were bought by the local population but several parcels were sold to industrials from Helmond. After the sale of the parcels, the buyers usually started reclamation within a short time (Hollenberg, 1980).

Bakel was also the only municipality where the inhabitants protested several times, because the areas necessary for the communal “plaggenstekerij” were going to be sold (Hollenberg, 1980). Even if the farmers did not resist these sales of communal land to private investors, reclamation efforts in the 1830s would have been wrought with difficulties due to the lack of fertiliser (Hollenberg, 1980). This might have been one of the reasons why the reclamation in the region near Bakel did not assume commercial proportions until after the introduction of guano and artificial fertiliser in the 1870s (Thissen, 1993).

Another important stakeholder during the reclamations in the Bakelse Peel was the “Nederlandse Heidemaatschappij”. On the reclamations that were put under the supervision of the “Nederlandsche Heidemaatschappij” between 1892 and 1910, forests with pine wood would be the core of the exploitation (Figure 22; Hollenberg, 1980). The sad story is that the poor municipalities Gemert and Bakel sold their wastelands for a song, which ensured that later on they did not (Gemert) or hardly (Bakel) profit of the increasing price of land in the Peel. On the other hand, the early sale promoted early reclamations, and the

municipalities Gemert and Bakel would become the test sites of the “Nederlandsche Heidemaatschappij” (Hollenberg, 1980).

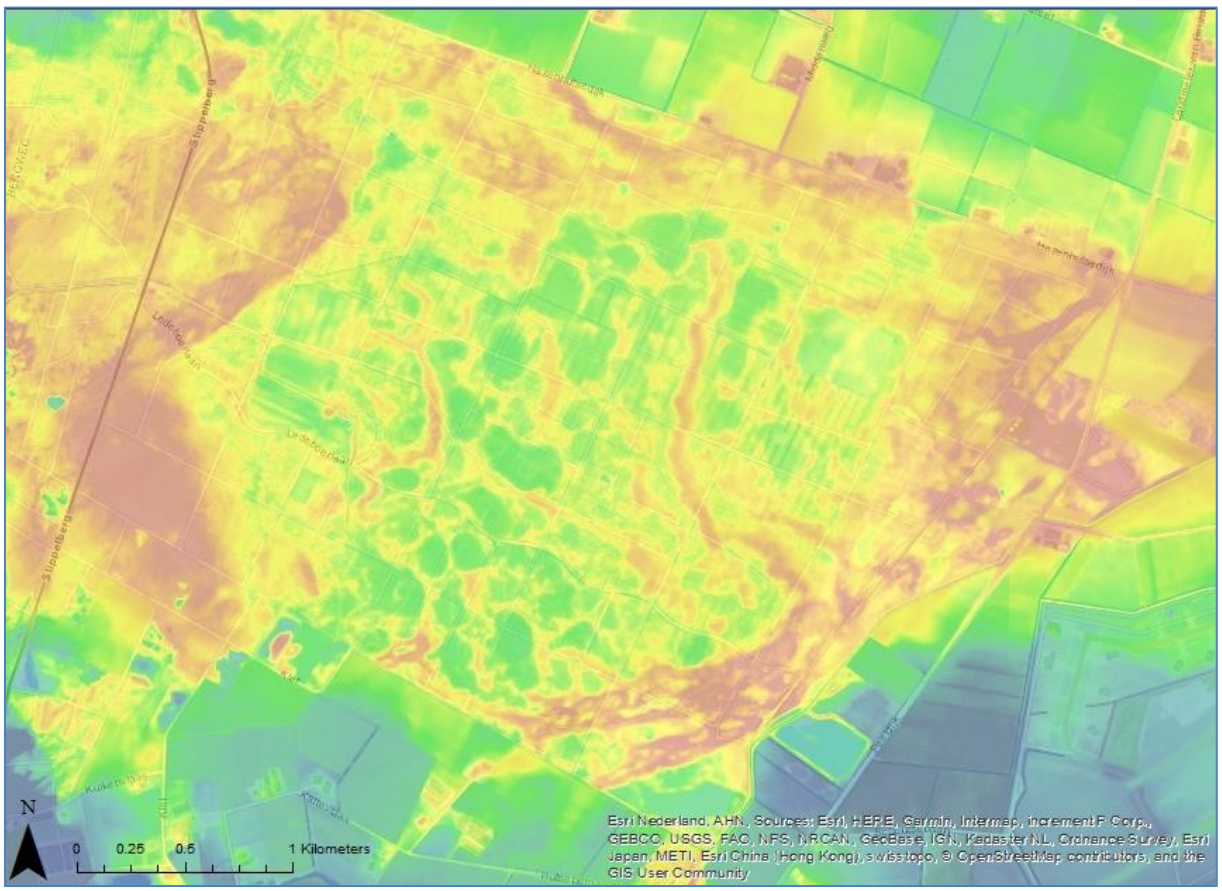

Figure 21: The Bakel microregion. The street map is from the ArcGIS Basemap and the colours are from the AHN-2. The rounded low-lying features are the result of unstructured peat excavation.

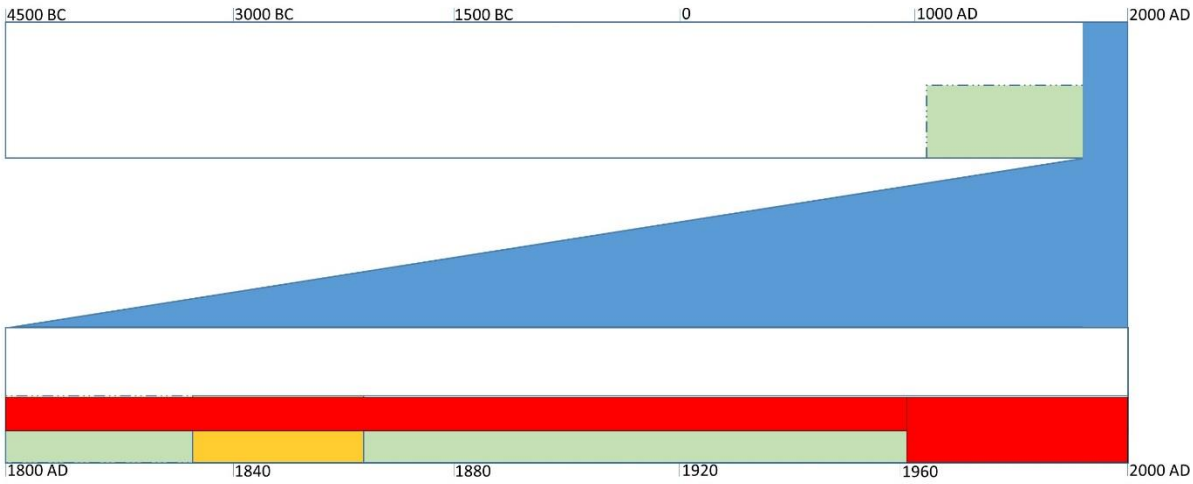

Figure 22: Peat excavation and reclamation during the last 6500 years around the village of Bakel. The years 1800-2000 have been zoomed in on. Green is the period of extensive excavation; gold is the period of local excavation with export; and red is the period of reclamation.

5.3 The microregions of the Hautes Fagnes

The microregions that were chosen for the Hautes Fagnes region are the Brackvenn and the Fagne de Clefay. The Fagne de Clefay is located in the south-western half of the Hautes Fagnes and the Brackvenn is located more to the north-eastern half of the Hautes Fagnes plateau (Figure 13).

5.3.1 Brackvenn

The Brackvenn is located in the north-eastern part of the Hautes Fagnes, close to the Misten bog. These two bogs are separated by a single road, from Eupen to Monschau. The Brackvenn is most famous for the numerous viviers that can be found in this region. They are assumed to be the result of a cryoturbations during the younger Dryas (between 11.000 BC and 9.500 BC; Figure 7), which filled with peat during the early Holocene (around 9.000 BC; Juvigne, 1979; van Amsterdam, 1996). These viviers have also been called pingos, and they form the basis of the raised peat bog that is nowadays known as the Brackvenn. Peat excavation was facilitated by the digging of the "Fosse d'Eupen" in 1774 (Hindryckx, 2000), and the construction of the road between the Brackvenn and the Misten Bog between 1779 and 1793 (Génicot, 1946). However, while the raised bogs in the pingos in this region are known to be mostly undisturbed (Whitton, 2000), it is likely that extensive peat excavation did occur around the edges by the local population (Figure 23). However, no indication has been found that the turf that was excavated in this region was used for anything other than personal use. This extensive excavation started in the southeast of the Misten Bog in 1330, and slowly moved northward (Hindryckx, 2000). This also means that, while there are some indications that the area covered with raised bogs has significantly decreased, this was mostly done by extensive excavation. On top of this lack of commercial excavation, or even export of turf from the Brackvenn region, the Brackvenn region became a part of the Hautes Fagnes-Eifel Nature Park in 1967. The lack of information on commercial peat excavation and local excavation with export is also in opposition to the other microregion, the Fagne de Clefay.

The reclamation in this region has also not been documented as well. Some indications of reclamation around 1900 AD have been found, but it has not been possible to validate this date (Hindryckx, 2000). However, the area is known for its pine forests, which were planted as a form of reclamation. For the Brackvenn, this means that the raised bogs still remain in the different pingos, but the areas that were excavated were generally planted by pines. These pines can still be found in this region. This is comparable to the Fagne de Clefay, which was also heavily influenced by forestry in the region.

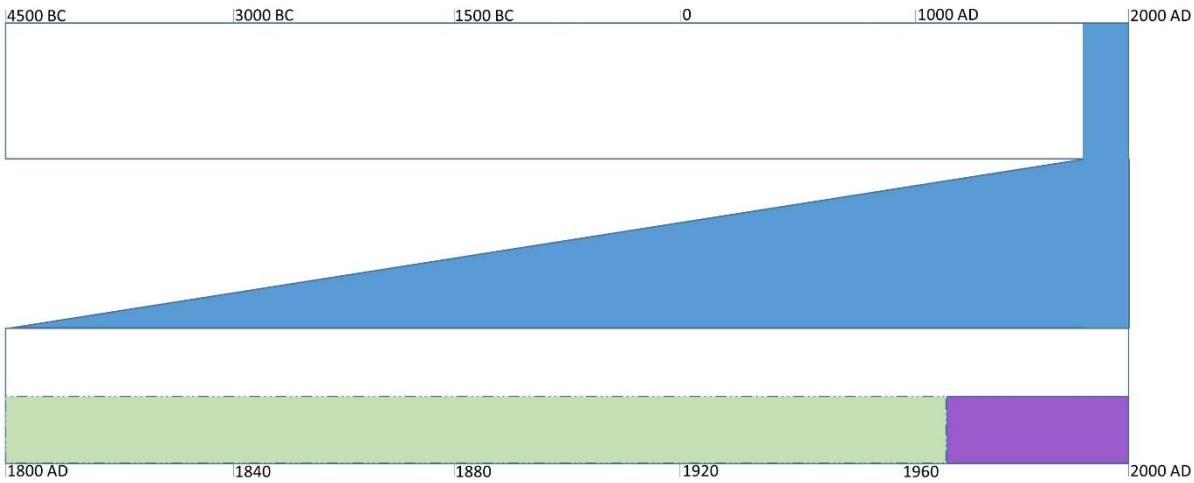

Figure 23: Peat excavation and reclamation during the last 6500 years in the Brackvenn. The years 1800-2000 have been zoomed in on. Green is the period of extensive excavation; and purple is the period of the national park.

5.3.2 Fagne de Clefay

The Fagne de Clefay is located to the south of the river Helle, and is positioned in a valley together with the Fagne Wallonne. These two raised bogs are separated by a small hill, and flanked by the Botrange and the Pannensterz hills, which are located to the west and east of the valley respectively (Damblon, 1978). Interestingly, despite the conditions for both raised bogs being relatively the same, there are a few differences between them (Streel, 1958; Damblon, 1969). Overall, the Fagne Wallonne is bigger, but the Fagne de Clefay is richer in nutrients. Of course, this is only a small difference, as they are both oligotrophic raised bogs, which have formed in the same climate.

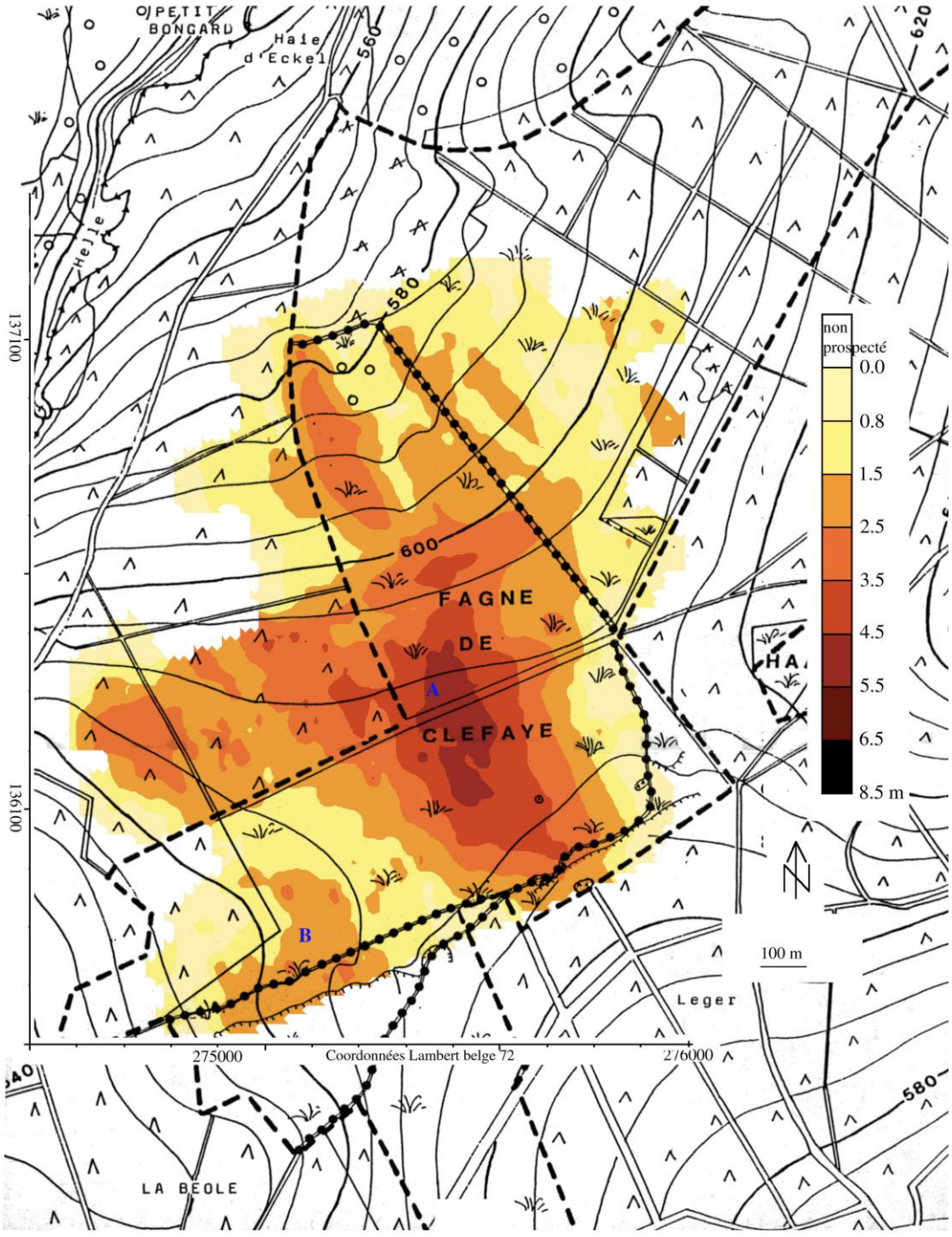

Figure 24: The Fagne de Clefay microregion. The colours indicate the depth of the peat layer that is present (Wastiaux, 2003)

Before the commercial and local excavations with export were occurring in the Fagne de Clefay, Bouillenne (1966) suggests that the peat was excavated extensively, according to the pyramid method. In this method, the blocks of turf are stacked in the form of a small pyramid, after which it is left to dry by the sun and the elements. As this method is not viable during a rainy season, it was only applied during the summer.

It is estimated by Damblon (1978) that 30 to 50 centimetres of peat was excavated on average in the Fagne de Clefay. Small excavations started to the south of the Fagne de Clefay in the first half of the nineteenth century and would continue to grow in intensity until 1971, when the area was incorporated in the Hautes Fagnes-Eifel Nature Park. This ended the peat excavation in the region, with several raised bogs still remaining (Figure 24)

While the exact dates of the changes in excavation intensity are absent in the Fagne de Clefay, the fact that several sources already mention that peat excavation did occur in the Fagne de Clefay indicates at least some level of peat excavation (Bastin, 1939; Robert, 1963). The wide variety of dates that are mentioned (sixteenth century by Bastin, 1939; eighteenth century by Robert, 1963), shows that it is not really clear at this point which peat type of peat excavation occurred when. This also means that Figure 25 is merely an indication of the actual situation.

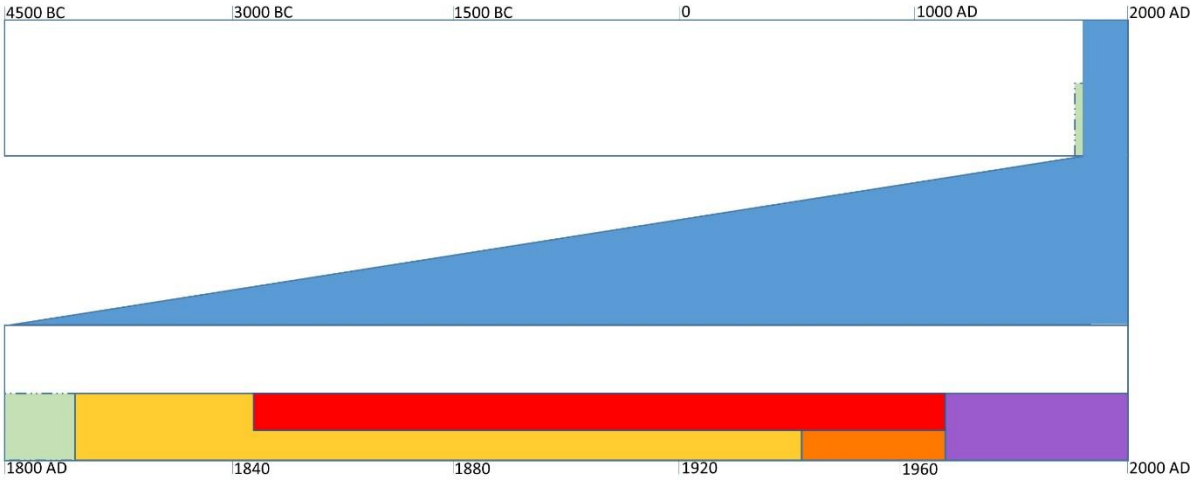

Figure 25: An indication of the peat excavation and reclamation during the last 6500 years in the Fagne de Clefay. The years 1800-2000 have been zoomed in on. Green is the period of extensive excavation; gold is the period of local excavation with export; orange is the period of intensive excavation; red is the period of reclamation; and purple is the period of the national park.

6 The underlying processes

In the previous chapters, the differences in land use developments for the different regions were analysed. Several trends have been identified, which result in a clear view of the underlying processes behind the trajectories that were found for each of the regions in the Low Countries.

6.1 Investments and infrastructure

The first requirement that was needed for intensification of peat excavation were investments of both time and money. Especially the financial side has played a major role over the centuries in each of the different microregions.

In Veendam, the investments of Groningen played a key role in their early development (Figure 26). With these investments the village was able to increase the amount of peat that was excavated, and export the resulting turf to Groningen. A second wave of investments was led by the cities in Holland and Utrecht. This would lead to the digging of the Winschoterdiep (1628), which increased the potential for transport around Veendam. Combined with several smaller canals that were dug during the seventeenth and eighteenth centuries, the amount of peat that was excavated increased. As the amount of excavated peat increased the turf would also be exported to the cities in Holland and Utrecht. Vriezenveen was behind Veendam in intensity of peat excavation for most of its time (Figure 26), which was linked to the relatively late investments of the lords of Almelo. As the investments were late compared to Veendam, the infrastructure lagged behind as well, with the “Overijssels kanaal” being finished in 1856. However, as the investments were relatively late the peat excavations in the Vriezenveen region would also continue for a longer period of time.

In the Peel region, the lack of investments and the resulting lack of infrastructure were the main reasons behind the limited peat excavations before the nineteenth century. Another reason was the instability of the region, as the ever changing borders caused friction between the different cities, and only limited interest in the Peel. With the borders of this region confirmed after the Napoleonic wars, the region would stabilize. The stabilisation would lead to an increase in investments and the digging of the Zuid-Willemsvaart in 1826. Bakel was one of the first regions that would benefit from the stability, as overland trade would increase. This led to a short period of export for Bakel, which would end in the 1860s. Helenaveen on the other hand would be founded in 1853 by the investor van der Griendt. As he focussed almost completely on the extraction of peat around Helenaveen, the investments would result in the Helenavaart and the rapid excavation of peat.

For the Hautes Fagnes, the investments appear to have been limited, with most of the excavations being extensive. It may very well be that some limited investments were done from Eupen, Monschau or any of the other villages in the region. While no concrete evidence was found of investments, a road between Eupen and Monschau is present, and numerous drainage canals can be found. As the peat in the Brackvenn was excavated especially in the eastern parts of the microregion, it is likely that the investments came from the direction of Monschau. In the Fagne de Clefay, the excavation of peat was preceded by the construction of drainage canals, showing that investments in the infrastructure were done here as well.

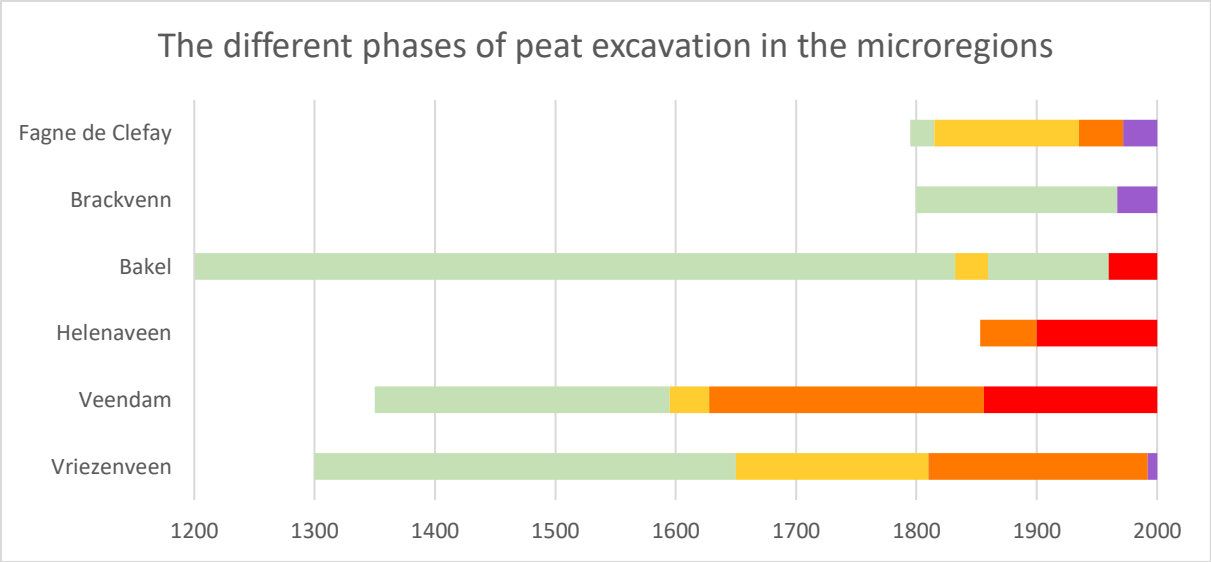

Figure 26: The different phases of peat excavation in the six microregions. Green is the period of extensive excavation; gold is the period of local excavation with export; orange is the period of intensive excavation; red is the period of reclamation; and purple is the period of the national park. Note that reclamation already occurred alongside the different forms of peat excavation in Vriezenveen, Veendam, Bakel, and possible Brackvenn, and Fagne de Clefay.

6.2 Distance to the peat consumer market

The distance to the peat consumer market is another crucial factor in the timing of the commercialisation of peat excavation in each of the regions. If the distance was too large, the investments would focus on the regions that were closer to the peat consumer market. This was already found by Leenders for the first part of the wave of reclamation, as initially the cities in Flanders were the primary peat consumers. This resulted in the initial focus of investments to be on the bogs in Flanders, and later on the raised bogs in western Noord-Brabant. The main peat consumer market shifted from Flanders to Holland and Utrecht in the sixteenth century. This coincides with the start of commercialized forms of peat excavation in the northern Netherlands, with the easily accessible Veendam being one of the first. As Veendam was better connected with the world after the digging of the Winschoterdiep in 1628, the commercial excavation of peat would start here much earlier than in Vriezenveen, as Vriezenveen was not as connected to Holland and Utrecht.

Before the Napoleonic wars, the Peel as a region was quite closed off to the outside world, and as such was not exporting a lot of turf towards the peat consumer market. After the stabilisation of the Peel, and the digging of the Zuid-Willemsvaart in 1826, the trend of “closest to the peat consumer market first” is found here as well. Bakel might not have been the best connected part of the Peel, but Helenaveen would have to wait until the digging of the Helenavaart in 1853 before any connection with the wider world could be established. As such, the initial peat excavation in the Peel was done in villages like Bakel, who had already some connections. However, as soon as the Helenavaart was dug, the focus shifted to these much better connected regions, as the turf could be transported to the peat consumer market much easier, and quicker.

In the Hautes Fagnes, the distance to the peat consumer market was one of the reasons for its relatively late peat excavation. There probably small peat consumption markets in the cities surrounding the Hautes Fagnes, like Stavelot, Eupen and Monschau. However, the consumption of turf in these cities will have been small compared to the many cities in Holland and Utrecht. This would have been compounded by the availability of wood as fuel, as forestry was one of the principle economic activities in the region. Therefore, the commercialisation of peat excavation would have been relatively late, compared to the northern Netherlands and the Peel.

6.3 Amount of available peat

Investments, infrastructure, and the distance to the consumer market all played an important role in the intensification of the peat excavation. The excavation of peat would continue for a period of time, which varies greatly between the microregions (Figure 26). However, in the nineteenth and twentieth centuries peat excavation would diminish. The main reason for this decrease in peat excavation, is that the amount of peat decreased, making the remaining bogs less economically viable. If not for the subsidies of the government in the 1920s and 1930s peat excavations would have ended completely around 1900.

As the raised bogs in the northern Netherlands were excavated first, it should come as no surprise that the commercial excavations in this region would be the first to come to a halt. Especially in Veendam, which was one of the first peat colonies, the commercial peat excavation stopped early due to a lack of easily accessible peat. In Vriezenveen the peat excavations would continue until after the Second World War, but would eventually run out of steam, as the raised bogs were depleted.

While the amount of available peat was important in the Peel, the accessibility of the peat was even more crucial. This is seen in both Bakel and Helenaveen, as both microregions were excavated intensively for a few decades before being abandoned. In Bakel, the amount of available peat might have been an extra factor for the stopping of commercial excavation. After all, in Bakel the amount of peat that had already been excavated extensively was quite substantial, and had been going on for centuries (Figure 26). Around Helenaveen there are still several raised bogs present, indicating that the amount of available peat did not play as big a role here as in Bakel. In 1880, the newly founded village of Griendtsveen would have simply incentivised the excavators to focus away from Helenaveen, resulting in the end of commercial peat excavations around Helenaveen.

In the Hautes Fagnes, the Brackvenn was excavated almost in its entirety, leading to the hypothesis that the amount of available peat may have been the limiting factor for commercial excavation. For the Fagne de Clefay, the amount of available peat will not have been a limiting factor, as significant bogs are still present. However, the most limiting factor for peat excavation in the Hautes Fagnes, will have been the formation of the Hautes Fagnes-Eifel nature park in the 1960s, as this put a complete stop to the excavation of peat in this region.

6.4 Availability of fertiliser

Alongside most of the peat excavations, the land was also reclaimed for other purposes, like agriculture and forestry. The largest swaths of land are reclaimed under commercial excavation, which is mainly due to the good infrastructure. However, good infrastructure is not the only driver for reclamation. Fertiliser has been one of the other more important factors required for the reclamation of the peat bog. In the age before artificial fertiliser, the amount of fertiliser that was produced by the farmers and the cities was limiting for the area of land that could be reclaimed. This is visible in the reclamations surrounding Veendam, as fertiliser was limited to the production of Groningen. After the commercial excavations had ended in Veendam, the reclamations would continue, especially with the introductions of guano and artificial fertiliser. In Vriezenveen the commercial peat excavations would continue until the 1950s, when the remaining bogs were bought by Staatsbosbeheer. The reclamations would also focus on agriculture, just like in Veendam. However, as the area available for reclamation was smaller compared to Veendam, there does not appear to have been a shortage of fertiliser.

In the Peel, the soils were generally poorer than in the northern Netherlands. The soils therefore required more fertiliser if they were to be used for agriculture. In Bakel this was a major issue, as after the peat was removed, only the cover sands would remain. This poverty of the soils was solved by planting trees, which over time slowly improved the soils. With the import of guano and the introduction of artificial fertiliser,

some of the soils could be used for agricultural purposes. This is in contrast to Helenaveen, where the white peat layer was used to improve the soils. This resulted in soils of high quality, which did not require much fertilisation and are used for agriculture to this day. In the Hautes Fagnes forestry was the main method of reclamation. As such, the amount of fertiliser required in this region has been limited.

7 Conclusions

7.1 Peat excavation and reclamation in the Low Countries

Before answering the first research question, it is repeated below:

> *How do historical, geographical, archaeological, and socio-economical sources describe the consecutive phases of human land use and excavation of peat bogs in the Low Countries?*

The different fields of study have each their own focus, which results in different types of data in different periods of time. A significant gap was found between 400 AD and 1500 AD. The archaeological and geological data focus on the period before this gap, and show that the raised bogs were used by the local population, although it is unclear how exactly. At the end of the Middle Ages, the historical and socio-economic sources appear. The start of this resurgence of data varies between the different regions in the Low Countries, as the northern Netherlands is mentioned first, the Peel second, and the Hautes Fagnes as the last one. This is probably linked to the establishment of more centralized governments compared to the more fragmented states of the Middle Ages.

According to the various sources, the wave of reclamation of Leenders (2013) is followed for the commercial peat excavation on a national level. The wealth of the Dutch Golden Age resulted in the rapid development of commercial peat excavation in the northern Netherlands during the seventeenth century. In the northern Netherlands the commercial excavation would continue until the nineteenth century, during which excavation in the Peel region and the Hautes Fagnes would also intensify. Alongside the excavations the land was also reclaimed for varies purposes. The reclamations focussed on agriculture in the northern Netherlands and forestry in the Peel and the Hautes Fagnes. The same is much less clear for the extensive or local excavation with export as these forms of excavation are much less documented, and continued for long periods of time. This also means that while these forms of excavation may have had a large impact on the raised bogs, we can only try to guess the total impact.

7.2 Peat excavation and reclamation on a regional level

Before answering the second research question, it is repeated below:

> *How do the raised bog areas in the northern Netherlands, the Peel and the Hautes Fagnes (Belgium) compare in their land use development?*

The extensive peat excavation is the starting point of the land use development of the northern Netherlands, the Peel and the Hautes Fagnes. The regions do however vary greatly from that point onwards. For the northern Netherlands, the intensification of the peat excavation already started in the seventeenth while it would take until the nineteenth century for the Peel and the Hautes Fagnes. This was mostly due to investments in the northern Netherlands, which were initially absent in the Peel and the Hautes Fagnes. The differences that these investments caused would be noticeable for some time. Peat excavation in the Peel would be extensive, until the necessary investments were made. At that time, the excavators would rapidly commercialise the excavations. Even in the Hautes Fagnes, while there is no conclusive evidence of investments, the peat excavation would intensify in the twentieth century.

With the intensification of peat excavation, the amount of reclaimed land would increase too. During the seventeenth and the eighteenth century the reclamations in the northern Netherlands would be limited by the amount of fertiliser. Therefore these reclamations tended to be sporadic until the introduction of other types of fertiliser. The Peel and the Hautes Fagnes would depend less on fertiliser, although it did help in their development. As other types of fertiliser would already be available at the height of their reclamation,

the Peel and the Hautes Fagnes would not be limited by the availability of fertiliser, like the northern Netherlands had been.

For all three regions, the peat excavation would remain intensive until halfway the twentieth century, when different factors contributed to the decrease of peat excavation. These factors include the competition between the regions, the competition with other sources of fuel, and economic crises. Most of the Hautes Fagnes was also declared part of the Hautes Fagnes-Eifel Nature Park. However, the reclamation for agriculture (in the northern Netherlands) and forestry (in the Peel and the Hautes Fagnes) would continue throughout these points in time.

7.3 Peat excavation and reclamation in the microregions

Before answering the third research question, it is repeated below:

> *What are the variations in land use development of raised bogs within the northern Netherlands, the Peel and the Hautes Fagnes (Belgium)?*

In the northern Netherlands, Vriezenveen and Veendam were investigated in depth. The same land use developments, namely extensive peat excavation, local excavation with export, commercial excavation, reclamation, and the use as a national park, are seen for both microregions. The difference however, is in the timing of these developments. Veendam was initially much faster in its land use development because Groningen heavily invested in its infrastructure to meet its rising demand in peat. Vriezenveen caught up by the eighteenth century, when its infrastructure improved thanks to the Lords of Almelo, who then financed the “Overijssels kanaal”. Peat excavation also stopped earlier in Veendam than in Vriezenveen, as the raised bogs were exhausted.

In the Peel, Helenaveen and Bakel were investigated. These two microregions vary greatly, as Bakel is one of the oldest cities in the Peel, while Helenaveen was only founded in 1853. Bakel never had the infrastructure and the capital to commercially excavate its raised bogs, but until the founding of Helenaveen there appears to have been some export of turf. As Helenaveen was founded by an investor, capital was not as much of an issue. This difference was compounded by the construction of the Helenavaart, which connected Helenaveen to the wider world. Bakel on the other hand would mostly remain isolated, and thus would find it more difficult to export turf to other regions. The more localised character of Bakel would also be reflected in its reclamations, as these were sporadic, and usually done by local farmers. In Helenaveen, the reclamations would be better financed and organised, resulting in a period of prosperity during the first half of the twentieth century.

In the Hautes Fagnes, the Brackvenn and the Hautes Fagnes were investigated. While in the Brackvenn the pingos filled with peat remained untouched, excavation occurred around the edges during the nineteenth and twentieth centuries. Especially in the eastern part of the Brackvenn a large amount of peat was excavated. In Fagne de Clefay the excavation was more generalised, but would not remove all peat, and to this day some peat still remains. It is however, uncertain when exactly this peat was excavated. While some indications for intensive excavation were found for the Fagne de Clefay, it is unclear how the different levels of peat excavation progressed. The reclamation in both microregions focussed mainly on forestry, for which peat excavation was not a necessity.

7.4 The underlying processes causing differences in peat excavation and reclamation

Before answering the fourth research question, it is repeated below:

> *What are the underlying processes causing the differences in human uses and impacts on raised bogs between and within northern Netherlands, the Peel and the Hautes Fagnes (Belgium)?*

The first requirement that was needed for the excavation of peat were investments of both time and money. This is noticeable in the northern Netherlands, as they were the first region with investments, as well as the first region with intensive excavations. Investments would not be made in the Peel and the Hautes Fagnes until the nineteenth century, which meant that commercial excavation before 1800 was not present in those regions. These investments could then be used for the digging of canals that drained the raised bogs, and made transporting the turf towards the peat consumption market easier and quicker.

As the raised bog was excavated, the canals grew more numerous, which resulted in a better accessibility for the excavators. The amount of excavated peat would thus remain high, until the peat was exhausted, or commercial peat excavation was no longer economically viable. For instance, in Veendam the amount of peat was exhausted in the nineteenth century, stopping the excavation of peat. Vriezenveen and Helenaveen on the other hand, would stop due to economic issues. A combination of peat exhaustion and economic pressure was found for Bakel. The amount of peat in that microregion had decreased over the centuries, and with the establishment of Helenaveen and various other peat villages, commercial peat excavation was no longer viable.

In the end, almost all peat excavation would stop after the Second World War. At that time, only small patches of peat remained, the competition with coal, gas, and oil increased, and the government was no longer willing to subsidize excavation.

8 Discussion

In history, the raised bogs started as having an impact on human life. With humans having difficulty crossing the vast raised bogs that spanned the country, the lives of men were limited severely by the raised bogs. However, with time and effort, parts of the great peat bogs were excavated and reclaimed for the use by humans. During the last millennium, the relationship between humans and raised bogs has flipped, as humans now decide where the raised bog is allowed to go. In the nineteenth and early twentieth century this lead to large-scale excavations and reclamations in the raised bog region. Nowadays, only a fraction of the original raised bogs remain. As nature conservation has become a hot topic in recent years, we now look for ways to reinvigorate the raised bogs. However, it is important to first understand how the raised bog landscape has changed over the years.

In this study, the changes in land use on several raised bogs in the Low Countries were identified. By looking at the differences between the various parts of the Low Countries, conclusions could be drawn about the processes that played a role in the interactions between humans and raised bogs. The conclusions that were found in this study show that the wave of reclamation of Leenders (2013) is a useful tool for a general impression of the trend of commercial peat excavation. However, when looking at the microregions, it was clear that this first impression hides a lot of detail.

This study showed that when looking at individual cases, the variation was quite significant. Especially the variation between Bakel and Helenaveen was large. The intensification of peat excavation was driven by the availability of capital, infrastructure and the amount of peat. This in turn led to different starting points, and different trajectories for each of the microregions. Therefore, the method chosen in this study, i.e. microregions, was shown to lead to valuable insights in the variation between the raised bogs.

8.1 Limitations

This study focussed mainly on the archaeological, historical and socio-economical literature that was available for the Low Countries, the three regions and the six microregions. While the initial intention of this study was to also focus on the geographical literature, the time the other steps took ensured that this angle could not be focussed on.

During the study it also became clear that the toponymy that was supposed to be used in the microregions was too much of a task to incorporate it. However, it would have been a valuable addition to this study. While the maps that were found sometimes gave a clear indication of the variation within the microregions, they might have missed some historical situations that were still captured by the names in the region. An illustrative example of this is for the Veendam region, where at least some names showed how the relation between the names and the landscape still reverberates years after the original situation has disappeared.

The archaeological finds pose another limitation. The problem that was encountered here was that it is unknown why the artefacts, peat trackways and bog bodies were deposited in the bogs. While these options are not a dime a dozen, they do influence the story of the history of the peat bogs.

The lack of literature in the Hautes Fagnes should also be a point of note, as the excavations in the northern Netherlands and the Peel are much better documented. The sources that were used in the Hautes Fagnes were not based on archival evidence or historical records, but on the stories of the local population. This did not result in clear boundaries, which showed in the bog use trajectory.

In hindsight, it should have become clear after the first two research questions that the Brackvenn microregion was not as interesting as initially expected. While it was definitely still a viable option, the choice of a different microregion might have made the overview for the Hautes Fagnes more variable.

Possible extra microregions in the Hautes Fagnes region could be the Fagne Wallonne, Fagne des Deux-Series or the Algemeines Venn, as each of these microregions could provide detailed information on the history peat excavation in the different parts of the Hautes Fagnes.

The dependency on the literature was a limitation that was valid for the northern Netherlands, the Peel, and the Hautes Fagnes. While this became painfully clear in the Hautes Fagnes, it is unknown whether there is a bias in the literature on the northern Netherlands and the Peel. In this study only the available literature was used, while other sources, like archival evidence, might have shown a different pattern for peat excavation in the Low Countries. Holes in the available literature will almost be impossible to find, and therefore it should be kept in mind that the results of this study might be significantly biased.

And lastly, the extensive excavation often started somewhere in the distant past, and while the local excavations with export and the commercial excavations are generally mentioned in the literature, this is often not the case for the extensive excavation. Looking back, determining the end date of the peat excavations is quite easy. However, there is simply no clear start date related to the extensive excavation. In this report, the lack of clear start date of the extensive excavation led to a focus on the local excavations with export and the commercial excavations. Surely, this bias should be kept in mind when reading this report, as in the Peel three-quarters of the raised bogs was already lost before the more organized peat excavations occurred. This extensive excavation also continued through the centuries alongside the local excavations with export and the commercial excavations.

8.2 Recommendations

Future research could focus on the fields of study that could have been incorporated in this study, but the time table would not allow. Arguably, the most important ones are the geography and the toponymy, as these might have given valuable insights that are not available in the literature for the microregions.

A second direction for a follow-up study is the inclusion of more microregions. It became clear early on that, while the regional development was clear cut, the development of the different microregions could be highly variable. Especially in the northern Netherlands, the variation between the microregions could be significant. As only two microregions were chosen here, it is possible that extra regions give a different view. In this study, both Frisia and eastern Drenthe were not looked at in much detail. However, even in the smaller regions of the Peel and the Hautes Fagnes more variability might be found when adding more microregions.

Another possibility for future research is the inclusion of microregions in the Gelderse Vallei. This area was also excavated, with its peak lying in the sixteenth century. The Gelderse Vallei was mentioned by Leenders as part of the wave of reclamation. It would therefore be interesting to see whether different parts of the Gelderse Vallei are as variable as the northern Netherlands, the Peel and the Hautes Fagnes.

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Appendix

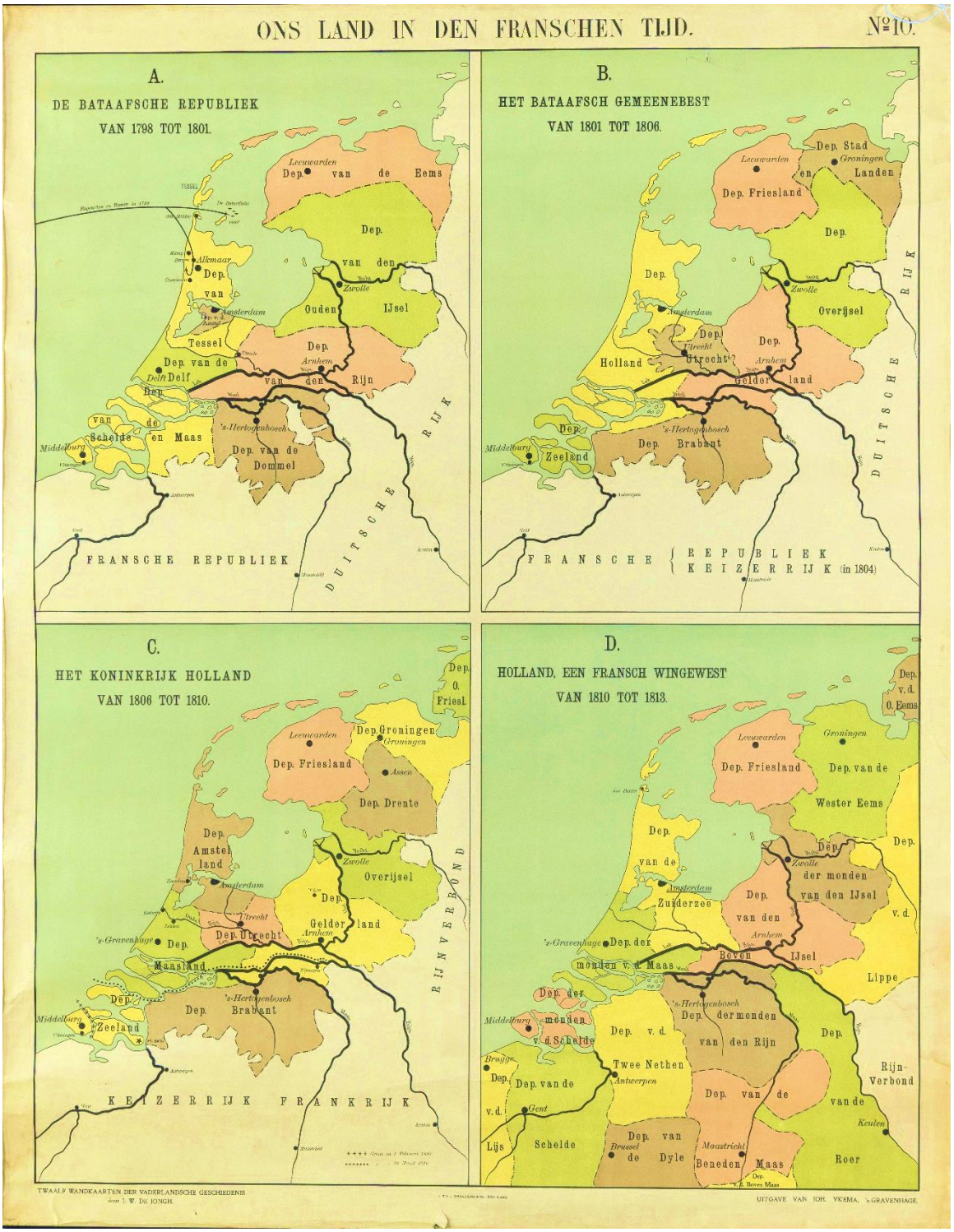

Figure 27: The Low Countries as the Batavian Republic between A: 1798-1801, B: 1801-1806, C: 1806-1810, and D: 1810-1813.