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The Roman Rhineland Farming and Consumption in different Landscapes

*Marion Brüggler, Karen Jeneson, Renate Gerlach,
Jutta Meurers-Balke, Tanja Zerl and Michael Herchenbach*

INTRODUCTION

Within the scope of the RurLand Project, the Rhineland is a peripheral zone¹. From a Gaulish perspective, one could say “The Rhineland – where is it? I know not how to find that country”, in a variation on an ironic remark by Michel Reddé², itself a variation on a statement by Goethe and Schiller³. Where is the Rhineland we are dealing with in the present article to be found? It is understood here as the “Rheinland” of the modern German state of Nordrhein-Westfalen (Northrhine-Westphalia) and the southern area of The Netherlands east of the Meuse river (fig. 1). The Roman part of the modern Rhineland stretches from Bonn in the south to the German-Dutch border near Nijmegen in the north and roughly between the rivers Meuse in the west and Rhine in the east.

The Rhineland may have been peripheral to the Roman Empire, but it was important in certain respects: the border of the Empire with *Germania magna* ran along the Rhine and large bodies of troops were stationed there. Two Roman colonies were located there, the *Colonia Claudia Ara Agrippinensium* (CCAA) with its capital Cologne and the *Colonia Vlpia Traiana* (CUT) with its capital at Xanten. The Rhine and Meuse were important trade routes, enabling the transport of bulk goods, such as agricultural products (fig. 2).

The Rhineland is also a transitional zone. While an extensive loess area covers its southern part in a belt stretching from Cologne into Belgium, the northern part is dominated by loamy and sandy soils. Do these natural conditions have consequences on agrarian production? – a point that we will go deeper into in the course of this article. Apart from the differences in the natural environment there is a clear division in the intensity of research. While rural settlements have been intensively investigated especially in the loess zone, very few rural sites in the northern regions have been excavated. Large-scale open lignite mining in the “Braunkohlengebiet” to the west of Cologne has given rise to a well funded rescue excavation programme in the last four decades. Even though gravel mining in the northern Rhineland covers immense areas, large scale rescue excavations have only been conducted there within the last decade. One problem with research in rural settlements in the northern Rhineland is the low visibility of sites on the surface due to the lack of typical finds, but also due to post-Roman coverage by anthrosols. Consequently, they are missed in the course of area development planning.

The first part of the present article starts with a short history of the archaeological research and a historical synopsis. Then the rural settlement in the loess zone and the loamy and sandy northern areas are presented, with a focus on settlement types and settlement densities. In these chapters, we focus mainly on the scale of archaeological sites. We also present archaeological

1. We would like to thank Wolfgang Gaitzsch and Arie J. Kalis for valuable comments.
2. In a conference in Mechernich-Kommern in 2016.
3. “Deutschland? Aber wo liegt es? Ich weiß das Land nicht zu finden [...]”, *Xenien*, Nr. 95.

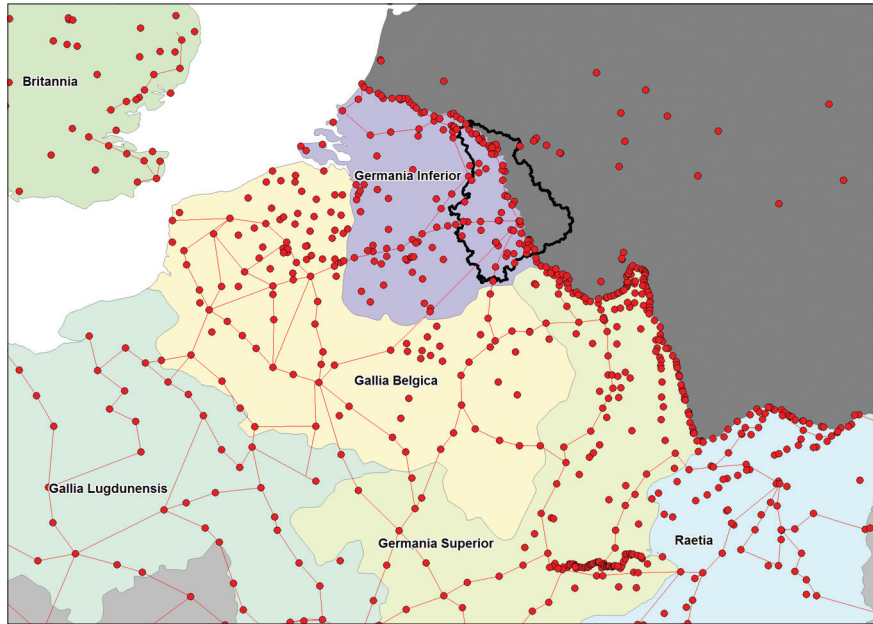


Fig. 1. Roman provinces, streets and sites (in red) in the northern part of Europe and the modern area of the LVR-State Service for Archaeological Heritage (in black) (S. Bödecker & S. Held, LVR-ABR).

evidence for the agrarian economy and give a short summary of the aspects of markets and transport. Recently, a team of Dutch researchers has presented a model for calculating the possible agrarian production of the Rhine delta. This model has been adapted for the northern part of our research area with its loamy and sandy soils. In the second part, the conditions of the different landscapes within the Rhineland are discussed from a geoarchaeological and archaeobotanical point of view.

LANDSCAPES

The Rhineland as understood in this paper, i.e. the part of the Roman province of *Germania inferior* that is in the heritage care of the LVR-State Service for Archaeological Heritage in the Rhineland (LVR-Amt für Bodendenkmalpflege im Rheinland), encompasses three natural units, following the Nature Area Classification of the Federal Republic of Germany (Negendank & Richter 1982): The Lower Rhine Plain, the Lower Rhine Bay (referred to in the following as the “Cologne Bay”⁴) and the low mountain range of the Eifel (fig. 2; 3).

1. The Lower Rhine Plain forms the northern part of the research area and leads over into the Rhine-Meuse-Delta in the Netherlands. It is formed predominantly of loamy and sandy sediments of the River Rhine (fig. 2,1) encompassing also some loess-isles.
2. To the south lies the Cologne Bay. The loess sediment is predominant here (fig. 2,2a). The Cologne Bay belongs to the northwest-European loess belt with its more or less continuous loess layer.
3. The low mountain range encompasses the Eifel (in Belgium and northern France: Ardennes) to the south of the loess zone and the “Bergisches Land” on the eastern side of the Rhine valley (outside the Roman Empire) (fig. 2,3). But since this paper concentrates on the comparison between the loess dominated Cologne Bay of the southern Rhineland and the more sandy and loamy zones of the Lower Rhine Plain to the north, the low mountain areas are not considered further.

4. We have decided to use the term “Cologne Bay” instead of “Lower Rhine Bay” in order to prevent confusion with “Lower Rhine Plain” although the two terms are not exactly congruent.

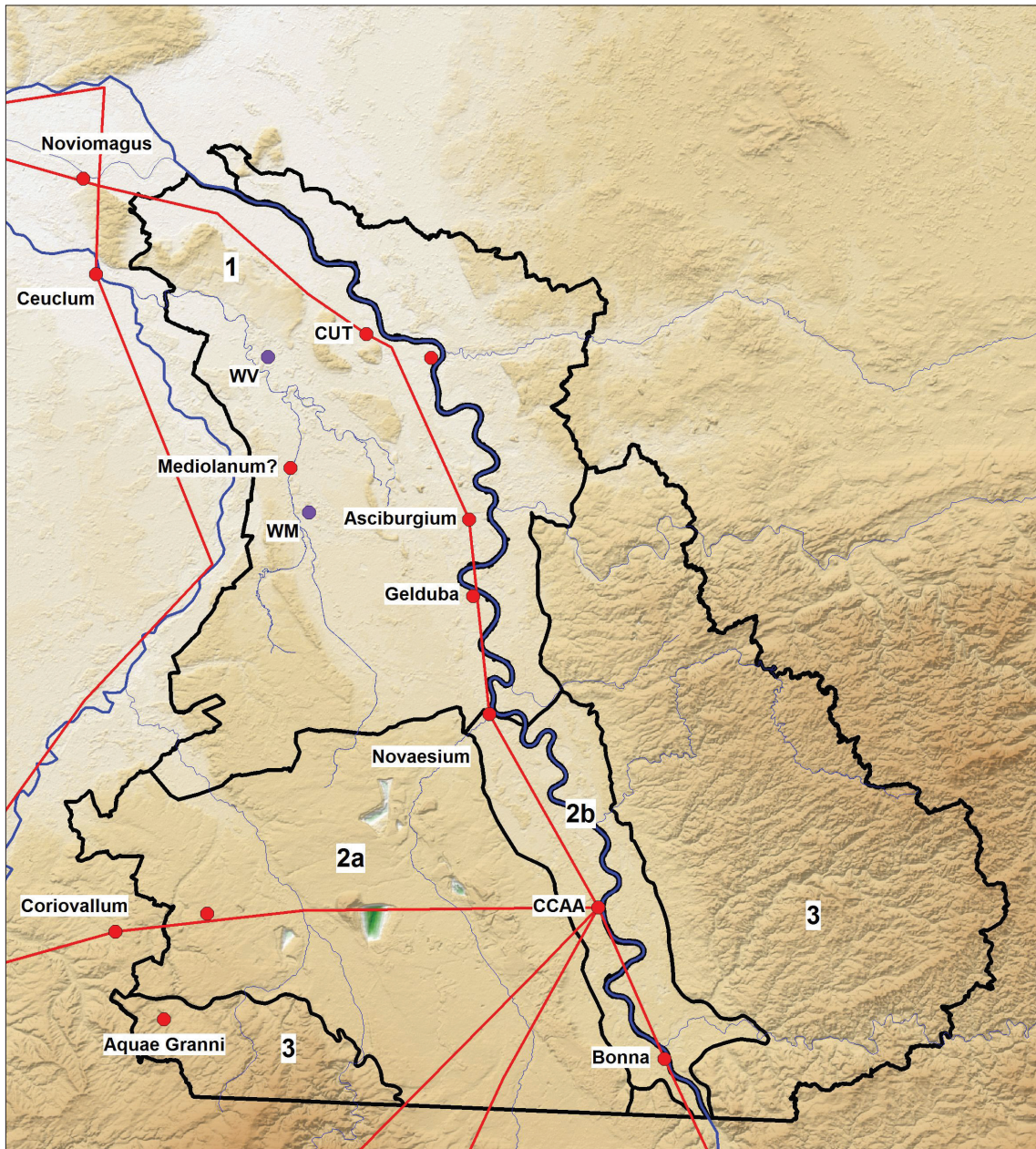


Fig. 2. Elevation map with natural units, Roman road network and central places. WV = Weeze-Vorselaer, WM = Wachtendonk-Meerendonkshof (R. Lubberich, LVR-ABR, LVR-ABR, based on SRMT).

Natural units	Mean annual precipitation	Mean annual temperature
1 Lower Rhine Plain	700-800 mm	10°-11° C
2a Cologne Bay (Loess)	550-800 mm	9°-11° C
2b Cologne Bay (Rhine valley)	700-800 mm	10°-11° C
3 Low mountain ranges	800-1,400 mm	7°-10° C

Fig. 3. Landscape units (modified after Negendank & Richter 1982) and climate data <http://www.klimaatlas.nrw.de>, Landesamt für Natur, Umwelt und Verbraucherschutz Nordrhein-Westfalen.

Part 1

Rural Settlements of the Roman Period in the Rhineland

Marion Brüggler, Karen Jeneson

HISTORY OF RESEARCH

The loess zone (Cologne Bay) (KJ)

The research history of the loess zone between the Meuse and Rhine rivers differs greatly whenever a national border is crossed. In Dutch Limburg, Roman villas were one of the few types of site to have attracted a great deal of archaeological attention as early as the nineteenth century, a situation unique in the Netherlands. The first half of the twentieth century saw rapid changes in the Limburg landscape, with the construction of railroads, new houses, improvement of roads, and the digging of channels for shipping. As a consequence, many archaeological remains were unearthed. These were inspected and retrieved by local individuals, such as the clergymen Habets and Goossens⁵. It is important to note that these early protagonists had no training as archaeologists, as it was not yet considered a discipline in its own right (Slofstra 1994, 12). Between the 1890s and 1940s over 20 villas were excavated. Typically only robber trenches and wall foundations of the main house of the settlement were investigated.

Interestingly, little archaeological research was carried out on Roman villas in the 1950s and 1960s. The villa of Voerendaal was the only site to undergo a series of excavations in this period. However, amateur archaeologists and local heritage groups remained active in the region, reporting sites to the newly-created State Service for Archaeological Investigations (Rijksdienst voor Oudheidkundig Bodemonderzoek). An important achievement of this institute was the creation of protected cultural heritage monuments. In South-Limburg, 63 Roman sites were listed as monuments, 53 of which are classified as villas (Groot 2006, 1, 4).

The villa site at Voerendaal was revisited in the 1970s, when new excavations were carried out by the State Service. These excavations clearly mirror the influence of New Archaeology. For the first time in the Netherlands the entire villa compound was excavated, rather than just the main dwelling. Attention was given not only to the luxurious house itself, but also to the economic activities that went on within its compound. The research focus was on the villa as an economic entity that formed part of the Roman market economy. The archaeologists used methods new to archaeology, such as pollen analysis and ¹⁴C and dendrochronological dating. Unfortunately, no complete account synthesizing the results has yet been published.

The introduction of the so-called “Valletta Treaty” – archaeological practice in the 1990s led to an explosion of projects carried out in South-Limburg. An analysis published in 2006 of 10 years of archaeological research shows that the number of projects in the region rose from two in 1995, to 43 in 2000, to 169 in 2004 (Baere & Mientjes 2006). One of the most important projects with reference to Roman villas was the excavation in 2000 of the villa settlement of Kerkrade-Holzkuil by a commercial archaeological company⁶. In a period of nine months the entire villa compound was excavated. Its publication includes several detailed reports by specialists, comprising research topics including archaeobotany, ceramics, iron ware, geomorphology, and microscopic analysis of natural stones and tiles. The excavators were able to reconstruct the phasing of the villa, showing its gradual transformation from a small-scale single farmhouse to a full-blown Roman villa (Tichelmann 2005). To date this remains the only full-scale excavation of a Roman villa in South-Limburg that has been published completely.

5. Clergymen with a special interest in the Roman period.

6. The Archeologisch Diensten Centrum of Amersfoort.

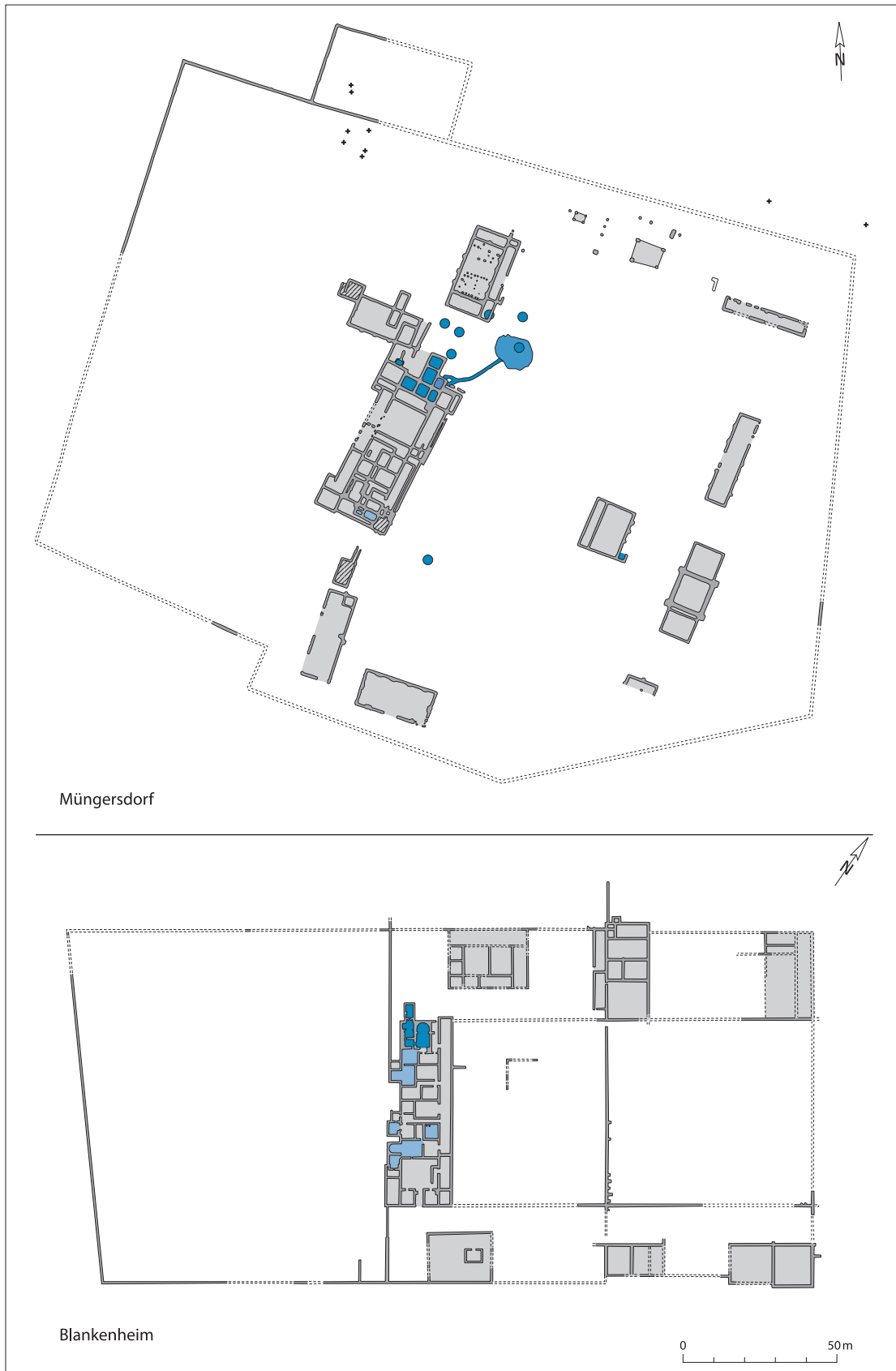


Fig. 4. *Villae rusticae* at Köln-Müngersdorf and Blankenheim (Eifel)
(C. Duntze, LVR-Landesmuseum Bonn; reprint from Heimberg 2002-2003).

“Commercial archaeology” has also resulted in an increase in many small-scale investigations, many of which have been carried out to assess the archaeological potential of a specific site⁷. These operations have provided important new data for Roman South-Limburg, particularly for elements contemporary with the villas, such as roads, towns, field systems, bridges, and farms without any stone structures.

For the German part of the loess zone, it can be said that military archaeology has dominated from the early days onwards (Kunow 1994; Kunow & Wegner 2006). With major military sites at Bonn, Cologne, Neuss, and Xanten, this preference seems only natural, but a consequence of it was that in the decades before W(orld) W(ar) II virtually no other aspects of the Roman world received any attention here. Investigations into civil settlement structures, if any, focused purely on villas, of which only two major sites were excavated in the period before WWII: Blankenheim in the Eifel and Cologne-Müngersdorf (fig. 4).

After WWII, this situation did not really change. There were, however, two notable exceptions in the 1950s: Harald von Petrikovits studied the Roman rural world in the north of the Eifel (Petrikovits 1960) and Herrmann Hinz carried out a survey in Kreis Bergheim (Hinz 1969). Their work shows an interest in reconstructing the Roman settlement system and was clearly influenced by the “Siedlungsarchäologie” of Herbert Jankuhn⁸ in the same era. Von Petrikovits’ work in particular sets out to analyse the entire landscape, including the natural environment. Hinz’s work consisted of a “Landesaufnahme” (survey) of the entire district of Bergheim, impelled by one of the most important factors in Rhineland archaeology: lignite extraction.

The triangle of Aachen, Cologne and Mönchengladbach holds Europe’s largest deposits of lignite (German “Braunkohle”). Today, three enormous open-pit mines – Inden, Hambach and Garzweiler – provide fuel for German power plants. These mines are situated in the loam zone near the current-day locations of the Roman *vici Juliacum* (Jülich), *Tiberiacum* (Bergheim-Zieverich), Baesweiler and Elsdorf. Although lignite had been used as fuel for over a hundred years by the local population, extraction took off in earnest after WWII. Thus, in the German Rhineland, rescue archaeology began some 30 years earlier than in the rest of Europe. Hinz realized that the new plans for extraction in the 1950s meant the potential destruction of vast areas containing important archaeological remains and that measures ought to be taken if archaeologists were to obtain the most basic of information from the region under threat. Consequently he carried out a large-scale survey of the entire district, using aerial photographs and field walking to map archaeological phenomena from all periods from the Neolithic to the Middle Ages.

The results, published in 1969, led to the number of known Roman sites in the area rising from 11 to 361 (Hinz 1969, 12). Although challenged by some, Hinz’s work undoubtedly set a new standard for archaeological research into Roman rural settlement patterns in the Rhineland (Kunow 1994, 151-153). His ideas concerning the villa settlement pattern, with different types of villas classified according to their size and type of main building, and the possibilities of centuriation were a clear indication that his aim was not just to map the region, but to analyse and interpret it too. His model of villa settlements alongside the Erft river is proof of this aim (Hinz 1969, 55).

The next impulse of research into Roman settlement in the hinterland of the German Limes came some 20 years later. It was, once again, provided by lignite extraction, when the Hambach open-pit mine was brought into operation in 1978. Because the Roman road from Tongres to Cologne ran right across the planned mine, it was decided to focus attention on the Roman period in the archaeological research accompanying this work. Another reason for this was the fact that most of the area had been covered by forest for hundreds of years, augmenting the chances of retrieving well-sites from the Roman period (Kunow 1994, 154). But the Roman period was investigated intensively in the other mines, too (fig. 5).

7. So-called “*Inventariserend Veldonderzoek*”, done using either none-intrusive methods, coring or trial trenches.

8. See Jankuhn 1977 for an overview of his work.

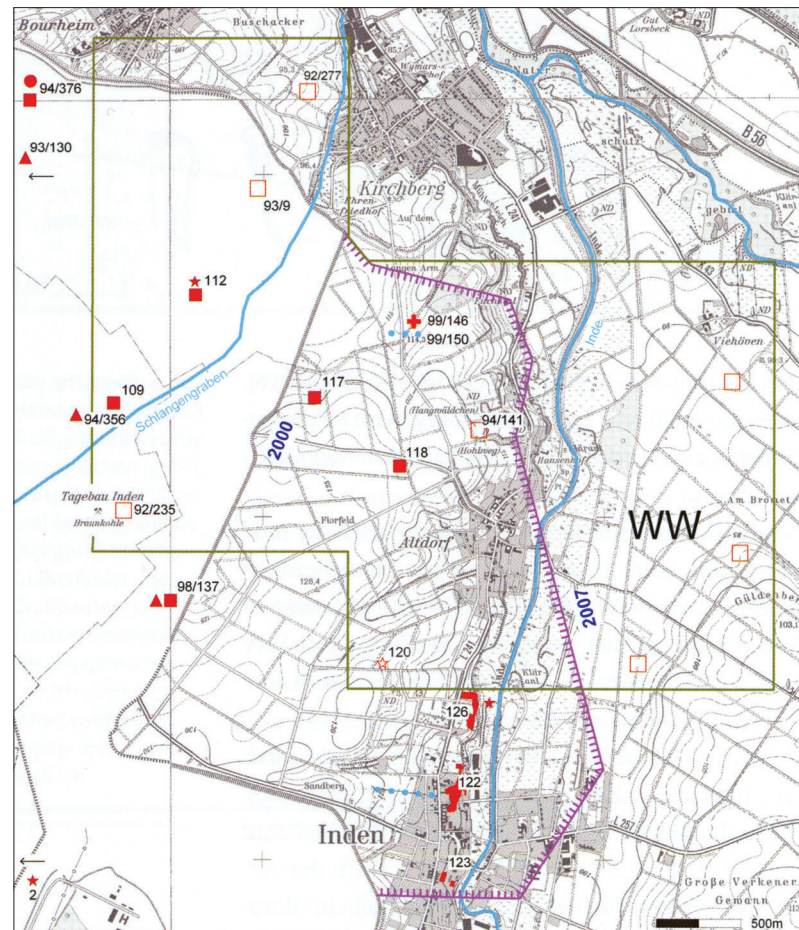


Fig. 5. Roman settlements south of *vicus Iuliacum* (modern Jülich). Squares: *villae rusticae*, polygons: excavation areas, open squares: surface sites, triangles: iron extraction/metal depot, cross: tile kiln, blue dots: aqueduct, star: burgus, dot: fortified settlement of the late Iron Age, green area: prospected zone 1991-96 (W. Gaitzsch *et al.*, LVR-ABR after Gaitzsch 2010).

The excavations carried out since 1978 by the Rheinisches Amt für Bodendenkmalpflege, under the supervision of Gaitzsch, have provided a unique opportunity for Roman villa archaeology in the north, namely the chance to excavate an entire Roman villa landscape. By employing different methods of field research, such as field walking, aerial photography and both small- and large-scale excavations, a wealth of information concerning the Roman rural settlement system in this part of the Empire has been collected. These techniques have been supplemented by modern research methods such as dendrochronology and archaeobotany (fig. 6). The results of this research have been published mostly in the form of excavation reports. The focus in these publications is on the development of the site itself and on what its material culture can reveal about the agricultural, economic, social and religious practices of its inhabitants. Specialist input such as archaeo-botanical and zoological research, ¹⁴C and dendrochronological dating and other methods have often been employed to address a wider range of issues (Heimberg 2002-2003; Gaitzsch 2010; 2011). Also outside the lignite mining area, development-led excavations of *villae rusticae* have boomed and a number of sites have been fully excavated or are known from aerial photography and field walking (fig. 7; 8).

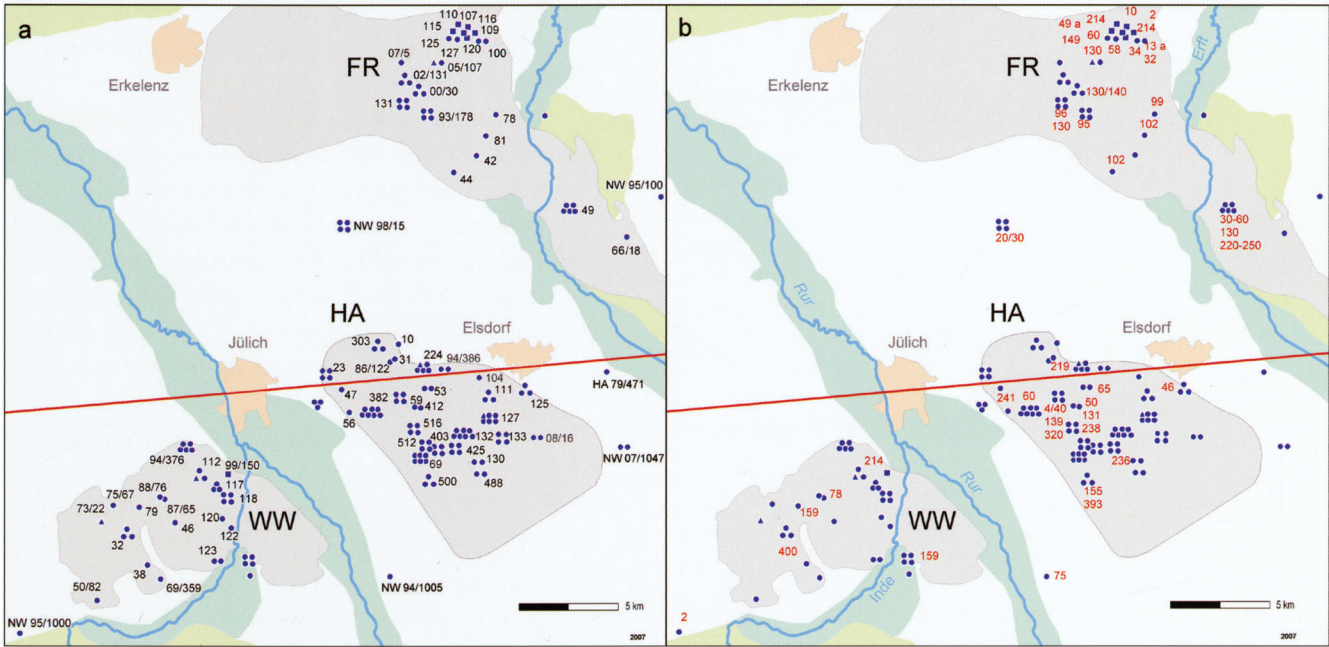


Fig. 6. Map of Roman wells (points), wooden constructions and waterpipes (squares), wells with skeleton (triangles). a. Discoveries and inventory number; b. Dendrochronological datation (reprint from Gaitzsch 2010).

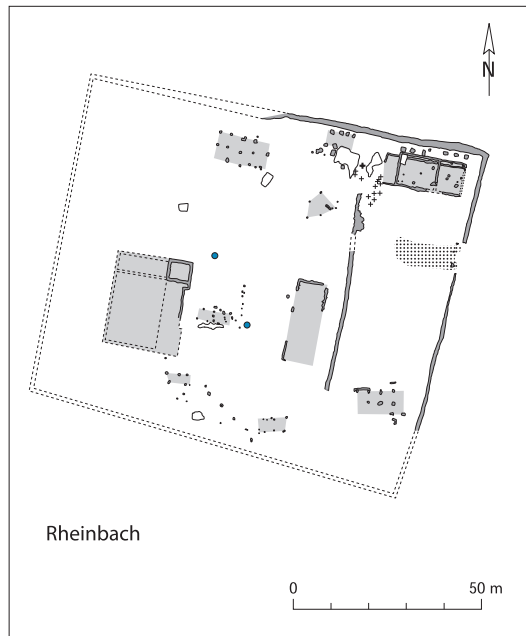


Fig. 7. Site Rheinbach, villa rustica (C. Duntze, LVR-Landesmuseum Bonn; reprint from Heimberg 2002-2003).

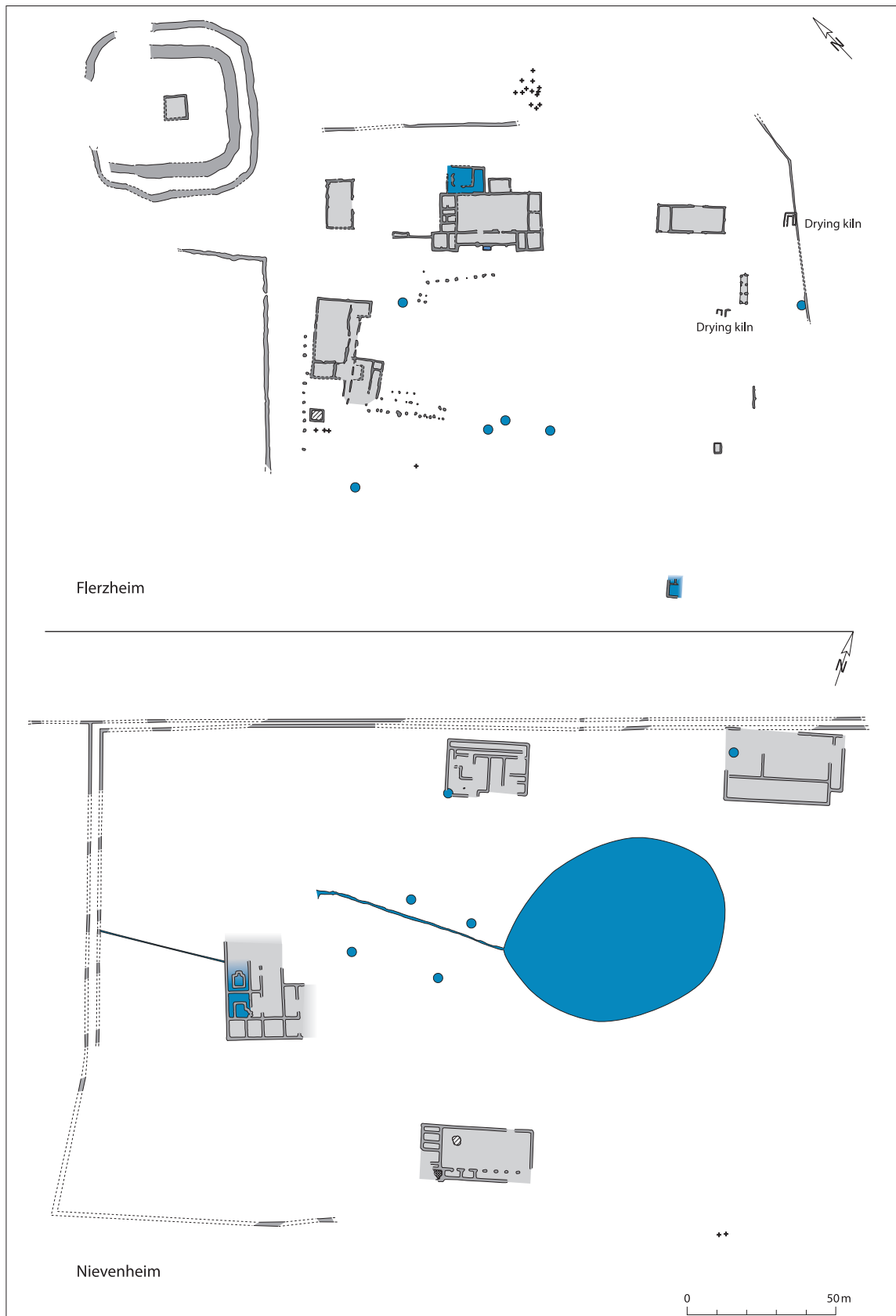


Fig. 8. Sites Flerzheim and Nievenheim, *villae rusticae*
(C. Duntze, LVR-Landesmuseum Bonn; reprint from Heimberg 2002-2003).

The Lower Rhine Plain (MB)

Archaeological research on the Lower Rhine Plain concentrated very much on the immediate Rhine-zone. First and foremost the two important Roman sites at Xanten, the legionary camp *Vetera* and the *Colonia Vlpia Traiana*, have to be mentioned. Much effort has been put into the research of Roman military installations, especially in the nineteenth century and before WW II, while the hinterland long eluded research. Military sites are more easily recognized by surface scatters of artefacts and building material as well as typical features which can be identified from aerial photography and elevation models. Rural sites, however, with their post-built structures and a limited surface scatter of building materials⁹ are less easily identified by these methods. Even if post-built structures can be spotted on aerial photographs, they can only be dated with certainty to a historic period in exceptional circumstances. Dating by ceramic finds on the surface is also difficult. Handmade pottery in the Iron Age tradition was used well into the second century AD and is therefore not easily recognizable as actually dating to Roman times. Furthermore, large extents of the sandy sediments lie under (plaggic) anthrosols, which were formed in Medieval Times. They effectively hide older habitation traces from detection by aerial photography and prevent finds from being ploughed up to the surface.

However, despite the aforementioned facts and the lack of excavation data until recently, the rural hinterland of the *Limes* attracted scholarly attention from early on. In the course of building- or draining activities or small-scale sand-extraction, Roman finds were dug up and noted. The surveyor and antiquarian Michael Buyx (1795-1882) mapped archaeological sites, many of them Roman, in his “Antiquarische Charte der Umgegend von Geldern” of 1878. The network of Roman roads also attracted interest¹⁰. A Romano-Germanic cemetery was rescue-excavated in the 1930s and gave a first glimpse of the rural population in the neighbourhood of the *Colonia Vlpia Traiana* (Petrikovits & Stampfuß 1940). In the 1960s, in the course of an archaeological inventory, Roman sites of the former district of Geldern (now part of the district of Kleve) were collated by Heinz Cüppers (Cüppers 1960), while those in the former district of Kempen-Krefeld were dealt with by Gudrun Loewe (Loewe 1971). Jürgen Kunow and Michael Gechter investigated the Kevelaerer Donkenland landscape in 1986 as part of a larger study¹¹. Parallel to that study, in the course of the preparation of the “Geschichtlicher Atlas der Rheinlande”, Roman settlements of the first to fifth centuries were mapped, with relatively few sites in the rural hinterland and fewer sites than the aforementioned study¹². Two trial trenches – in fact the first excavations on Roman rural sites in the study area – were dug in Weeze-Seisterather Hof and Viersen-Dülken in 1987¹³. Also in 1986 and 1987, a field-walking programme was carried out in parts of the “Kevelaerer Donkenland” in an attempt at an archaeological area survey¹⁴. A few years later, in another paper on Roman rural settlement in the southern part of the Rhineland, Kunow also mapped settlements in the northern part of the Rhineland, but without listing them in his catalogue (Kunow 1994). The “Kempener Lehmplatte” west of the modern town of Krefeld was intensively studied by Clive Bridger as part of his PhD project (Bridger 1994), which also encompassed the analysis of a rural cemetery at Tönisvorst-Vorst (Bridger 1996). Bridger later studied Roman settlements in a roughly 30 km radius around Xanten (Bridger 2000a). Parallel to his publication, Erika Riedmeier-Fischer carried out a diachronic study of a small area of 36 km² between the Niers and the Kendel (Riedmeier-Fischer 1998).

Development-led archaeology has since helped to enhance our knowledge: mainly the extension of modern gravel extraction quarries away from the stream channel zone of the Rhine to the hinterland together with a stricter application of heritage laws has led to several excavations of Roman rural sites in the last decade. Since 2007 excavations have taken place

9. While in the villa areas surface scatters of tiles, mortar and tufa help to spot rural settlements, the surface scatter in the northern zones is limited: tiles and bricks can be found on these sites as well, but in smaller amounts.

10. Hagen 1931 with older literature.

11. Gechter & Kunow 1986. The data were taken from unpublished archival material of the LVR-State Service for Archaeological Heritage.

12. Cüppers & Rüger 1985. As Bridger has already critically remarked, this map is incomplete even for the state of research in the mid-1980s.

13. Only excavated in one trial-trench, cf. Gechter 1988. An excavation prior to road-building was carried out in Niederkrüchten-Boschershausen in 1995, where a byre-house was documented, NI 1995/1038, cf. *Bonner Jahrbücher* 197, 1997, 290 and unpublished report.

14. Research by Manfred Gross & Hannelore Kretzschmann, pers. comm. H. Kretzschmann.

at Weeze-Vorselaer, Kevelaer-Grotendonk, Wachtendonk-Meerendonkshof¹⁵, Nettetel-Breyell¹⁶, Tönisvorst¹⁷ and Krefeld-Vennikel (Hofmann 2016a; 2016b).

HISTORICAL SYNOPSIS (MB)

Around 50 BC Caesar had conquered the Rhineland. According to his own reports he eliminated the tribe of the Eburones who had settled here (Caes., *Gal.*, 5,26ff., 6, 29ff; cf. Eck 2004, 41ff.). It is still debated whether he destroyed the whole tribe or just the elite. In the first case, we have to speak of a discontinuity of settlement and empty landscapes as a consequence of Caesar's Gallic War (Heimberg 2002-2003, 63). This is assumed for the neighbouring Meuse-Demer-Scheldt area (Roymans & Derks 2015, 24-25). In the Rhineland, this view has been contested on the basis of sites that seem to have continued through late La Tène and early Roman times (Andrikopoulou-Strack 2001; Brüggler & Frank 2015; Kempken 2012). The pollen-evidence, however, indicates a decline in agricultural use at the end of the Iron Age in the southern Rhineland (Kalis *et al.* 2007, 148). Moreover, recent detailed re-evaluations of the excavations at Jüchen-Neuholz and Pulheim-Brauweiler lead to the conclusion that there was no continuous settlement on these sites¹⁸.

In the Lower Rhine Plain, late Iron Age sites are hard to identify¹⁹. The main problem lies in dating late Iron Age handmade pottery. Some general observations suggest that the Lower Rhine Plain was not completely depopulated. The pollen diagram of Kleefsche Beek (cf. fig. 41b) seems to indicate uninterrupted agricultural activities (Kalis *et al.* 2008, 33-37). The handmade pottery of Roman date follows regional Iron Age traditions. The Oss-Ussen 4B and later Alphen-Ekeren house-types are developments from regional Iron Age house types. However, the regional pottery and house-building traditions cover large areas of the Lower Rhine, west as well as east of the river. The river itself did not function as a boundary, so new settlers – if they came from just beyond the Rhine – would hardly be identifiable (Reichmann 2007, 77; cf. also Roymans & Derks 2015, 30).

According to historical sources, during the reign of Augustus population groups from beyond the Rhine were resettled, the *Ubi* in the area around Cologne (Eck 2004, 46ff. Strab. 4,194; Tac., *Germ.*, 28,4) and others in the vicinity of the later *Colonia Vlpia Traiana* (Tac. ann. 12,39; Suet. Tib. 9). Johannes Heinrichs thinks that the latter, namely *Sugambri* and probably *Suebi*, merged with local groups from the left bank of the Rhine to form the *Cugerni*.²⁰ West of Cologne the new settlers, immigrants from central Gaul and probably extant Iron Age groups together constituted the rural population of the loess zone (Heimberg 2002-2003, 71).

Rural settlements are documented in the loess area as early as Augustan times with sites such as Pommenich or Aldenhoven-Langweiler (Geilenbrügge *et al.* 2016). They began with the opening of the Roman road linking Cologne to Bavay. Some house layouts in Weeze-Vorselaer in the Lower Rhine Plain can clearly be dated to the beginning of the Common Era (Brüggler & Frank 2015). Central settlements were already established, then, with primary centres that were later inferred to be colonies or municipia and secondary centres (Heimberg 2002-2003, 63). In the loess zone (Cologne Bay) in the first half to mid-first century, extensions of individual compounds began with wooden buildings. These were later constructed in whole or in part of stone (Gaitzsch 2011, 286). In the second half of the first century AD, there was a distinct increase in settlement density in the Lower Rhine Plain. Bridger reports a drastic rise of sites on the Kempener Lehmplatte around AD 100. Throughout the second century and into the early third century, settlement density remained at the same high level (Bridger 1994, 86f; van Enckevort 2000, 338).

15. Brüggler 2016. NI 2014/0040 Wachtendonk is being evaluated as part of a master's thesis by Theresa Langenhoff at Freiburg-University; the excavations in Weeze-Vorselaer are being prepared for publication by one of the present authors (Marion Brüggler).

16. Unpublished: NI 2016/1020: Nettetel-Breyell, under excavation. Currently, Roman settlements in the region between Erkelenz and Nettetel are being studied in a project by Eva Cott (LVR-ABR, preliminary report cf. Cott in print).

17. NI 2015/1053 Tönisvorst.

18. The Iron Age features that had been dated to the late Iron Age in the preliminary reports were in fact older, cf. Weber 2015; Granderath 2010.

19. Cf. Brüggler 2016.

20. Heinrichs 2000, 70-71. Cf. also Reichmann 2007; also for the south-eastern Netherlands van Enckevort 2000, 347 states that new settlers merge with the remaining population.

Settlement density peaked in the second century before a decline set in in the third century. In the loess-area, even though some villas were strengthened with fortifications (Henrich 2015) (fig. 8), many of the villas were abandoned by the late third century (Gaitzsch 2010, 81; Päßgen 2012). Several of the former villa sites were reused: this time glass production took place there (Gaitzsch *et al.* 2000; Brüggler 2009) (fig. 9). In the Lower Rhine Plain, settlement intensity was slowly declining already after around AD 200, for example on the Kempener Lehmplatte (Bridger 1994, 86f.). The excavated settlements of Weeze-Vorselaer, Kevelaer-Grotendonk, and Wachtendonk-Meerendonkshof were abandoned in the third century. Detailed finds analyses still have to be carried out to be certain of the exact time of abandonment. While military sites along the Rhine and the Meuse were still in use in the fourth and early fifth centuries (Brüggler in prep.; Haalebos 2006; Goudswaard *et al.* 2000; Brüggler 2014 (2016)), the hinterland in the Lower Rhine Plain shows very few indications of settlement activities, like a large coin hoard and stray finds²¹.

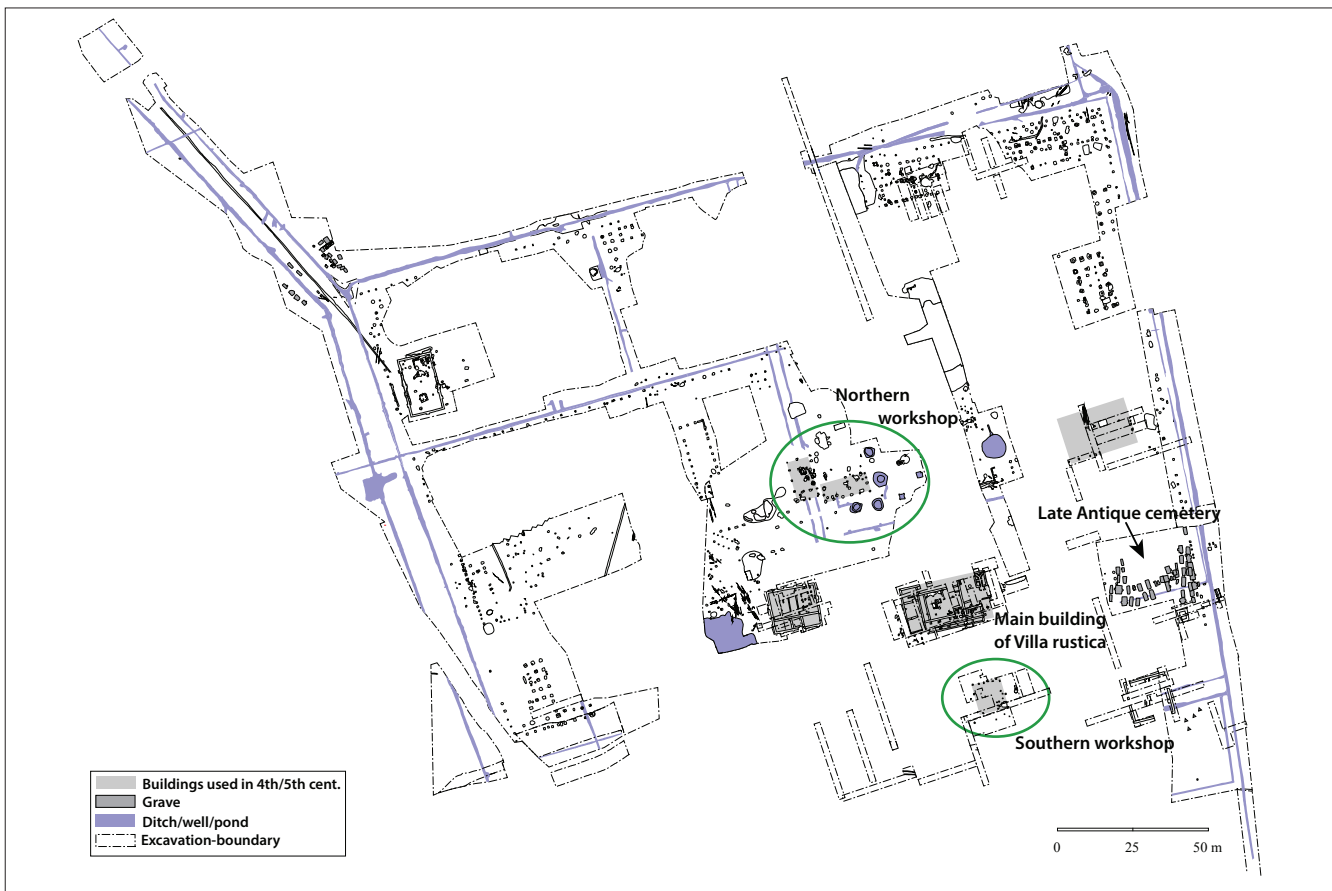


Fig. 9. Site Hambach 132, *villa rustica* (1st-3rd cent.) and glass workshop (4th-5th cent.) (M. Brüggler, based on an excavation documentation by H. Haarich *et al.*, LVR-ABR).

21. In the WUKS-area (cf. below) a hoard consisting of 5,200 coins was found in Weeze (town) in 1880 and is unfortunately lost today. It was probably hidden in the years around or shortly after AD 337, cf. Geschwendt 1960, 311-312. A probable early fifth century hoard was found in Sevelen-Huynbusch, cf. Geschwendt 1960, 225. Otherwise only solitary finds can be mentioned: Uedem-Keppeln, arming fourth c., cf. Petrikovits & Stampfuß 1940, Fig. 8 no. 7; potsherds: Geldern-Veert (NI 1111/0023); Weeze-Vorselaer (NI 2007/0115); Walbeck-Hövelshof (OA 0001/4901); Geldern-Pont Geschwendt 1960, 219; Issum Geschwendt 1960, 182f.; single coins: Sonsbeck, Follis fourth cent. (Ni 2011/0222). A few sites on the Kempener Lehmplatte feature finds of the fourth and fifth centuries, cf. Bridger 1994, 87. At Wachtendonk, several finds such as fragments of mountings and armings reported by metal-detectorists may indicate a Niers crossing.

The archaeological evidence is supported by the pollen diagram from Kleefsche Beek (cf. fig. 41b) near Cuijk, where a drastic decline in settlement-indicating pollen can be observed from the second half of the third century (Kalis *et al.* 2008, 36). These pollens dropped to levels not reached since the Neolithic. This development seems to be comparable with the Meuse-Demer-Scheldt region (“MDS”), where not only was a population decline observed, but complete depopulation took place between 250 and 280 (Heeren 2015, 281). Only later, in the late fourth and fifth centuries was the area re-occupied by new settlers from outside the Empire. Between the Meuse and the Rhine the depopulation does not seem quite so complete: the stray finds have to be accounted for, and someone must have hidden the coin hoard in Weeze, probably near some sort of habitation. Close to Cuijk at Gennepe, at the confluence of the Niers and the Meuse, a settlement of new groups – people from beyond the Rhine – was founded in the 390s, parallel to developments in the MDS-region (Heidinga & Offenberg 1992).

RURAL SETTLEMENTS

The loess zone (Cologne Bay) (KJ)

Characterization of settlement

The vast majority of rural settlements in the loess zone between the Meuse and Rhine rivers can be characterized as being of a stone-built type. This means that the settlement boasts at least one building, commonly the main dwelling, made with typical Roman building material such as natural stone, ceramic building material (roof tiles, floor tiles), and mortar. Very few rural settlements were found to consist exclusively of organic material. In a recent inventory (Jeneson 2013), the proportion of rural settlements including stone versus rural settlements made of organic building materials alone was 97:3%. These numbers suggest that the rural landscape in the loess zone was completely dominated by stone-built settlements, and that the vernacular style of building in the region was replaced almost completely by the Roman-influenced style. Interestingly, nearly all post-built sites can be dated to the early and early-to-middle Roman period. In contrast, sites that were classified as stone-built predominantly dated to the middle and late Roman period (Jeneson 2013, 87). This could be interpreted as evidence backing up the assumption that the post-built type of rural settlement was a legacy of the pre-Roman period, being replaced almost entirely by stone-built settlements in the mid-Roman period. This would mean that it is unlikely post-built farms were present in the loess area by the second century AD. New excavations in Dutch Limburg, however, have proven the existence in the middle Roman period of farms without any stone-built structures. This type of farm can only be recognized by means of excavation. Typically, the earliest discoveries of Roman settlements were all stone-built sites, easily recognizable by the stone foundations, even to the untrained eye. It is therefore likely that the proportion of post-built rural settlements in the loess zone could be higher than the 3% based on actual sites registered over the last 150 years. The stone-built settlements were present from the beginning of the Roman period, but their number grew substantially over the first century, displaying a real “boom” in the second century AD, before declining sharply in the third and fourth centuries.

Rural settlement hierarchy

The fact that stone-built rural settlements make up the vast majority of the dataset entails an important implication. Rural settlement in the study area is typically characterized as being either a Roman-style villa or a farm built in the native tradition, the obvious distinction between the two being the use of stone, ceramic building material, and mortar. The villas are generally seen as the residences of members of the elite, in line with the situation in other parts of the Roman Empire. Although, however, more than 90% of all rural settlement sites in the study area can be characterized as villas, it cannot be maintained that they represent the residences of the elite, since, by definition an elite forms a minority within society. The assumption that every stone-built settlement is a villa estate, and as such the residence of a member of the elite, must be altered at some point. If it is to be maintained that the local elite lived on villa estates, and this elite constituted a minority in society, not all settlements characterized as stone-built should be interpreted as villa estates. This suggests a need to find new ways to differentiate between groups of stone-built rural settlements.

In his recent study of Roman villas in the northwest of the empire, Habermehl analyses different characteristics of rural settlements labelled as *villa*, such as the architecture of the main house and the layout of the settlement (Habermehl 2011).

It makes sense to use this information to examine different aspects of the stone-built settlements in the loess zone between the Meuse and Rhine. For example, regarding the architecture of the main house, Habermehl identifies four different types: traditional house (TH), Romanized traditional house (RTH), timber-frame house (TFH) and multi-roomed house with stone foundations (MRH-SF). This characterization shows that between the obviously distinct types of the post-built traditional house and the stone-built multi-roomed house, there are two other types that seem to be a combination of vernacular and Roman elements. For his characterization, Habermehl uses only completely excavated and published settlements.²² Of the suitable sites, 171 were of the type “multi-roomed house with stone foundations”, 30 were of the “traditional house” type, 9 were “timber frame houses” and 10 were categorized as “Romanized traditional houses”. These numbers translate into the following percentages: 78% for the MRH-SF-type, 14% for the TH, and 4% each for RTH and TFH. Applying Habermehl’s criteria thus results in slightly different proportions regarding the vernacular and Roman-style architecture in the study region, but obviously the traditional house remains overwhelmingly outnumbered by the multi-roomed house with stone foundations. Regarding the types of houses with mixed elements, the timber-frame house is found mostly in the road-side villages and *vici*, whereas the Romanized traditional house is found predominantly in rural settings.

Habermehl also used a classification based on the layout and organization of the entire settlement (Habermehl 2011). He distinguished five types: the axially organized settlement, the large organized enclosed compound, the open multi-farmstead settlement and the enclosed multi-farmstead settlement, and, finally, the single farmstead. Only 142 sites in the settlement dataset of this study provided the necessary details for this classification, a result of the fact that most rural stone-built sites in the study area have not been examined outside of the main building. Details concerning the enclosure of a settlement are often such that no reliable verdict can be reached regarding its character (open or closed) and therefore the multi-farmstead types have been grouped together for this dataset.

Of the 142 sites, 104 (73%) were characterized as large organized enclosed compounds, 24 sites (17%) as multi-farmstead settlements, and 14 sites (10%) as single farmsteads. Interestingly the fifth type in this category, the axially organized settlement, although quite common in some parts of Gallia Belgica, is lacking completely in the study area. These results show that, although the characterizations regarding house type and settlement type do provide new insights into the (rural) settlement category in general, they do not shed light on the issue regarding the supposed “elite” status of (some of) the stone-built settlement sites. Therefore, a third variable used by Habermehl, relating to the size of the main house in a stone-built rural settlement, is examined. His study distinguishes between houses that had fewer than 10 rooms, houses that had between 10 and 30 rooms, and 30+ roomed houses (Habermehl 2011). Obviously for this characterization, detailed information regarding the main house was necessary, and only 51 sites in the study area provided sufficient information.

Of these 51 sites, 25 belonged to the “less than 10 rooms” category and 24 to the “10 to 29 rooms”, with only 2 sites in the study area being of the “more than 30 rooms” house type. In other words, the “number of rooms” variable allows for a subdivision of stone-built rural settlement sites into small, medium, and large houses, whereby small and medium-sized houses were the more common type of rural dwelling in the study area, with almost equal numbers. Interestingly, the large “palatial” type, usually associated with the term villa, appears to have been almost completely lacking in the region.

The distribution of the different sites shows that there is no obvious clustering of any one type in the study area, as both the small and medium-sized houses were found throughout the region.

To conclude, the use of Habermehl’s classifications has resulted in new information regarding the (stone-built) settlement types. If the numbers obtained can be considered as representative of the Roman settlement landscape, the average stone-built rural settlement on the loess soils between the Meuse and Rhine rivers was a large organized enclosed compound, with a small to medium-sized multi-roomed house, built on stone foundations. Nonetheless, more convincing evidence is needed with regard to establishing the residences of the local elite. It is proposed here to follow the method of another researcher working with Roman settlement differentiation. In her work analysing Roman settlement in Languedoc, France, Laure Nuninger proposed a methodology for settlement hierarchy based on the presence or absence of particular types of material evidence. Evidence of decorative elements, such as frescoes, mosaics, and precious natural stone such as marble, is seen as indicating a

22. In Habermehl’s study, the research region is much more extensive than that of the study at hand.

high status site (Nuninger 2003, 71; Bertoncello & Nuninger 2005, 9-10). Using this form of interrogation, specific architectural elements, such as a hypocaust or a private bath house, can be interpreted as characteristic elements of the “classic” Roman villa and, arguably, the opulent life style of its inhabitants. Thus, if it could be established what proportion of the dataset had evidence of such elements, more information could be provided as to a possible hierarchy within stone-built sites in the study area. As reliable evidence for these elements is limited to excavated sites, only part of the dataset of this study could be analysed. Although fragments of tubuli, tesserae, or painted plaster may be found during a field survey, they are likely to be reported as generic “ceramic building material” or “plaster” (if mentioned at all) and therefore only excavated sites have been used for the analysis in this study.

Within the study area, 172 rural stone-built sites provided sufficient information to be used with this characterization. Of the 172, 46 had evidence of a hypocaust, which corresponds to 27%; 33 sites had evidence of a private bathhouse, which corresponds to 25%, and only 15 sites had evidence of rich decorations in the form of painted plaster, mosaics, or decorative natural stone, which corresponds to 23%. When analysing the sites for a combination of the three elements mentioned above, 12 sites or 25% had one of the three elements, 30 or 61% had two of the three, and only 7 or 14% had all three elements. Without jumping to any conclusion, these lower percentages seem to be a better reflection of a more affluent minority that would be expected for a hierarchy.

The distribution maps show that, some regional differences notwithstanding, the sites with evidence of these specific elements are quite evenly spread over the entire study area, i.e. it is difficult to identify a particular area with substantially higher numbers of any one element. A possible exception are sites showing evidence of decorative interior elements such as frescoes and plaster, of which a high number are located on modern-day Dutch territory.

The next obvious step is to combine the results of the classifications by Habermehl and Nuninger. Of the sites characterized as having a “medium-sized main house”, only four showed evidence of a hypocaust, baths, and rich building materials; three sites did not have evidence of a hypocaust, baths or rich building materials. Interestingly, of the sites classified as having a “small main house”, three had evidence of a hypocaust, one site had baths, and one site had evidence of rich building materials. It is therefore important to conclude that the relations between the type and size of the main house and its architectural elements are far from straightforward. Smaller houses could have had more “luxurious” elements, and bigger apparently did not always mean better.

It is hoped that this closer exploration of stone-built sites has shown the usefulness of analysing many different variables of the settlement dataset. Information was obtained regarding the size of the main dwellings, the organization of the settlement and the presence of typical “wealthy” Roman-style architectural elements such as a hypocaust, private bathhouse, and ostentatious decorations such as mosaics and frescoes. If the subsets are considered to be reliable samples of the entire settlement dataset, these results hint at a settlement hierarchy within the subcategory of stone-built rural sites, indicating that one in ten to one in four of them stand out as being more conspicuous in terms of the architecture of the main house. The foregoing suggests that the Roman villa should not be seen as a single type of settlement, but rather as a group of different types of settlement. The presence of at least one stone-built structure is one of the main archaeologically recognizable traits, but it is the presence or absence of other variables, such as a hypocaust, private baths, ostentatious building material, size of the main house, and spatial organization of the farmyard that determines the different types of *villae*.

Whether or not all or part of the rural sites characterized as a villa should be considered as residences of the upper class of Roman provincial society in this part of the empire is the obvious question; one that needs much more research before it can be reliably answered. It can, however, be said that if the appearance of the main house is seen to be a reliable indicator of the status of its inhabitants, the results of the analysis above suggest a considerable variety in the status of villa-owners in the Meuse-Rhine region. This is in stark contrast with the common assumption that every stone-built site was the seat of a member of the local elite. This should be seen as an important clue to the composition of society in Germania Inferior. In any case these results should be seen as conclusive evidence against the monolithic interpretation of stone-built rural sites as a single type of settlement, automatically associated with “the elite”. To further explore this issue and substantiate the claims made above more fully, new empirical data on this issue are required.

Chronology of the stone-built rural sites

The last factor to be examined here concerns the development of the rural landscape through time. It could be argued from the evidence above, that evidence in the study area of a wealthy life style did not appear until the prosperous middle Roman period. Following this line of reasoning, settlement sites dated to the middle Roman period should be expected to have proportionally more of the elements mentioned than sites dated to the early or late Roman period. Table 1 below shows that, of the eight sites dated to the early Roman period and that are suitable for this analysis, none have any of the four specific elements considered to be evidence of a wealthy life style. In contrast, in the early to middle Roman period, at least nine sites appear to have had one or more of the elements identified and it could be argued that a proposed increase in wealth, expressed through architectural elements, appears to have taken place. However, the middle and middle-to-late Roman periods do not show an increasing number of sites using such architectural elements. In fact, the only thing these numbers seem to prove is that there is no pattern of increased wealth over time expressed through the four identified architectural elements. A direct correlation, as described above, does not seem to apply to rural settlement in the study area. However, it must be pointed out that so few sites qualify for this characterization that the reliability of the results can be questioned. Again, further investigations into this subject to provide new empirical data would be welcome.

Structure of rural settlement

Throughout the loess region completely excavated rural settlements appear to have had a distinct layout, regardless of whether they are characterized as being stone-built or post-built. Both types demonstrated a recognizable division between the inhabited space of the settlement and its uninhabited space, often with a third area designated for a cemetery. Fig. 10 shows an example from the German Hambach region, whereby the inhabited space (in grey) is seen as a nucleus within the entire settlement (the land outside the ditches), and the burial sites on the edges of the inhabited space form a separate zone between the two. On the right, this information is translated into an abstract visualization.

It is argued here that all Roman rural settlements in the study area had a zonal structure as depicted in fig. 10. The inhabited space, zone A, was characterized by the presence of dwellings and utility buildings. Because off-site archaeology has only recently been introduced, only zone A is known for most settlement sites. In fact, often only part of zone A is known, as researchers typically examined only the main dwelling. It should be reiterated that the division of a settlement in inhabited and uninhabited parts, marked by a demarcation of the inhabited nucleus, was not restricted to stone-built settlements, as evidenced by completely excavated post-built settlements found in the Dutch part of the study area. These settlements consisted of several contemporary farmhouses made of organic materials, located within rectangular ditch systems and surrounded by arable fields and pastures (Vanderhoeven 2006; Tichelmann 2014). This type of settlement can also be found in other regions, for example the Rhine Delta (Vos 2009, chapter 3 and 4).

The third element in the archetypical settlement concerns the evidence of funerary practices. Burials in a rural context were often located just outside of the ditches or palisades, marking the boundary between the inhabited and uninhabited space. This identifies a third element in the settlement, the burial zone, as shown in fig. 10.

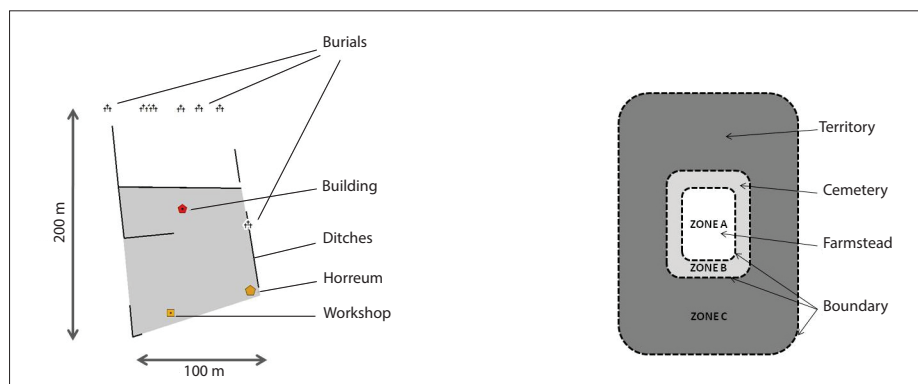


Fig. 10. Example of a completely excavated farmyard, HA 59 from the Hambach area, and the abstract visualisation based on this information.

Measuring the size of individual sites, a range and average value for zone A, the inhabited space, can be established. Enclosed farmyards in the region measured on average approximately 2.5 hectares, with the largest farmyard measuring nearly 7 hectares (WW 122) and the smallest less than 1 hectare (HA 69, fig. 11; Nuth-Vaesrade).

Detailed examination of the excavated farmyards in the study area shows that they were all rectangular structures with fixed length-width dimensions. This means that, although an area of 2 hectares could in theory be anything from a square of 141 m x 141 m to a rectangle of 10 m by 200 m, in practice, the length-width ratio is such that odd-shaped rectangles are rarely found, if at all. There are 18 completely excavated farmyards in the study area with the following length-width dimensions:

Site	width (m)	length (m)	area (m ²)	
WW 81	85	85	7,284	
HA 69	89	107	9,925	Cf. fig. 14
Nuth Vaesrade	100	100	9,999	L/W dimensions by approximation
Spaubeek zuid	78	133	10,481	
HA 130	85	115	10,565	
HA 516	86	135	11,351	Cf. fig. 14
HA 59	104	109	11,801	Cf. fig. 12
HA 53	98	176	17,507	
Kerkrade-Holzkuil	90	219	20,154	
HA 512	119	213	25,013	Cf. fig. 13
HA 412	139	158	25,143	
HA 303A	110	140	30,464	Settlement HA303 consists of two individual adjoining and enclosed settlements
HA 303B	70	223		
Butterweiden	140	250	34,873	L/W by approximation
Backerbosch	200	200	38,818	L/W dimensions by approximation
HA 132	200	250	48,933	Cf. fig. 9
WW 122	265	265	69,866	L/W by approximation
Herkenberg	217	244	53,787	L/W dimensions by approximation

Tab. 1. Spatial dimensions of completely excavated farmyards (zone A).

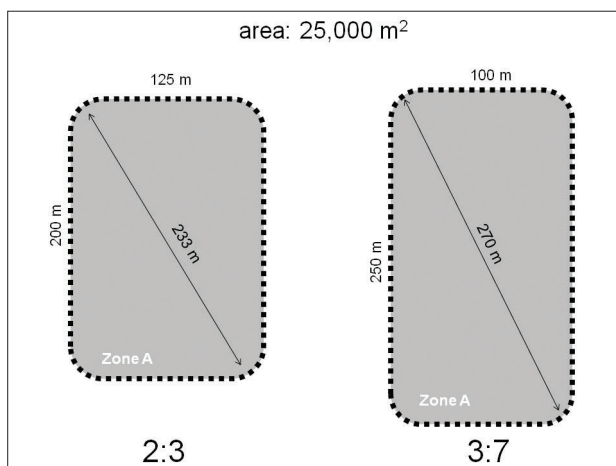


Fig. 11. Average spatial dimensions of the inhabited zone of a rural settlement.

Table 1 shows that all of the 18 farmyards were rectangular, with the proportion of width to length ranging from 1:1 (HA 59, fig. 12, WW 81, WW 122, Nuth-Vaesrade, Backersbosch) to 3:7 (Kerkrade – Holzkuil), but the most common proportion seems to be 2:3 (HA 130, HA 516, HA 53, HA 512, HA 132, Butterweiden, Spaubeek Zuid). Using the average value of 2.5 hectares and a proportion of 2:3 this corresponds to a rectangular structure of 125 m x 200 m; using the 3:7 proportion results in dimensions of 100 m x 250 m. This information was used to add a spatial dimension to the abstract visualization, as shown in fig. 11.



Fig. 12. *Villa rustica* Hambach 59 (C. Duntze, LVR-Landesmuseum Bonn; reprint from Heimberg 2002-2003).

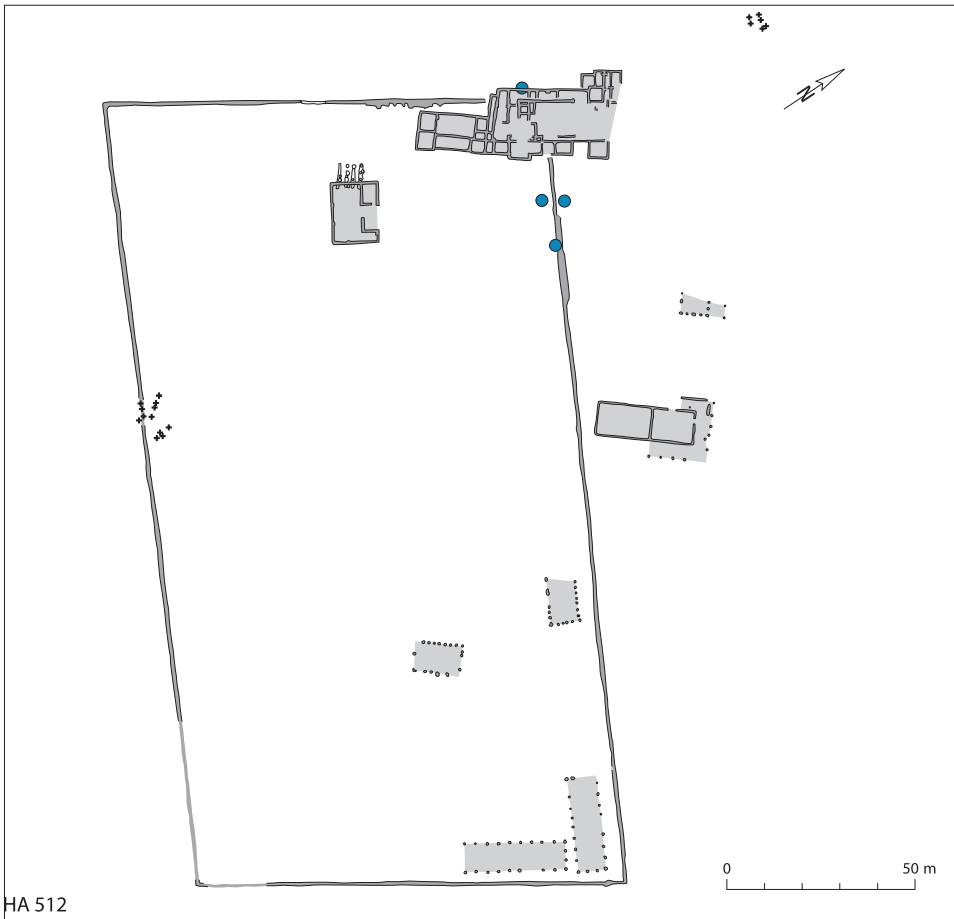


Fig. 13. *Villa rustica* HA 512 (C. Duntze, LVR-Landesmuseum Bonn; reprint from Heimberg 2002-2003).

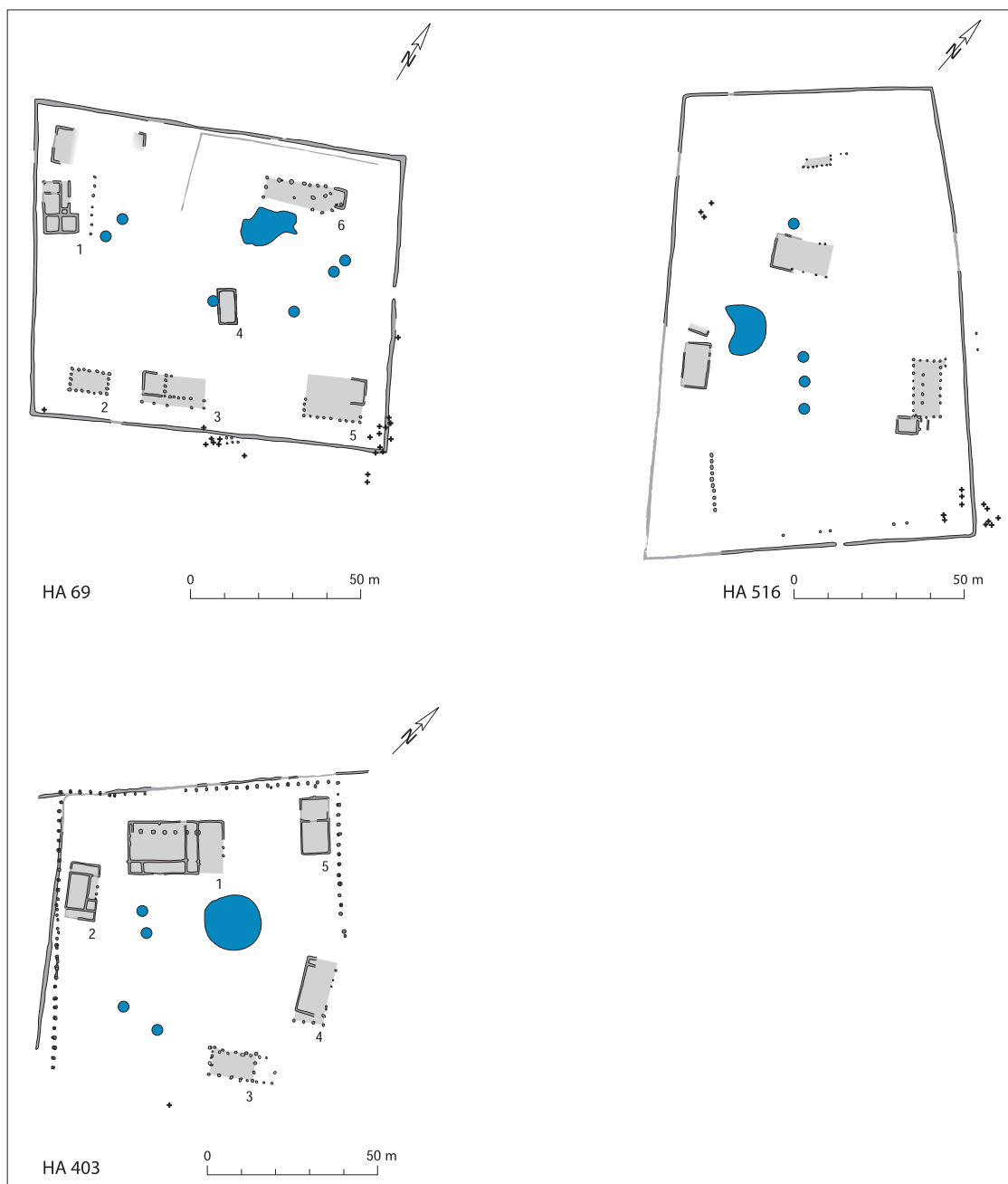


Fig. 14. The sites of Hambach 69, Hambach 516 and Hambach 403
(C. Duntze, LVR-Landesmuseum Bonn; reprint from Heimberg 2002-2003).

Settlement density

In the landscape archaeological study mentioned earlier, the similarity in layout of the rural settlements in the loess region was used to reappraise the basic dataset, creating a new dataset using not only settlement data, but also burial evidence and even sites that were only vaguely interpreted as rural settlements²³. This new dataset can be seen as a maximum scenario for the region, with the basic dataset serving as a minimum scenario. The two datasets were then used to evaluate rural settlement density in the Meuse-Rhine region (fig. 15). Interestingly, even though the number of sites differs between the two datasets, the density patterns are very similar, with regards to the location of areas of higher settlement density. In this chapter the settlement density based on the “maximum scenario” will be used for analysis²⁴.

The general pattern of the settlement density map indicates that the central eastern part of the study area was more densely populated than the central western part of the loess region between Meuse and Rhine. This could be a reliable reflection of the actual situation in the Roman period and, if so, specific conditions in the areas of high settlement density should be identifiable that made those parts more attractive to Roman farmers. For example, it is generally accepted that environmental factors such as climate, soil type, the presence of water, and elevation determined the suitability of a region for farmers. With this line of reasoning, it was to be expected that the environmental conditions of areas with highest settlement density would be substantially better than those of areas with low settlement density. However, the spatial analyses showed that soils, proximity to water, elevation, and the occurrence of natural stone deposits could not account for the differences observed in rural settlement density within the loess zone area (Jeneson 2011).

Not only environmental factors influenced settlement location. It could be claimed that the development of an interregional market has to be considered as the driving force behind the development of the Roman provinces. For example, the Limes located on the Rhine is usually considered to have been a major stimulus for the development of the countryside, with the army camps and new towns in this zone functioning as important consumers of agricultural produce. It can therefore be argued that the Limes zone would have had an impact on settlement, the assumption being that settlement numbers in close proximity to these areas of high demand would be higher. However, analysis shows that this argument does not apply to the study area, as the region closer to the Rhine has in fact lower density numbers than the zones situated further away. Likewise, proximity to a *civitas* capital, in general, could have influenced settlement patterns, based on the same assumption that proximity to an area of high demand was an important settlement stimulus. However, the analysis of these factors showed that they could not explain the higher settlement density in the central-eastern part of the loess zone (Jeneson 2011).

It seems that the differences observed in settlement density cannot be explained by the presence, absence, or proximity to any environmental factor, whether natural or cultural²⁵. Therefore another possible factor was taken into account, namely the past and present archaeological activity in the Netherlands on one hand and Germany on the other. One very obvious difference between the two nations is the large-scale archaeological operations carried out in the heart of the Rhineland in the vicinity of the towns of Jülich and Bergheim. Due to the open-cast mining there, the land within the projected mines has been constantly subjected to the entire range of archaeological activities, from survey to excavation. The land to be destroyed was systematically surveyed several times, under different circumstances. The activities have been carried out by the same archaeological institute and all sites were recorded uniformly within a single database. Archaeological activities in Dutch Limburg have also been connected to building and development projects, but field surveys have not been as common as in the German region, and the activities have been carried out by many different companies.

23. See Jeneson 24.01.2013 chapter 5 and Jeneson 2016.

24. See Jeneson 24.01.2013 for the analysis using both scenarios.

25. For the analysis of the perceived influence of more than one factor at the time, see below.

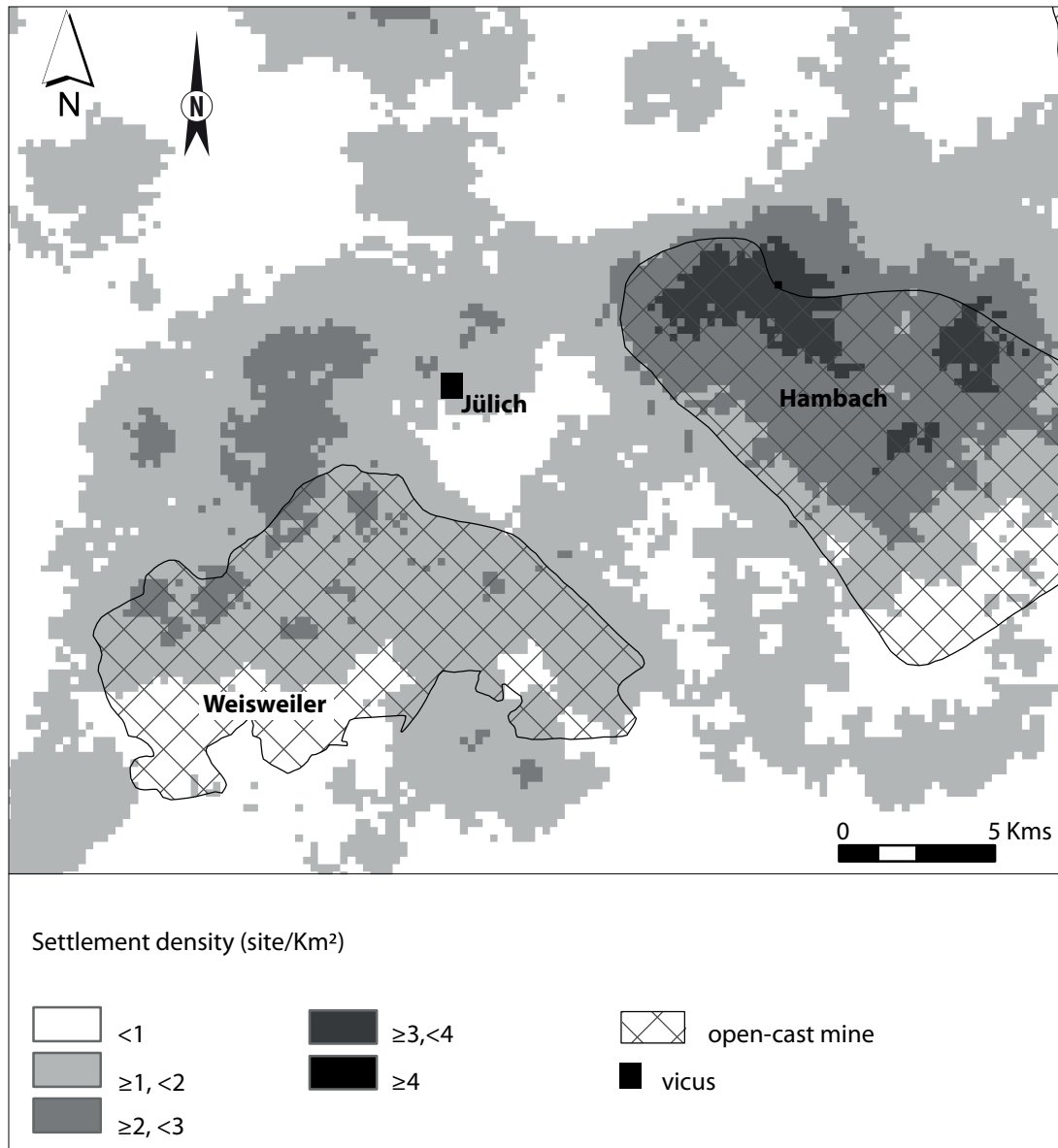


Fig. 15. Close up of the settlement density situation in the region around Jülich, with the two open-cast mines of Weisweiler and Hambach.

The archaeological activities in the German mining area means that, here, it is possible to speak of landscape archaeology in the most literal sense, as practically the entire landscape is subject to archaeological examination, before it is destroyed forever. The use of systematic surveys in particular has distinguished this region from the rest of the study area. In fact, the practice of systematic field surveys has not been tied exclusively to the mining areas as, just after WWII, professional and amateur archaeologists carried out large-scale survey projects of the region around Jülich and Bergheim.

Clearly the areas of highest settlement density can be associated with the open-cast mines and the large-scale survey projects carried out in the vicinity of Jülich and Bergheim. The current settlement density maps are the result of a bias created by archaeological activities rather than a reflection of the actual situation 2 000 years ago. The areas with the highest settlement density are located where intensive archaeological activities have been carried out, in particular systematic field surveys. Likewise, low(er) settlement density numbers can be related to areas with low(er) intensities of archaeological activities. Whether or not systematic field surveys have been carried out seems to have had a direct effect on settlement density numbers.

Low settlement densities at the two large mines of Garzweiler - Frimmersdorf do not lessen the argument, as these mines were exploited much earlier in the twentieth century, prior to the era of intensive archaeological prospection. In contrast, settlement densities are highest at the location of the Hambach mine, situated between Jülich and Bergheim. Work here did not start until the late 1970s, and field surveying was part of the systematic research approach from the outset.

Differences in past and current land-use certainly have had an influence on settlement density numbers, as particular practices enhance the visibility of archaeological remains, while others diminish it; in addition, it can be said that in certain circumstances archaeological remains are better protected. For example, in the Weisweiler region, west of Jülich, the land has been farmed and ploughed for hundreds of years. Although archaeological remains are quite easy to detect in such circumstances, centuries of ploughing will have also meant substantial damage to these remains. The Hambach region, east of Jülich, was covered by a large forest for centuries, before the mining activities started. Archaeological remains here did not suffer from agricultural activities the way they did in the Weisweiler region, which could explain why of the two areas, settlement density is higher at Hambach.

An important implication of the above is that the high densities observed in the German lignite mining areas can be regarded as the most reliable reflection of the Roman situation. After all, if the main cause for differences in settlement density amongst micro-regions lies with the archaeological practices, it follows that the density of the region that has been the focus of intensive systematic research should be considered as the most probable scenario. In other words, the average settlement density in the Hambach and Weisweiler regions could be applicable to the entire study region, meaning three to four settlements per square kilometre. Following the evidence regarding the types of rural settlements from the Hambach region, at least two of these rural settlements were villas. The validity and possible consequences of this observation should be further explored.

The Lower Rhine Plain (MB)

The loamy and sandy soils in the northern Rhineland have a different type of farmstead from the loess zones: no *villa rustica* can be found between Meerbusch near Krefeld and the German-Dutch border near Nijmegen²⁶. As in the case of Metz (Reddé 2016, 18), the nobility of the *Colonia Vlpia Traiana* seem not to have held estates in the immediate vicinity of the town. They rather held estates a considerable distance – around 100 km – to the southwest in the loess zone near Maastricht and Heerlen²⁷. Here, at a *villa* at Valkenburg-Ravensbos, bronze tablets have been found belonging to a *decurio* from Xanten²⁸.

In contrast, the farms that are to be found in the loamy and sandy areas between the Meuse and the Rhine are built of wood without stone foundations. The main buildings are byre houses, as in the Iron Age (van Enckevort 2000, 337). Because so far only very few rural sites have been excavated in the research area, it is too early for a general outline. Instead, we can go into more detail in describing the single sites in the following section.

Weeze-Vorselaer

Weeze-Vorselaer is situated *ca.* 15 km west of Xanten and midway between the Meuse and the Rhine rivers (fig. 2, WV). It was rescue excavated between the years 2007-2011 by the Xanten department of the LVR-State Service for Archaeological Heritage in the Rhineland (LVR-ABR) because of large-scale gravel extraction. As part of the permit procedure prior to the gravel extraction,

26. Heimberg 2002-2003, 58; Clive Bridger disagrees and points out three potential villa sites at Sonsbeck, Moers-Schwafheim (Bridger 2000b, 60), and Bedburg-Hau Till-Moyland (Bridger 2000a, 20; 2009, 251). While the latter recently turned out to be an auxiliary fort (Brügger & Drechsler 2012), the site at Sonsbeck was already observed in the early seventeenth century and cannot be verified so far (cf. Teschenmacher 1721, 28). Also at Moers the original report from the mid-nineteenth century only mentions “ausgedehnte Reste von römischem Mauerwerk aus Ziegel, Hau- und Tuffsteinen” (Rein 1859, 157), whose attribution to a *villa rustica* is far from certain. But in 2004 Bridger excavated a risalith building only 90 m from the town walls of the *Colonia Vlpia Traiana* (Bridger 2009, 243-251). It is dated from the late first to the beginning of the third centuries. It may have belonged to a *villa rustica*, but a *villa suburbana* or a hostel are also conceivable.

27. Derks 2011; and also some veterans settled here, Bridger 2006.

28. Derks 2011; even if the rather small villa itself might not have been the original location of display of the tablets – they may have been taken there as part of late Antique or post-Roman scrap collection – they show that the order of the *decuriones* of the CUT held land in the surroundings.

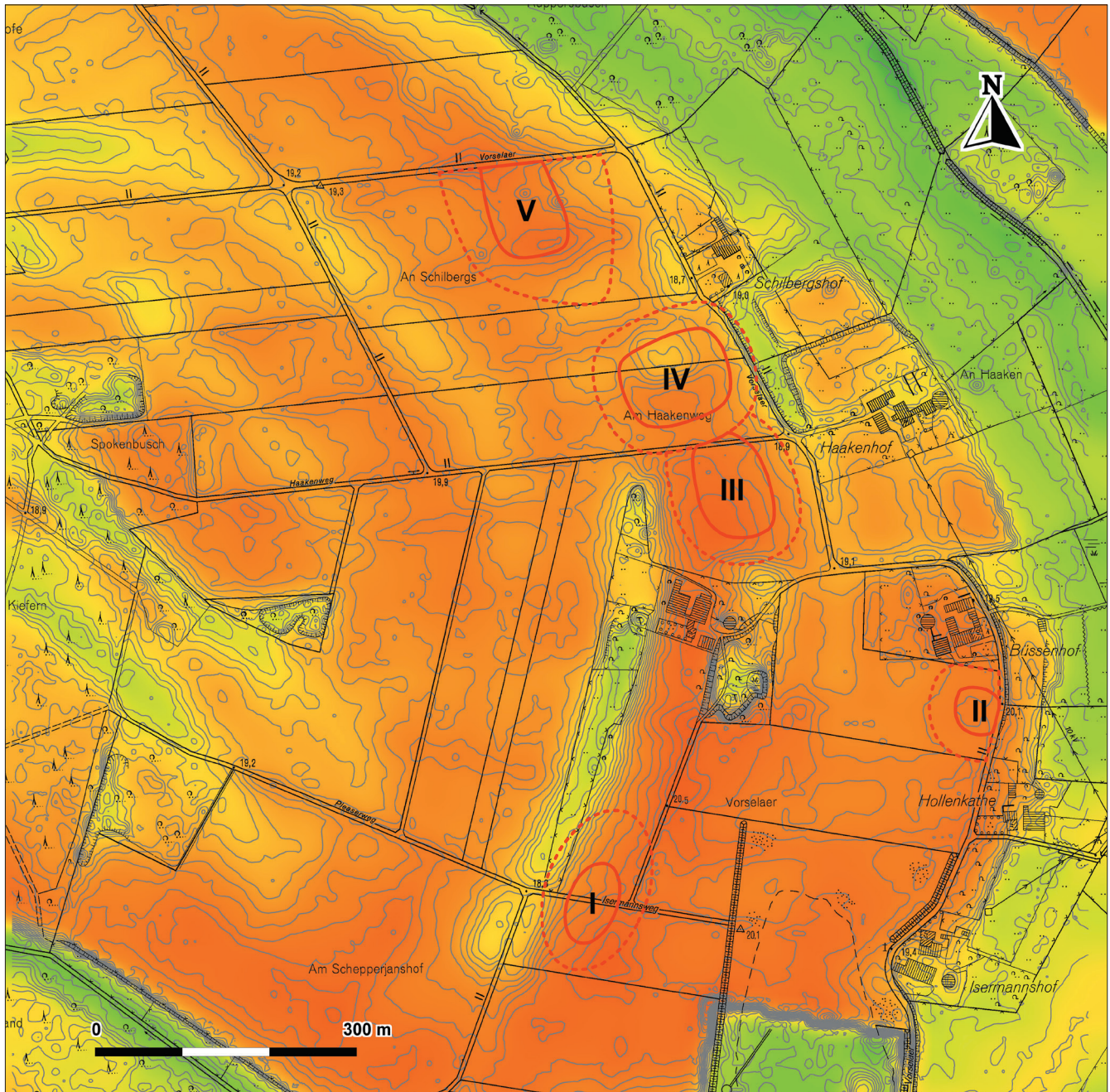


Fig. 16. Zones I to V in Weeze-Vorselaar before excavation on elevation map
 (H. Berkel, LVR-ABR. Basis: DGM10-data and Deutsche Grundkarte 1:5 000 © Geobasis NRW).

the private archaeological company W.S. van de Graaf undertook archaeological surveys and test excavations. Together with topographical data, five zones of potential archaeological concern were identified (fig. 16). The zones were numbered I to V from south to north.

They are situated on a low elongated plateau with an elevation of around 20 m above sea-level along the Vorselaer Ley brook, a former oxbow of the River Niers. The difference maximum in height between the plateau and the floodplains of the brook is 2 m. The elevations were formed as fluvial deposits and consist of sand. Along the edges of the sandy elevations, denser,

loamier deposits occur. This soil is described as humic cambisol on the “Bodenübersichtskarte 1:50 000”²⁹, but excavation revealed it to be a kind of plaggic anthrosol, resulting from fertilizing with sand used in stables, enriched with dung and then spread on the fields (Steeger 1939). This resulted in a slow increase in the depth of the upper soil, effectively hiding Roman and earlier features under a 0.8 m layer of cover. This procedure was started after the Roman period³⁰.

The following summarizes the preliminary results of the excavations of Zones III to V. Zone I has not yet been excavated and Zone II was destroyed by the mining company prior to the planned excavation. All in all, around 5 hectares have been investigated (fig. 16 and 17a-b). Trial trenches established that the settlement structures continue to the north of the rescue excavation boundaries but, as the proposed gravel-extraction did not cover these areas, they were not excavated in full.

The oldest settlement features were found in the northern part of Zone V, the northernmost of the excavated zones. They belong to the Middle Bronze Age, as is proven by the presence of Hilversum pottery. A number of post-built structures were uncovered that have been dated to the Iron Age, but a more precise date is not yet possible at the current stage of finds analysis. To the west of Zone IV, a well was excavated with a ¹⁴C-date of 814-766 calBC (68.2%), proving that at least during the early Iron Age the site was settled³¹. Immediately to the south of the Bronze Age and Iron Age features, a zone of several overlying structures from the beginning of the Common Era were investigated. At least three layouts of buildings can be discerned, which intersect one another. The most recent and best preserved of the three layouts is 18 m by 7.7 m (fig. 18.1). It was aligned southwest-northeast, lying perpendicular to the plateau. The house was two-aisled, divided into living and byre sections of almost equal size. The central posts do not appear in the short sides, indicating that the building had a hipped roof (Hiddink & Roymans 2015, 54). The wall posts were accompanied by outer posts to support the eaves. An entrance lay midway along the southern wall with another entrance possibly opposite it. In the south-western part of the building, a pit was discovered with the lower half of a Roman oil amphora standing in it (fig. 18.1a). Adjacent to the southern corner of the house a second and probably earlier structure of the same type of 21 m by 7.1 m was excavated (fig. 18.2). Even though it was less well preserved, in the north-eastern part of the building, three parallel shallow ditches can be interpreted as the remains of cattle stall walls. Yet another layout of the same type can be made out adjacent to the two houses and partly built over by them (fig. 18.3). These buildings resemble layouts of the Oss 4B type, which is a derivative of the Iron Age Haps type (fig. 19) (van Es 1982). Oss 4B type houses are dated to the late Iron Age in the Meuse-Demer-Scheldt region (Hiddink & Roymans 2015, 53). In Vorselaer, however, the Oss 4B type still seems to have been in use around the beginning of the Common Era. Adjoining the north-western wall of building fig. 18.1 was a sunken-feature-building (fig. 18.4), whose fill contained two sherds of Italian Terra sigillata. Their presence not only provides a date around the beginning of the Common Era, it further illustrates the close connection of the native settlements in the hinterland with the Roman Army (Roymans 2011, 148, 150). Several pits surrounding the house structures contained pottery and other finds that can be dated to the first decades of the first century AD. One of these pits also contained the only coin recovered in Vorselaer, an Aduatuca coin dating to the end of the first century BC (fig. 18.8)³². Finds from the fill of the postholes do not contradict this dating.

To the south of this cluster of features, several smaller post-built structures can be made out (fig. 17a-b). They appear to be granaries or outbuildings. Finds from the fills of their postholes and stray finds from the area consist of Roman wheel-thrown pottery and hand-made pottery. Most of the small fragments cannot be dated more closely, but it seems probable that the small buildings were used at the same time as the aforementioned byre houses.

A few metres further to the south, the terrain slopes slightly downward and archaeological features thin out. Zone IV is situated beyond this depression (fig. 20). Other than in Zone V³³, ditches were excavated. These apparently belong to different phases, since they have different alignments. The ditches were all very shallow and narrow, ruling out a use in fortification.

29. Geologischer Dienst Nordrhein-Westfalen.

30. Dating of a sample excavated from zone V by optically stimulated luminescence (OSL) revealed it to be High Medieval (tenth century), cf. Burow 2010.

31. Measured by Janet Rethemeyer, University of Cologne centre for AMS. Calibrated after OxCal 4.2.

32. dIT 8868; pers. comm. Claudia Klages, LVR-LandesMuseum Bonn.

33. Neither the Iron Age settlement nor the early Roman settlement at site V feature ditches. The only ditches in the vicinity are of modern date.

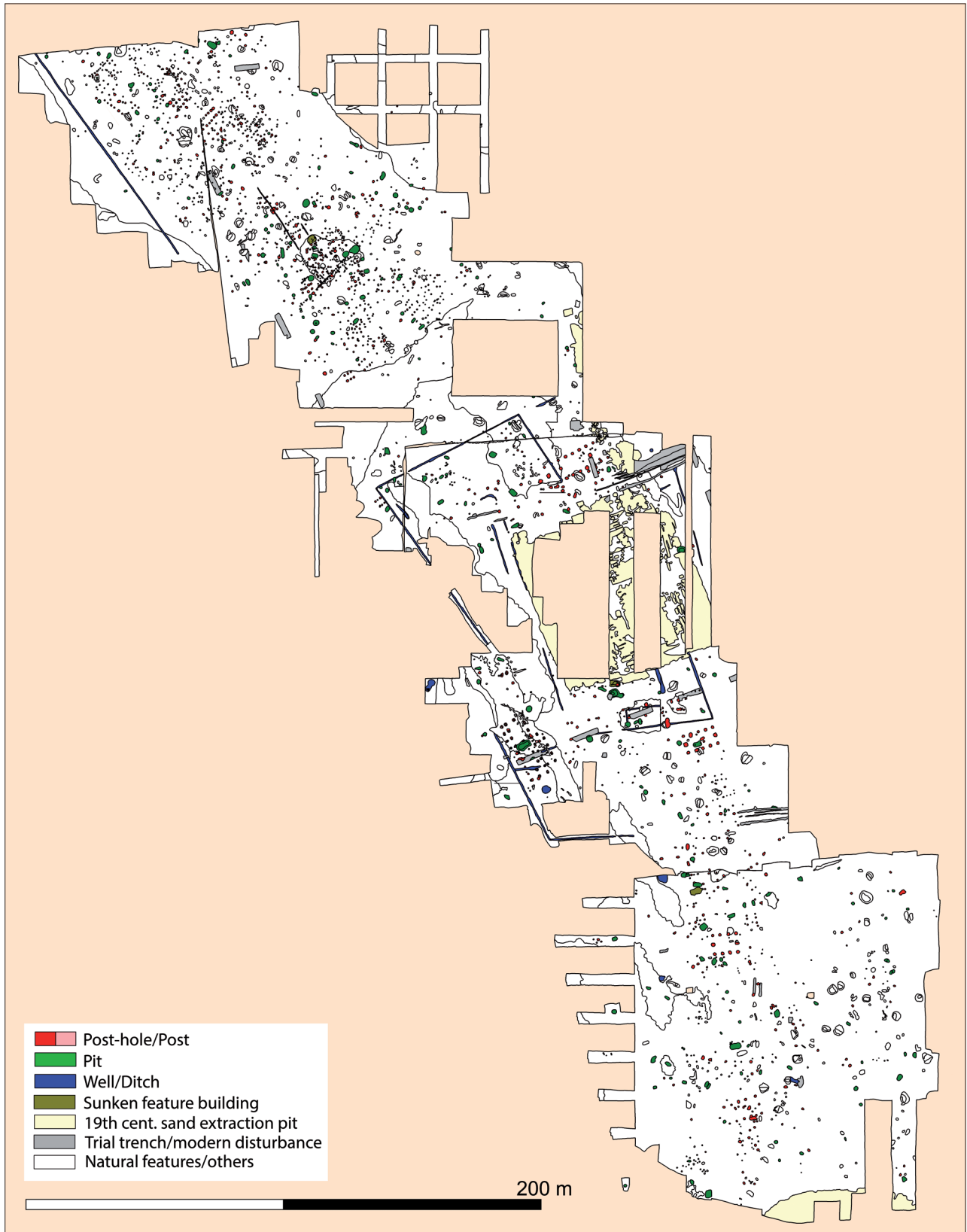


Fig. 17a. Weeze-Vorselaer, excavation plan of Zones III to IV. Detailed plan with features (H. Berkel, layout M. Brüggler, LVR-ABR).

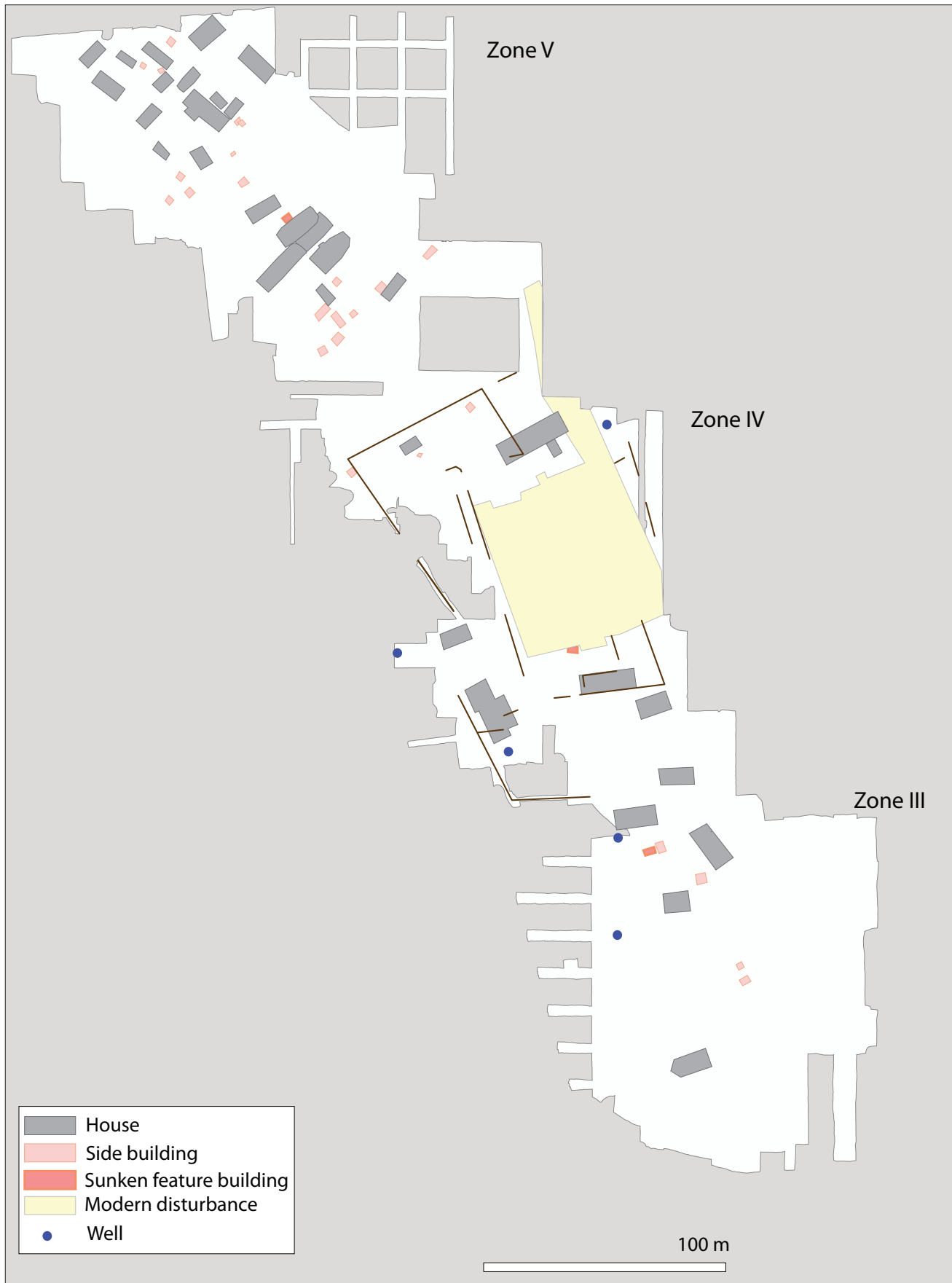


Fig. 17b. Weeze-Vorselaer, excavation plan of Zones III to V. Schematised plan (M. Brüggler, LVR-ABR).

Fig. 18. Weeze-Vorselaer, detail of Zone V: Three overlaying byre-houses from the beginning of the Common Era (H. Berkel & M. Brüggler, LVR-ABR).

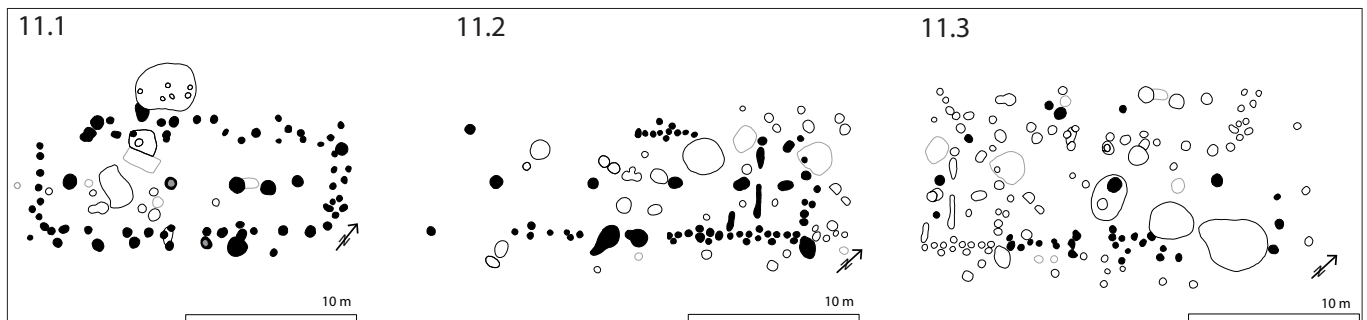
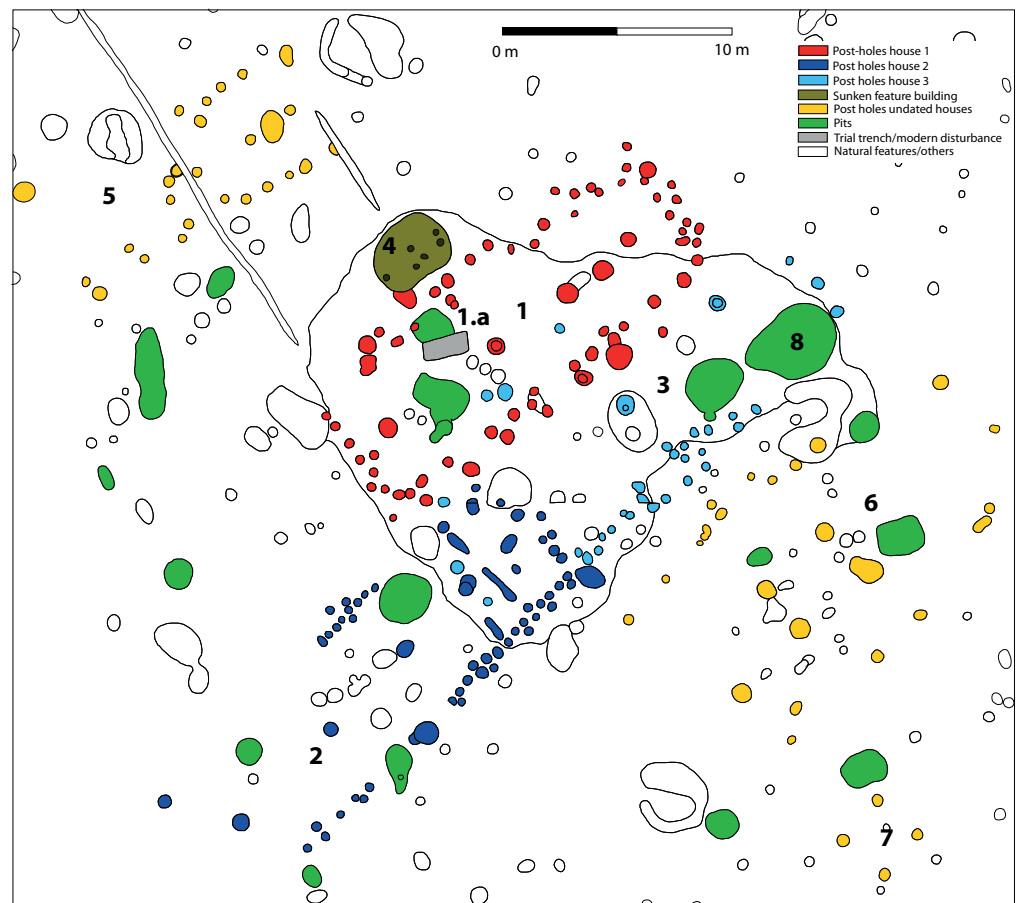


Fig. 19. Weeze-Vorselaer, house plans type Oss 4B of fig. 11 (M. Brüggler, LVR-ABR).

Rather, they can be interpreted as boundary-ditches. Unfortunately, large parts of this site were destroyed by nineteenth-century sand extraction.

One ditch system is situated in the northern part of Zone IV. On the eastern and southern sides, no boundary ditch was made out, but taking the furthest reaches of the other sides, the enclosed area must have been at least about 6 500 m² in size (fig. 20, a). A large byre house (fig. 20, 1 and fig. 21) can be ascribed to this ditch system, its centre-line having the same alignment as the northern ditch. One of the ditches seems to intersect the house layout, but may have been a drainage feature contemporary with the use of the house. The two-aisled house is 29 m long and 8.5 m wide. Its central postholes were rather shallow with remaining depths of 30-40 cm, but very wide, up to 1.5 m in diameter. To the south, a small side building was attached. The ceramic finds within the postholes of the byre house can be dated to the second century AD; however, the sherds may have entered the posthole fill during the dismantling of the house and a construction during the late first century cannot

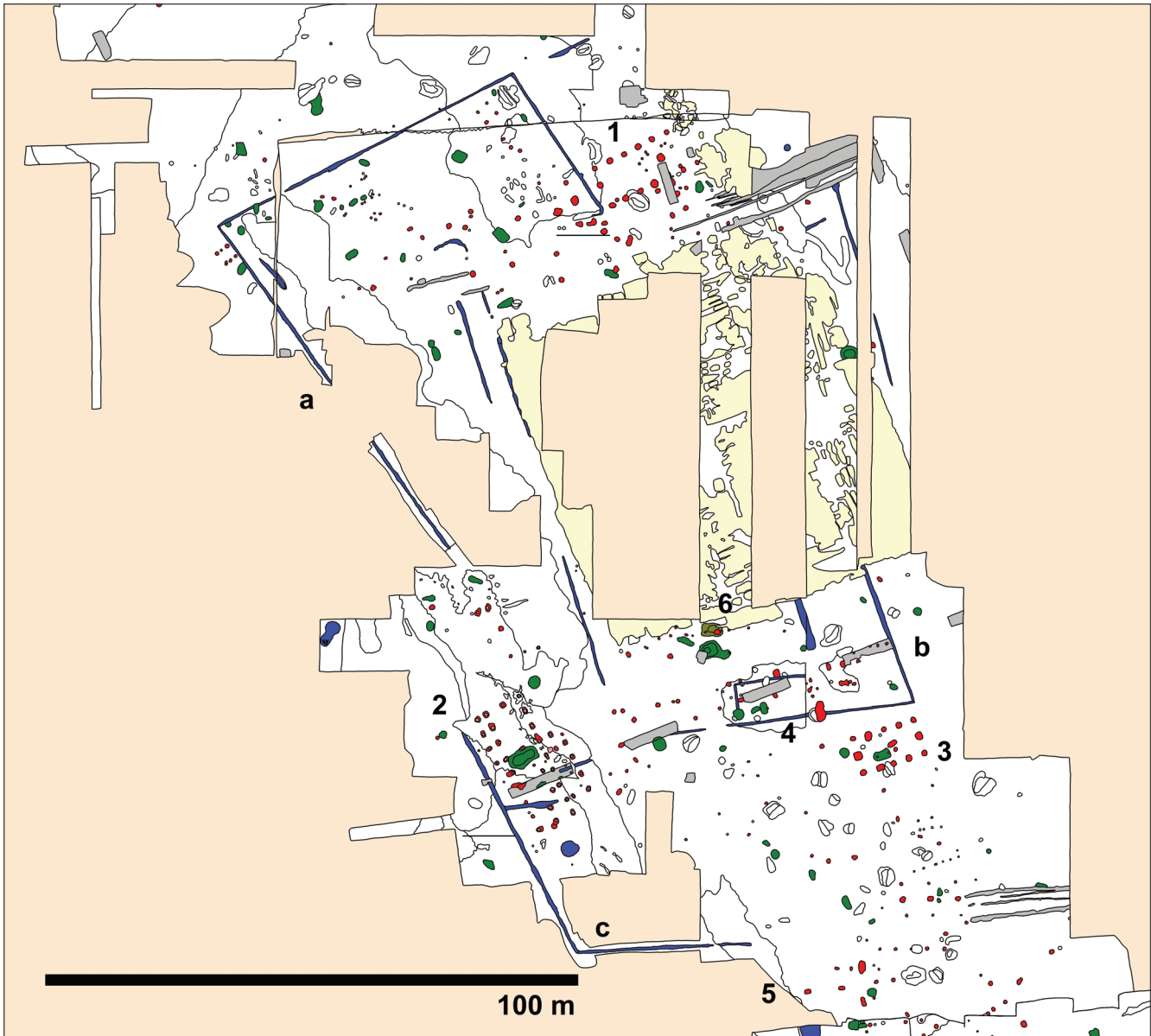


Fig. 20. Weeze-Vorselaer, zone IV (H. Berkel, layout M. Brüggler, LVR-ABR).



Fig. 21. Weeze-Vorselaer, zone IV, house layout no. 1 from fig. 20 (M. Brüggler on the basis of digitised field-drawings by H. Berkel, LVR-ABR).

be ruled out. The layout can be compared to the Alphen-Ekeren type that is dominant in the Roman period in the Meuse-Demer-Scheldt region of the Netherlands. It appeared around the beginning of the Common Era, being a development of the Iron Age Oss-Ussen 4 or Hapstype (Hiddink & Roymans 2015, 54-56). The characteristics of its development in the second and third centuries are best comparable to the house discussed in this paragraph (Slofstra 1991, 141). A well was located 16 m to the east of the byre house, and although it cannot be dated more precisely than “Roman” its proximity to the house suggests that it was used at the same time. Nearby, and also orientated on the same ditch system, were a four-post building and a six-post building, the latter located just outside the enclosure and most likely also belonging to this phase.

Around the large modern sand extraction pit, another group of ditches can be made out. Here, remains of all four sides were detected that enclosed an area of 4 800 m². Because of the modern disturbance, a main building of this phase is uncertain. It may have been the one shown in fig. 20 no. 4, but it cannot be ruled out that another building existed that was destroyed by the sand extraction pit: during the preliminary survey and also during our excavation, many finds of Roman brick roof tiles and stone building materials such as tufa were found in the fill of the modern sand extraction pit. This building, dating to the second or third century (fig. 20, 4) was a two-aisled structure 23 m long and 7.7 m wide. Its outline is partly delimited by a shallow ditch, a feature that none of the other houses in Weeze-Vorselaer exhibit. Close by lay a sunken-feature-building. Its fill can be dated to the second half of the first century, thus belonging to the earliest more precisely datable features of Zone IV (fig. 20, 6).

A third ditch system was documented in the south-western part of Zone IV. Only small parts of the southwestern corner of this enclosure remain, so no minimum area size can be calculated. With its axis parallel to one of the ditches and only 2 m away, lay another two-aisled building. It was 25 m long (fig. 20, 2 and fig. 22). A small ditch leading from within the southern half of the building into the main ditch probably functioned as a drain. The rectangular core of the house is 8 m wide, two-aisled, with two annexes on the eastern and western sides. The western annex is only 1.7 m wide, measured as the distance between the postholes, thus being too small for a portico. It may have been a simple roof-extension. The eastern annex, however, is 4 m wide and corresponds to a set of posts within the building that together may have formed an entrance. A small ditch runs in the centre of this entrance (?) structure. Another interpretation would be that of a side-building. In the middle of the building, a large pit was documented. Next to the building a well was situated. Its fill can only be roughly dated to the second or third century, as the wooden remains were not suitable for dendrochronological dating.

Several other buildings belong to Zone IV. One of these (fig. 20, 3) is a rectangular building 13.3 m by 7.7 m in size. Inside, a shallow pit along its southern wall containing two postholes might be interpreted as a partly dug-in vertical loom. The alignment of the building does not allow it to be definitely attributed to one of the three aforementioned ditch systems. Several more remains of buildings with more or less well-preserved layouts can be interpreted as outbuildings, again without definitely ascribing them to one of the ditch systems.

In the current state of research, the settlements at Zone IV can be dated between the second half of the first to around the mid-third century. The three ditch systems with their main houses seem to replace each other, suggesting that only one farmstead probably existed at one time.

The boundary between Zone IV and III to its south is less clear than the one between IV and V with its gap of features in a depression and clearly marked out ditch. One boundary ditch running east-west partially separates Zones III and IV, but it is only preserved for a length of around 30 m before a modern road-ditch disturbs the feature. Just to the south lay another two-aisled building of 14 m by 6.6 m which is dated to the second or third century (fig. 20, 5). Its plan is incomplete, but is comparable to houseplans in Flanders (De Clercq 2011, 246). Only three further large buildings can be made out in Zone III. All of them were 8 m wide, their lengths vary, measuring 11 m, 14 m, and 18 m. They can be dated to the second/third century, the

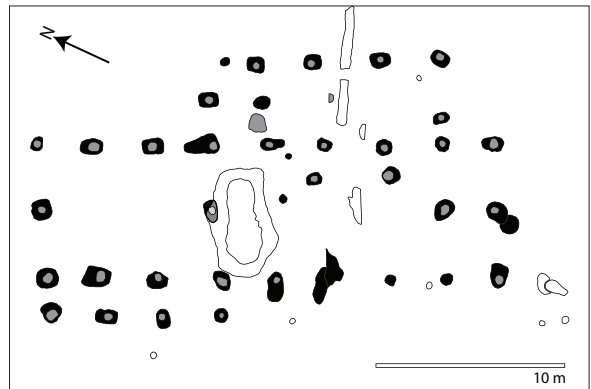


Fig. 22. Weeze-Vorselaer, zone IV, house layout 664 (M. Brüggler on the basis of digitised field-drawings by H. Berkel, LVR-ABR).

first half of the third century and the second century, respectively (fig. 17). In addition, two four-post buildings and a six-post building were documented, and a sunken-feature-building with two posts on its narrow sides lay in the northern part of Zone III. Two wells belong to Zone III, the construction of which were dendrochronologically dated to after AD 128 (± 5) for the one and AD 136 (± 5) for the other³⁴. The latter date is confirmed by four more samples dated to between AD 126-131 (± 5). The fill of the second well contained a piece of wood that was dated to AD 169 ± 5 , giving a terminus post quem of the abandoning of the well. The well therefore remained in use for at least 23 years, and probably longer³⁵. In general, the finds belonging to Zone III can be dated to the second and third centuries; Iron Age features also occur.

The ceramic finds from Vorselaer consist of Roman wheel-thrown pottery as well as handmade pottery in local Iron Age tradition, often found together in one archaeological context. Not surprisingly, in the earliest Roman contexts dating to the Augustan period, handmade pottery predominates. The picture changes after the second half of the first century, wheel-thrown pottery then clearly predominates. However, in most of the Roman contexts, handmade pottery is still present in quantities that exceed the intrusion of older settlement scatter. Handmade pottery still occurs in a number of contexts that can be dated to the second half of the second and third centuries. The Roman pottery assemblage is similar to that in Roman *villae rusticae* in the southern parts of the Rhineland: colour-coated wares, Terra sigillata, a few sherds of these with relief-decoration, fine and coarse wares, mortaria, dolia and amphora sherds are present. Among them, a few sherds of Lowlands-ware occur. Sherds from salt containers from the Channel coast belong to the finds spectrum. The amphora sherds mostly belong to Iberian oil amphorae. The amphorae were used as storage containers, as mentioned above for one house in Zone V. It cannot be ruled out that they were also sought after for their contents. In one posthole belonging to an incomplete house layout, an intact Stuart type 2 beaker was found (Stuart 1963, 23). The beaker may have been an offering, as similar finds in Oss-Zomerhof (Wesselingh 2000, 70) and Tiel-Passewaaij (Heeren 2006, 215) suggest.



Fig. 23. Copper alloy and iron bells (T. Königs, LVR-ABR).

Very few objects recovered during the excavation were made of metal, i.e. iron or copper alloy. This may be the result of unfavourable soil conditions or a limited use of metal detectors during removal of the topsoil: metal detectors could not be used effectively due to large scale contamination with Second World War grenade shrapnel and lack of time. Two bells were found in Zone IV, one made of copper alloy, one of iron and were most likely used for animals (fig. 23) (Brüggl 2012). A few fibulae also came to light. The earliest ones were a Riha 2.6/ Haalebos 5A1-variant, dating to the late Augustan to Claudian era and two Almgren 19 fibulae from a pit near the Oss-Ussen 4B-houses at site V. The latter were associated with fibula with studs, dated also to the first half of the first century (fig. 24; Boelicke 2002, 54, 58, type 2.9).

The microregion of Vorselaer, i.e. the area that is almost completely surrounded by the Vorselaerer Ley brook (fig. 25), comprises (modern) soils of Humic Cambisols and Humic Cambisols/Gleysols. The grain size is classified as 5 and 7, i.e. medium-heavy and light soils. These soils cover an area of 181 hectares of possibly arable land, before a small depression indicates the edge of this plateau about 1.3 km from Vorselaer. The settlements lie on the eastern rim of that area. On the western rim, two further sites only known by surface finds may indicate another settlement cluster³⁶, the arable land being divided between the two settlement clusters. On the lower ground of the former oxbow, gleysols and histosols occur, which might have been used as grazing grounds.

34. Expertise by Thomas Frank, Laboratory of Dendrochronology, Institute of Prehistoric Archaeology, University of Cologne.

35. The timespan fits in with the periods of use of wells in the Meuse-Demer-Scheldt region. Cf. Heeren 2015, 275.

36. Brüggl 2016, catalogue number W016 and W023. For the site catalogue cf. annex 1.

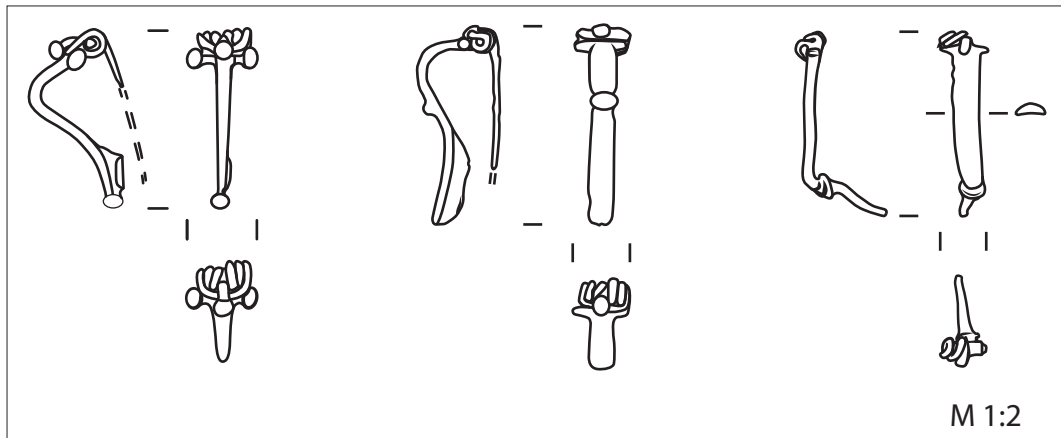


Fig. 24. Three fibulae from pit fig. 18 (T. Könings, LVR-ABR).

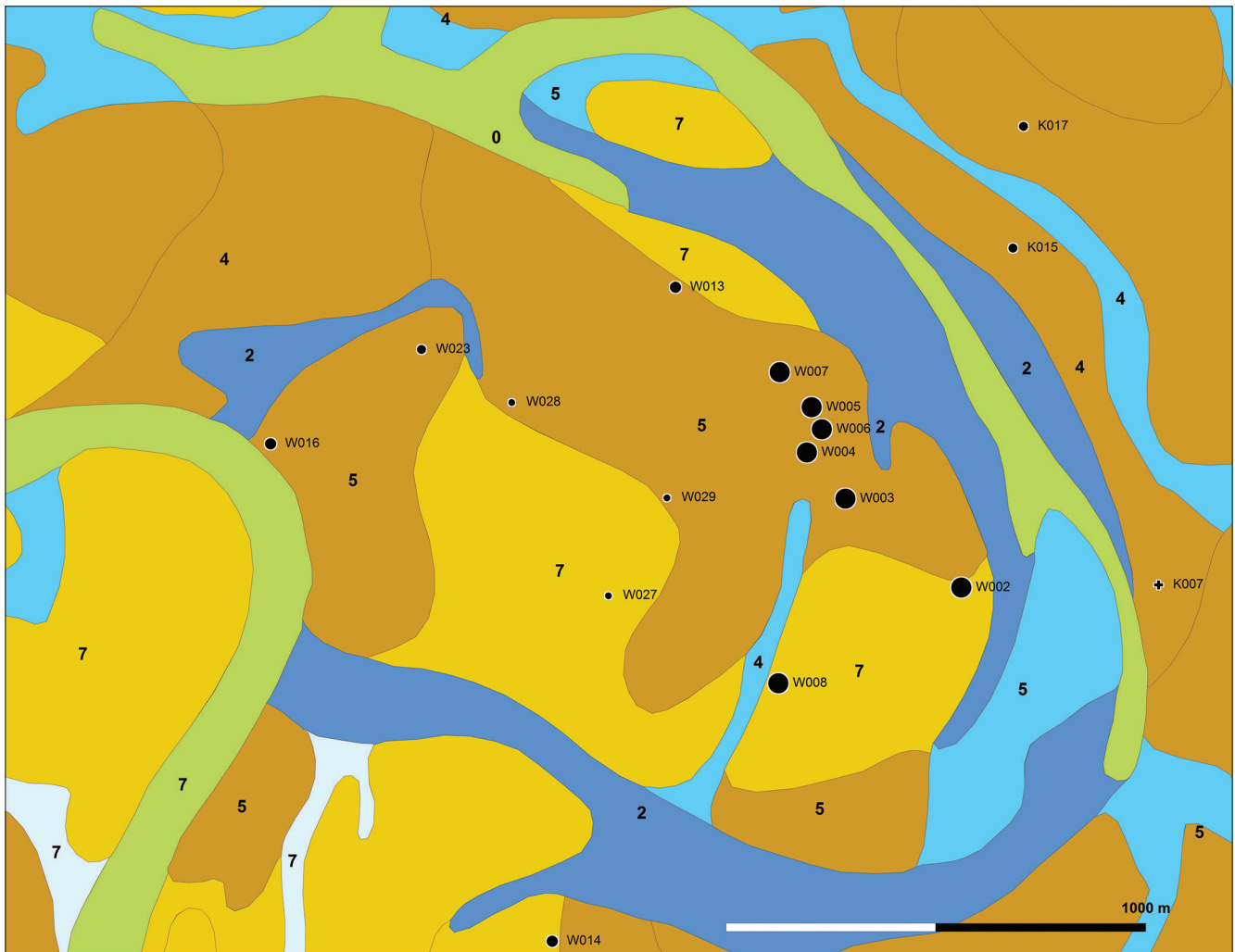


Fig. 25. Soil types and grain size in the microregion Weeze-Vorselaar. For legend cf. fig. 33 (M. Brüggler, LVR-ABR, basis: Bodenübersichtskarte 1:50 000 Geologischer Dienst NRW).

Kevelaer-Grotendonk

Just one kilometre northeast of Weeze-Vorselaer, the site of Kevelaer-Grotendonk was excavated in autumn 2014 by the private archaeological company Ocklenburg-Archäologie³⁷. The name “Grotendonk” translates as “large sandy plateau”. As at Vorselaer, the reason for excavating was gravel extraction. Field surveys and test trenches established that the site to be excavated was limited to one hectare (fig. 26). The centre of the site could not be excavated because of the presence of a pylon and one house layout was therefore only partially investigated. It dated to the first to third century and was at least 12 m long and 5-6 m wide, but its original length was probably around 20 m. At least four more buildings can be surmised from clusters of postholes, but none of these layouts were complete. The eastern cluster of post-holes was noteworthy, containing a rectangular 13 m x 5 m pit up to 0.36 m in depth that may have been a deepened byre section. Within another cluster of post-holes, a probable sunken-feature-building was observed. The site was obviously not enclosed.



Fig. 26. Kevelaer-Grotendonk, plan of the settlement (U. Ocklenburg (Ocklenburg-Archäologie), modified by M. Brüggler (LVR-ABR)).

37. My thanks go to Ulrich Ocklenburg for permission to use this unpublished data. Cf. Ocklenburg 2015.

Handmade pottery occurred, which was dated by the excavators partly as Iron Age, partly as pre-Flavian. As small sherds mostly cannot be dated precisely, those fragments dated to the Iron Age might in fact be of Roman date. Wheel-thrown pottery dominates the finds spectrum. First century material occurs, but none of it can be dated securely to the beginning of the Common Era. Instead, the finds suggest that the settlement started in the middle or second half of the first century. The latest Roman finds can be dated to the end of the second and the first half of the third centuries. Since there are no later finds from Roman times, this clearly shows that the settlement was abandoned at some point in the third century.

Wachtendonk-Meerendonkshof

The site of Meerendonkshof lies a few kilometres north of the modern small town of Wachtendonk (fig. 2, WM). Excavations were conducted in summer and autumn 2014 by the LVR-State Service for Archaeological Heritage in the Rhineland³⁸.

The site lies, as the name already implies, on a Donk, like Grotendonk and Vorselaer, and like these, near a small stream. Again, proposed gravel extraction was the cause for excavation. Nineteenth century reports mention several Roman graves in the area. Therefore, a field-walking survey was carried out in 2003 by the private archaeological company Goldschmidt and a settlement site thereby narrowed down to an area of half a hectare. Trial trenches in summer 2014 located a rural settlement of Roman date and immediately afterwards a full-scale excavation was undertaken.

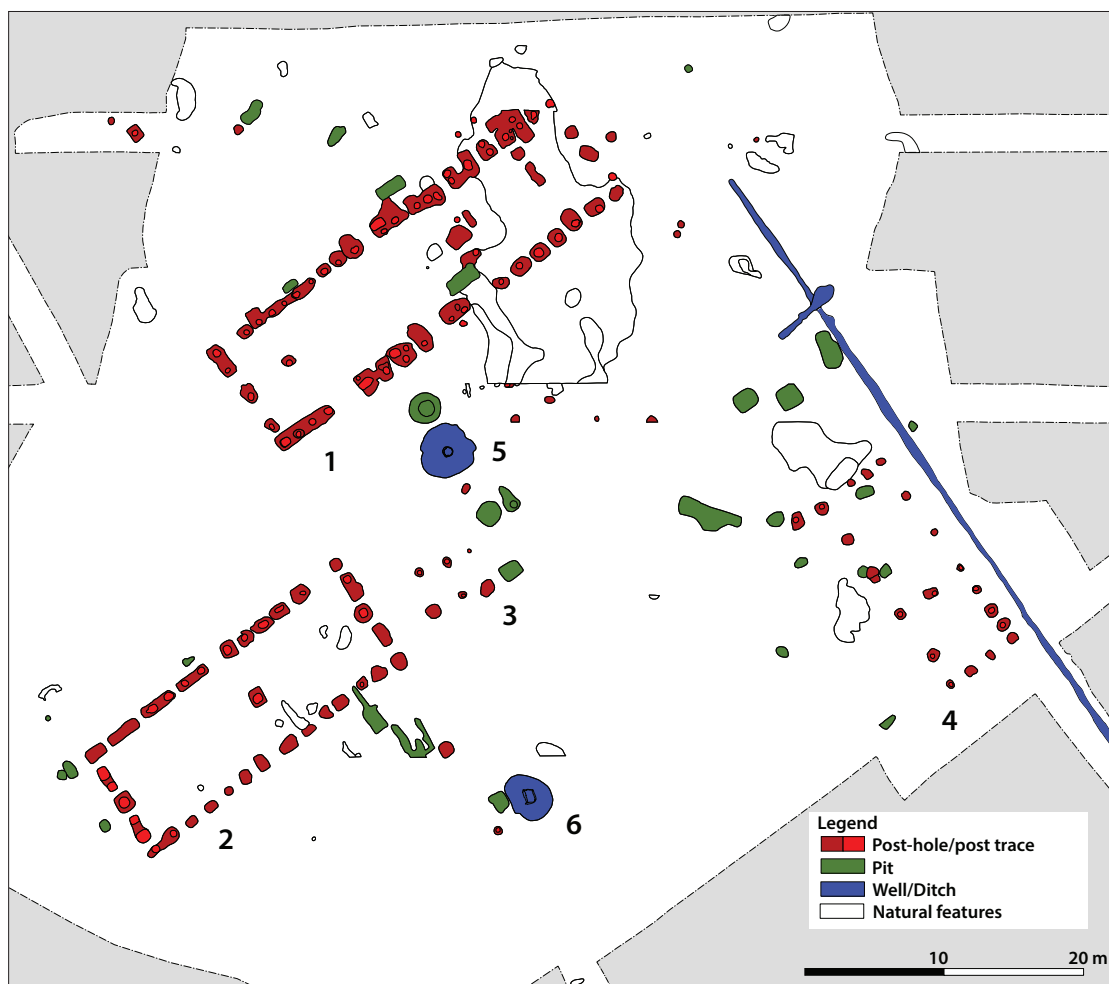


Fig. 27. Wachtendonk-Meerendonkshof, plan of the settlement (H. Berkel, layout M. Brüggler, LVR-ABR).

38. A detailed study of structures and finds is currently in progress as a master's thesis at the University of Freiburg by Theresa Langenhoff.

Three large buildings, a six-post building, a ditch, two wells and several pits were excavated. Two buildings were orientated southwest-northeast and measured 30 m by 9 m (fig. 27, 1) and 24 m by 9 m (fig. 27, 2). Their orientation is perpendicular to the ridge. Both houses had very few roof-supporting posts along their central axis. Only three postholes in House 1 and one in House 2 were used as such. House 1 had two entrances opposite each other in the middle of its side walls and a separate section on its northeastern gable. Their layouts are similar to a building in Nederweert, which can be attributed to the Alphen-Ekeren type (Hiddink & Roymans 2015, 55, no. 304). Another post-built structure of 17 m by 6 m lay at right angles to the aforementioned buildings and parallel to a small ditch (fig. 27, 4).

The finds consist mainly of wheel-turned pottery dating to the late second century and first half of the third century. The six-post building seems to be of an earlier, probably Iron Age date, since only handmade pottery was found in it (fig. 27, 3). Handmade pottery was otherwise completely lacking from the site.



Fig. 28. Grave inscription from a secondary context in Meerendonkshof (T-Könings, LVR-ABR).

Within a post-hole belonging to House fig. 27,1, a square limestone block was used as a support for a post (fig. 28). It turned out to be a gravestone with remains of an inscription, lying on its face. The inscription is mostly worn away, maybe from secondary use of the stone, maybe by weathering. The formulae *D(is) M(anibus)* in the beginning and *F(aciendum) C(uravit/uraverunt)* clearly mark it as a funeral inscription. Of the deceased, only the first three letters survive: TET, maybe *Tettius* or *Titus Ettius*. The last name of the dedicant or one of the dedicants ends with “RNVS”, which may be the ending of the names *Maternus* or *Paternus*, both of which are common in the Rhineland (Kakoschke 2006, 96-97 and 178-181). In the corners, four roses can be reconstructed. The stone therefore should be interpreted as part of a grave monument rather than a sepulchral stele. The style of the decoration and lettering as well as the use of the formula DM points to the monument having been erected in the first half of the second century³⁹. Since the building in which it was found can be dated to the late second century, the monument seems to have stood for only about two generations. The grave monument was most likely situated in the vicinity, since graves are mentioned in the area in find reports from the nineteenth century (Geschwendt 1960, 263), and the stone was probably too heavy to have been easily transported from the

next *vicus* at Geldern-Pont 6 km away, where a cemetery was situated (Cüppers 1962). It may also have been connected to a secondary road mentioned in an older report that ran past the site 800 m to the northwest⁴⁰.

All in all, the site at Wachtendonk-Meerendonkshof exhibits more Roman features – the gravestone, the pottery assemblage, two cherry-stones (cf. below) – than the more northerly Weeze-Vorselaer.

To sum up some developments in the loam and sand regions, if this can be done at this early state of research: Around the beginning of the Common Era, byre houses derived from the Haps type, i.e. Oss-Ussen 4B/5 were used. During the middle Roman period larger houses of a different type were built. These now belong to the Alphen-Ekeren type and its variants (van Enkevort & Hendriks 2014, 243). Whereas at Vorselaer V, the Oss-Ussen 4B/5 type houses are only 18 m long, lengths of 25-30 m can now be measured at Vorselaer IV. Also, at Vorselaer IV, the single farms were surrounded by ditches probably already in the first century AD. At Wachtendonk, a ditch was observed, too, but no enclosures were existent at Kavelaer-Grotendonk and at Vorselaer III, both of which were settled in the middle Roman period. Similar developments were observed for the south-eastern Netherlands for the period between 50 BC to AD 50 (van Enkevort 2000, 368f.).

The house types present in Vorselaer, Meerendonkshof, and Grotendonk, namely Oss-Ussen 4b and Alphen-Ekeren, are comparable to those in the Dutch-Belgian Meuse-Demer-Scheldt (“MDS”) area. However, some differences can be pointed out.

39. Thanks to Susanne Willer, LVR-LandesMuseum Bonn.

40. It probably connected the main Xanten-Venlo road in the west to the Rhine in the east, Geschwendt 1960, 265.

On the German Lower Rhine, deepened byre sections, which are often found in the MDS area from the early second century onward, have not been documented so far apart from maybe Grotendonk (Hiddink & Roymans 2015, 59, van Enckevort 2000, 383; van Enckevort & Hendriks 2014, 244). Also striking is the absence of sunken-feature-buildings in the MDS-area in the Roman period⁴¹, whereas in Vorselaer three such buildings were used at the beginning of the Common Era, in the late first and the second centuries respectively. Four- and six-post buildings (granaries or outbuildings) are infrequent in the MDS area which Hiddink and Roymans claim is because cereal was not produced in large quantities on the sandy soils. In MDS four- and six-post buildings found on the Roman period sites are thought to be of Iron Age date (Hiddink & Roymans 2015, 60). This is probably true for the six-post structure in Wachtendonk-Meerendonkshof. But they do occur in Vorselaer, and they can be linked to the Roman period settlements.

Settlement density

Settlement density in the Lower Rhine Plain cannot be reconstructed from the excavated sites alone. Old reports and surface finds are needed to complete the picture. The BoDeOn “BOdendenkmalpflege und DENkmalpflege ONline” database of the LVR-State Service for Archaeological Heritage registers numerous entries on Roman finds and sites. This database collates all available archaeological information in the Rhineland. Entries go back to about the mid-nineteenth century. Due to the long timespan of data collection the quality of the entries is very heterogeneous. Furthermore, it is activity-based, with entries for each modern activity that took place on a site. A single site may have several entries when multiple observations took place. Simple queries therefore do not yield feasible results.

Bridger conducted such a database search almost twenty years ago (Bridger 2000b, 185 footnote 1). He classified the heterogeneous entries into large settlements (excavated sites or surface sites with many finds, indicating settlements with several households), small settlements (few finds pointing to a single household), grave/graves, other features (wells, roads, etc.) and finds/coins (Bridger 2000b, 191). He then discerned what he regarded as genuine settlements by summing up multiple entries, eliminating single surface finds and using graves and coin hoards as indicators of settlements. On this basis, he estimates the settlement density as 0.14 settlements/km² for the left bank of the Rhine (Bridger 2000b, 207). Within the RurLand Project a small part of this region was investigated for settlement distribution and density, the area of the modern municipalities of Weeze, Uedem, Kevelaer and Sonsbeck (WUKS)⁴².

The BoDeOn database was searched for all “Roman” entries, which then were manually checked and merged. In a further step, they were cross-checked with older publications and archival material of the “Ortsarchiv” in the LVR-Amt für Bodendenkmalpflege in Bonn. Then the entries were categorized as single finds, finds (i.e. 2-5 artefacts), more than five finds, settlements, single graves, graves, cemeteries, other features, single coins, and coin hoards. The categories single find and single coin are self-explanatory. Singular finds in the vicinity of 100 m of a settlement were taken to belong to the settlement and merged with the settlement. Finds and more than 5 finds are entries with 2-5 or 5+ artefacts on the same parcel of land. The artefacts mostly consist of pottery sherds. At 13 sites (including settlements) Roman building material (tiles/bricks) are mentioned. These can be taken to indicate settlements, but it cannot be ruled out that they represent graves, or in one case, may have been part of an aqueduct. Examples of other features include a pit near the River Niers without further indications of Roman settlement, and ditches in the Sonsbecker Schweiz that seemingly accompany the aqueduct for the Colonia Vlpia Traiana. The latter is not listed as a findspot, since it does not belong to the rural settlement category. For the same reason, the temporary military camps in the Hochwald are not considered in this paper (Bödecker 2013). The settlement category was only used for excavated settlement sites where several settlement features were proven.

In most cases, the findspots can be localized with sufficient precision of up to 50 m, though some old entries are vague with possible margins of error of up to 200 m. We have included these datasets anyway, since for the scale of my investigation, they were still precise enough.

41. They first appear in the late fourth century with the influx of new immigrants from areas north of the Rhine, where sunken huts were already present in the second to fourth centuries, cf. Heeren 2015, 284.

42. This section was published online in 2016, see Brüggler 2016 and has since been revised and updated.

After this categorization, there remained 94 entries dating to the Roman period, or 67 entries if single finds and single coins are excluded.

In general, a number of different factors influence settlement density. These can be distance to rivers or brooks, distance to roads, accessibility of markets and towns, or topographical features such as elevation, slope, aspect, height above ground-water and soil quality. Of these, the factors distance to rivers and brooks, roads and towns can be examined in the research area, as well as elevation, soil type and grain size. Not enough data was available for height above ground-water. Slope and aspect have been disregarded, since the slopes are very gentle.

The dataset was mapped and analysed with the 1:50 000 soil map (Bodenkarte) of the State Geological Service of Northrhine-Westphalia and a digital terrain model with 25 m resolution⁴³. In the soil map table, the dataset was plotted against soil type and grain size. On the terrain model, the dataset was checked against elevation. Because the beds of the rivers and brooks have been greatly modified in modern times, a flow accumulation grid was calculated using the terrain model, to locate potential former riverbeds⁴⁴. A buffer was then created around the resulting stream valleys and checked for incidents with the archaeological dataset.

Before drawing conclusions from this analysis, one has to bear in mind that the data is heavily biased by highly uneven research intensity. Development led field surveys have been carried out since the second half of the 1990s prior to gravel extraction in the centre of the research area, especially in the Niers plains. Further field surveys had been carried out there in 1986/87, as a training programme for excavation technicians. As already mentioned, the problem with simple field surveys, especially in the Niers plains, is that large areas of arable land are covered by post-Roman anthrosols which hide Roman sites. Large-scale excavations have only been carried out on a few sites, dictated by the location of proposed gravel extraction. Moreover, coins only seem to occur in the southeast of the research area, in the municipality of Sonsbeck. Here, metal detectorists cooperating with the Heritage Service have been searching the area. On the other hand, this is also near the road from Xanten to Tongeren (cf. below), so the coins here might in fact reflect a higher original frequency.

The 94 Roman sites were distributed in the categories as follows (fig. 29, table 2):

Single find	18	17%
2-5 finds	18	17%
>5 finds	18	17%
Single coin	9	8,4%
Coin hoard	1	0,94
Archaeological feature (e.g. pit)	6	5,64%
Grave	10	9,4%
Graves	3	2,8%
Cemetery	2	1,88%
Settlement	9	8,46%
TOTAL	94	100%

Table 2. Distribution of sites by category

43. The data for the latter stems from geoBasis NRW, the land surveying office of Northrhine-Westphalia. For the calculations, I used MapInfo with the Vertical Mapper extension.

44. My thanks go to Irmela Herzog, LVR – State Heritage Service, for calculating the model. The programme used was gvSIG with the Sextante Plugin. In a first step, depressions were filled with “sink filling”. On the resulting modified terrain model, the method “Flow accumulation” was used, variant “Multi flow direction” with standard parameters.

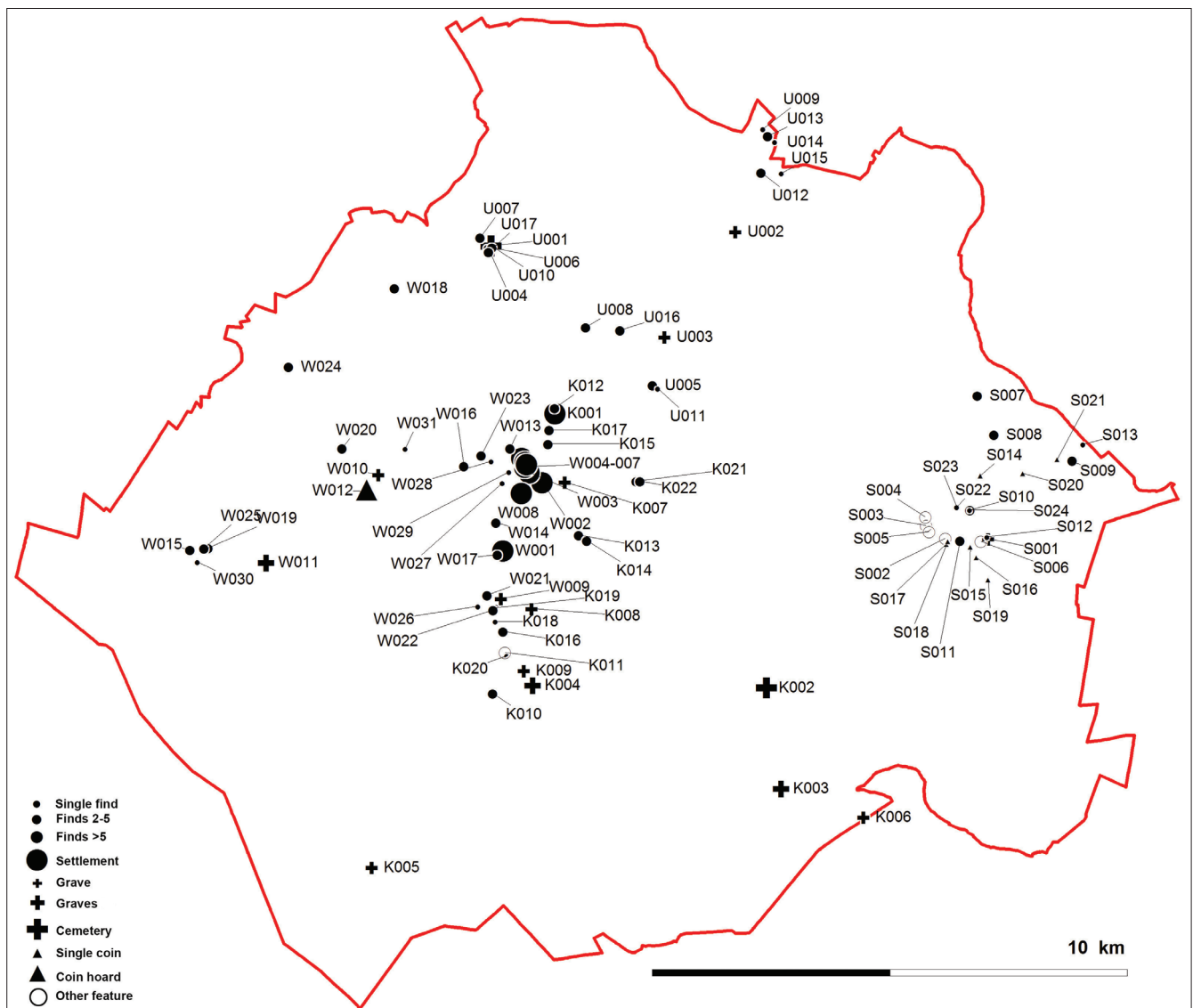


Fig. 29. Site map of the research area. The numbers refer to the site-catalogue in annex 1 (e.g. W001 = Weeze 001). (M. Brüggler, LVR-ABR).

The find spots cluster in the centre of the research area in the Niers plains (fig. 30) and occur on the perimeter of the heights. The higher slopes of the moraines seem to be left out. However, a dense cluster of find spots on the “Gocher Heide” just north of the research area, where an amateur archaeologist has been systematically field-walking in the last two decades, shows that the southern slopes of the moraines were obviously settled up to elevations around 32-34 m above sea-level. There does not seem to have been a preference to settle in close proximity to the brooks (fig. 31). A buffer around the brooks of 300 m and 800 m has been tested, but no preference for proximity to a brook could be detected. It cannot be ruled out, though, that sites have been destroyed by the shifting Niers Riever in post-Roman times. In the Niers plains, brooks are never far away, so it appears that elevated plateaus were sought, rather than areas adjacent to brooks.

Roman roads in the Lower Rhine Plain have not been studied in detail since Joseph Hagen’s opus in 1931, apart from the Limes road along the Rhine (Hagen 1931; Becker 2007). The northeastern part of the research area with 12 (of 94) incidents

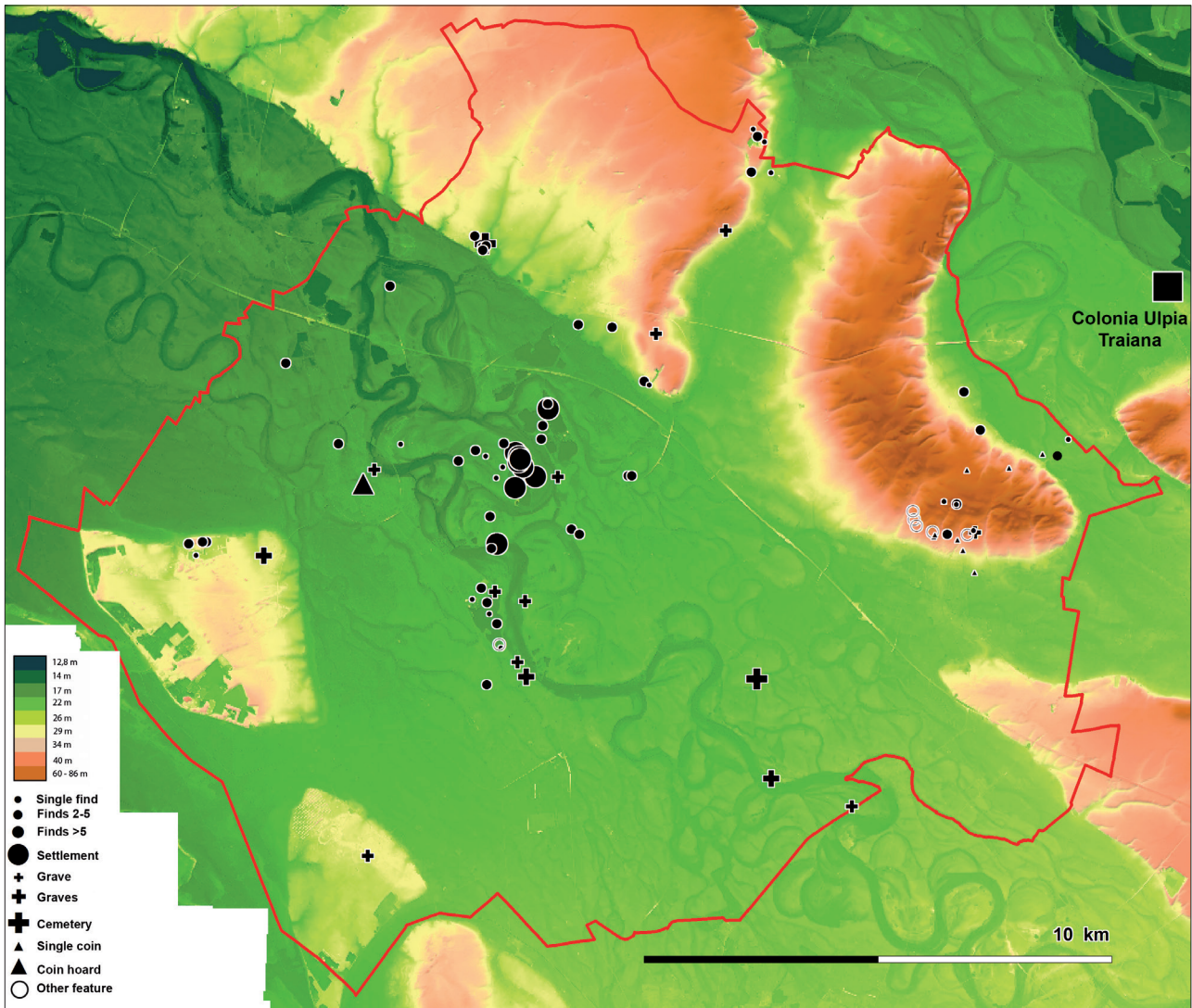


Fig. 30. Sites on elevation-map (M. Brüggler, LVR-ABR. Basis: DGM25 Geobasisdaten des Landes NRW © Geobasis NRW, 2015).

is 5 km from this road⁴⁵. These are four single finds, five finds/finds>5, two coins and one grave. Another larger road led from Xanten in a southeastern direction via the *vicus* Geldern-Pont to the Meuse. It intersects the research area in the southeast near the modern town of Sonsbeck, though its exact route here is not clear. If the possible route is given a 5 km buffer, 27 of the 94 sites lie within this area. These consist of nine coins, four single finds, five finds/finds>5, four grave/s and five ditch features. This does not indicate a preference for sites closer to the road.

Thirty of the 94 sites lie within 10 km of the *Colonia Ulpia Traiana*. Removing single finds and coins, 14 (of 67) occurrences remain. It does not seem to be a clear indication for a preferred settlement within that zone. Only the small cluster of sites to the northwest of the heights of the “Sonsbecker Schweiz” might point to a preference for proximity to the *Colonia*. On the other hand, the furthest point in the research area is only 23 km away from the town, so it was within a day’s walk or march from the whole of the research area.

45. This buffer has been used for example by Karen Jeneson in her PhD thesis (Jeneson 24.01.2013).

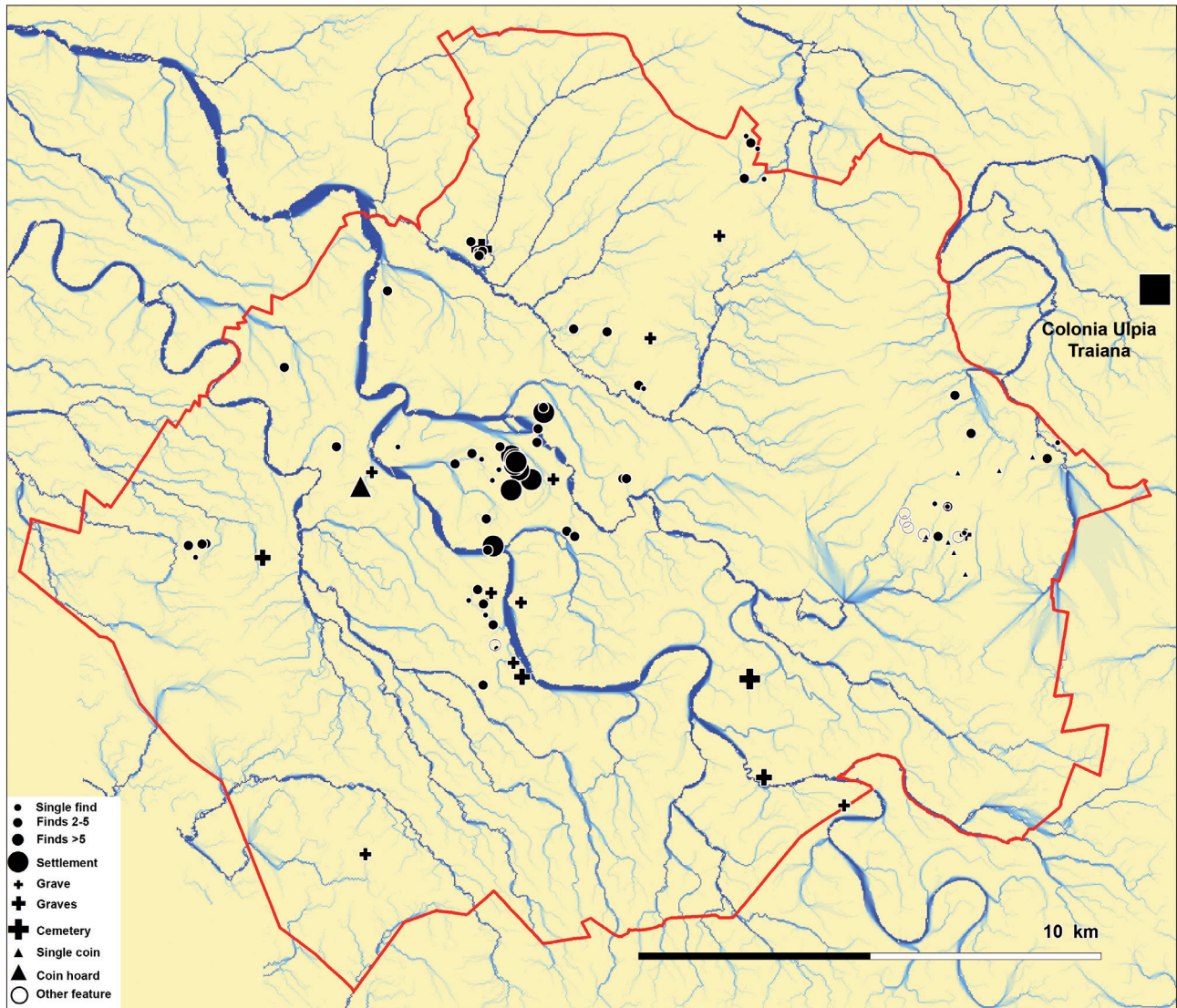


Fig. 31. Sites on flow accumulation (I. Herzog, LVR-ABR. Basis: DGM25 Geobasisdaten des Landes NRW © Geobasis NRW, 2015).

Within the research area, soils with grain sizes 2 to 8 occur. Settlement indicators, i.e. the categories finds, finds>5, feature, settlement and coin hoard, appear with 20 occurrences on light soils and 31 occurrences on medium-heavy soils and only one on heavy soils (fig. 32, table 3).

Soils	Occurrences (n=67)	Settlement indicators	Graves
Heavy (2, 3)	4	1	3
Medium (4, 5, 6)	35	31	4
Light (7, 8)	28	20	8

Table 3. Distribution of sites on different soils (grain size).

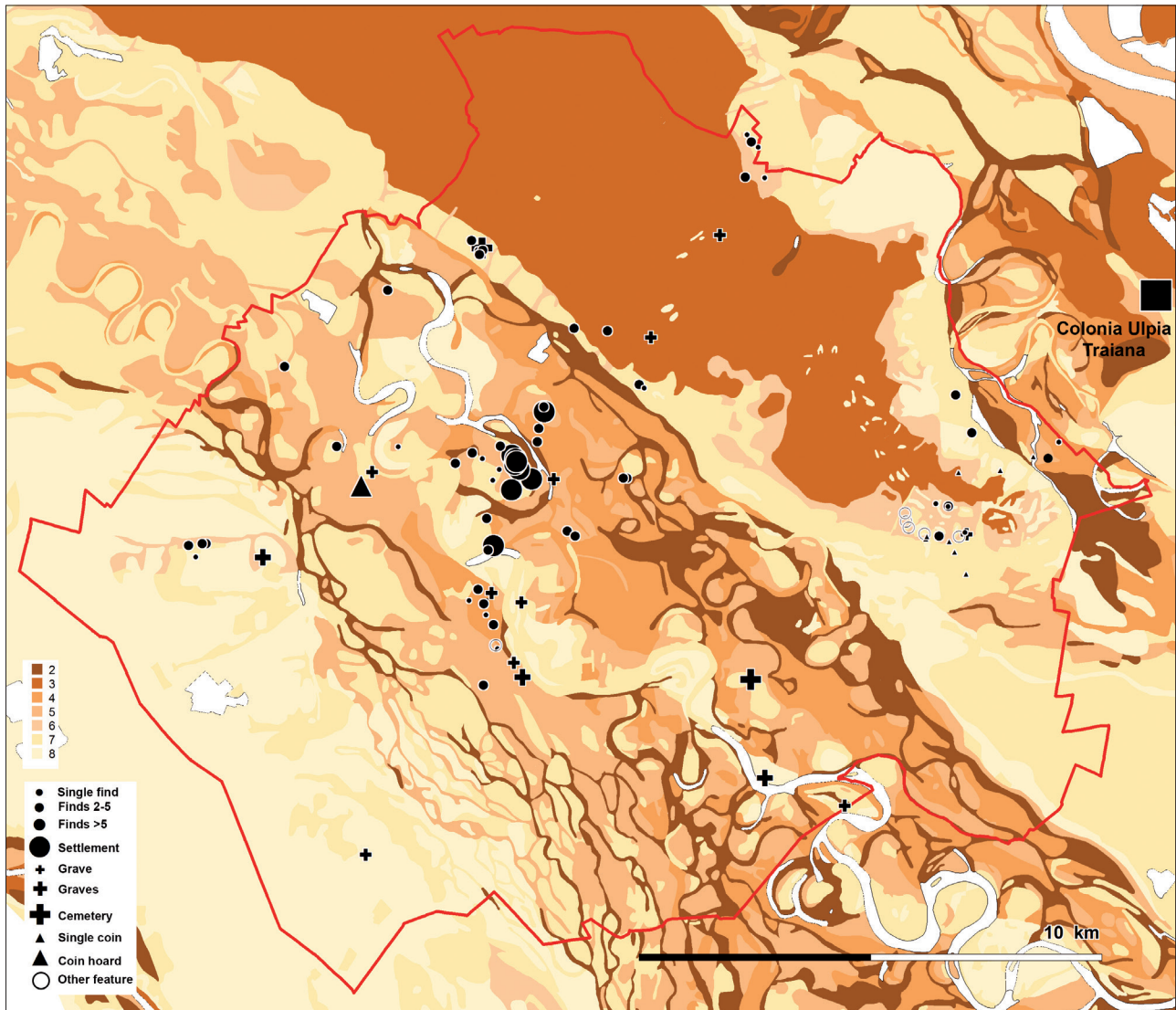


Fig. 32. Site distribution on different soils: Grain-size (M. Brüggler, LVR-ABR; based on Bodenübersichtskarte 1:50 000 Geologischer Dienst NRW).

Clearly, medium-heavy soils were preferred. Within the light soils, those with a loamy content (type 7) were preferred over sandy soils (8) because of their greater capacity for retaining water.⁴⁶ Eight graves are found in light soils, four in medium-heavy soils, and three in heavy soils. Here the picture is less clear, for while most graves were situated on soils that were not so suitable for farming (i.e. light soils with no loamy contents, as well as heavy soils), they were present in medium-heavy soils that were favoured for agricultural use.

As for soil type, most sites were found on humic cambisols followed far less frequently by Luvisols, plaggic anthrosols and Podzol-Cambisols. There are no sites in Stagnosol and Histosol areas. The four incidents on Gleysols do not seem to fit in the picture, as they are wet and not arable, but all but one of these sites were graves (fig. 33, table 4).

46. This observation was also made in the Meuse-Demer-Scheldt region, cf. Creemers *et al.* 2015, 41.

Soil type	Occurrences (n=67)	Settlement indicators	Graves
Humic Cambisol	34	31	3
Luvisol	9	5	4
Plaggic Anthrosol	5	3	2
Podzol-Cambisol	6	5	2
Cambisol	5	4	1
Gleysol	4	1	3
Gleysol-humic Cambisol	3	3	
Modern deposition	1	1	

Table 4. Distribution of sites on soil types.

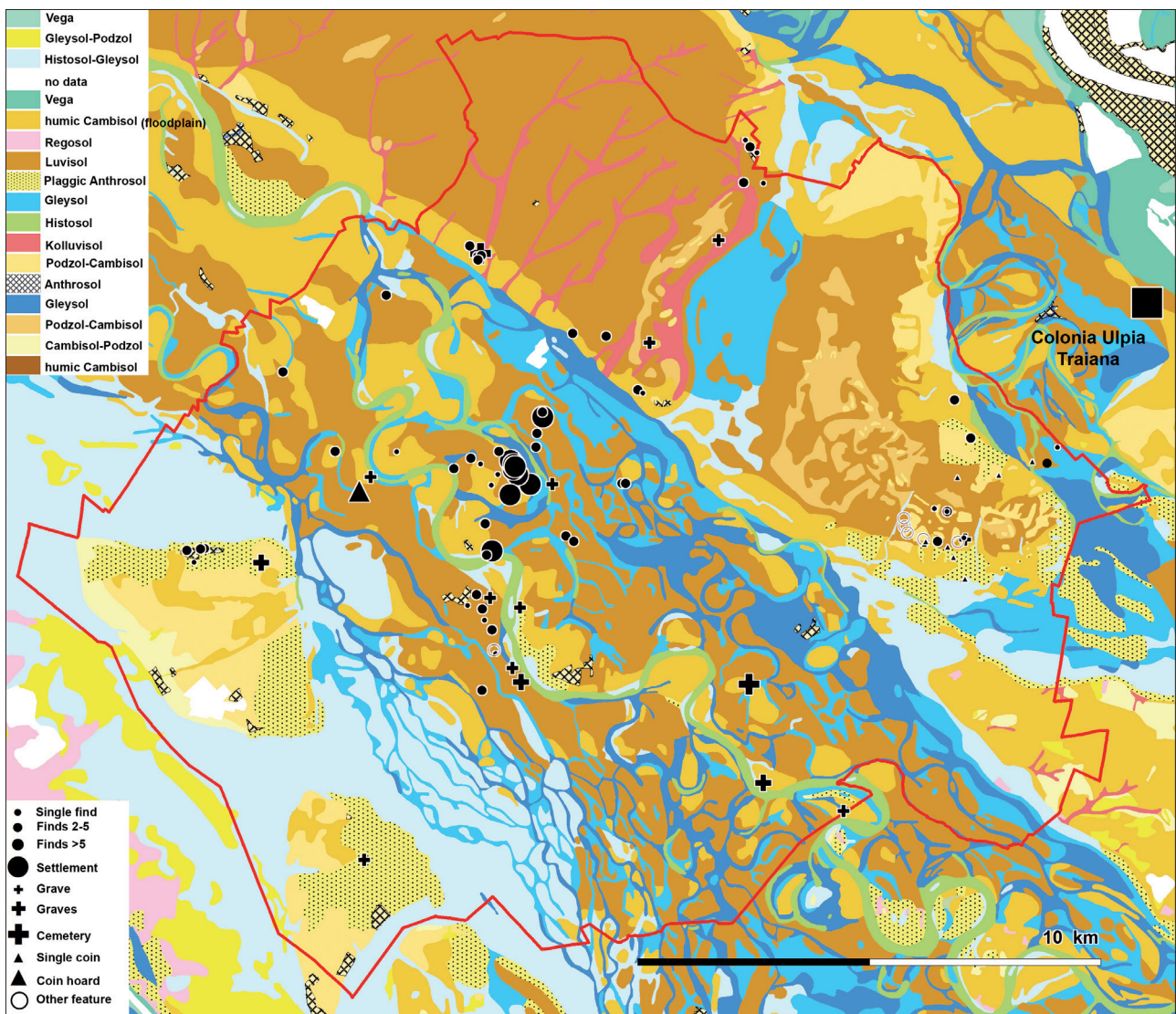


Fig. 33. Site distribution on different soils: Soil type (M. Brüggler, LVR-ABR; based on Bodenübersichtskarte 1:50 000 Geologischer Dienst NRW).

The predominance of sites on humic cambisols deserves comment. As the excavations in Weeze-Vorselaer showed, this label hides plaggic anthrosols. These are of post-Roman date, as shown above. The coincidence of settlement sites with plaggic Anthrosols shows that later (post-Roman) settlements used the earlier settlement areas as fields. It does not suggest that Roman settlements preferred plaggic Anthrosols.

Below, Renate Gerlach has classified soil types according to their agrarian potential. In the WUKS-area, the sites have been checked with this map. The following table gives the result. The settlement indicators are mostly found on medium quality soils, because these predominate by far. They can also be found on low quality soils, but always on the border with a higher-potential-soil. Graves were found in soils of all three qualities that are to be found in the research area (table 5).

Soil value unit	Occurrences (n=67)	Settlement indicators	Graves
High	12	8	4
Medium	42	35	7
Low to very low	13	9	4

Table 5. Distribution of sites on soil value units.

The elevation data were classified into three groups. The first (15-24 m above sea-level) comprises the Niers plains; the second group includes the tectonic plateaus and the lower parts of the moraines lying on elevations of 24 m to 40 m above sea-level; the last group is 40 m and higher (table 6).

Elevation	Occurrences (n = 67)	Settlement indicators	Graves	Area km ²	Sites/km ²
15-24 m above sea-level	40	31	9	196 (66.5%)	0.2
>24-40 m above sea-level	18	13	5	71 (24%)	0.25
40+ m above sea-level	9	8	1	28 (9.5%)	0.3

Table 6. Distribution of sites on different elevations.

As this table shows, the Niers plains have a similar site density as medium elevations. Elevations below 17 m were shunned due to poor soils and the danger of flooding. The medium elevations show 18 incidents and the higher elevations nine. The Niers plains have 31 settlement indicators and nine grave sites, the medium elevations 13 settlement indicators and five grave sites and the high elevations eight settlement indicators and one grave site. Five of the eight settlement indicators in high elevations are ditch features on the Sonsbecker Schweiz hill, where a functional interpretation is not clear; they may have belonged to an aqueduct for the Colonia Vlpia Traiana.

Burial evidence for the research area is very scarce. Graves occur in the centre of the Niers plains and on the edge of the heights⁴⁷. The choice of grave location may have been incidental, but Roymans and Derks observe that native Roman cemeteries were often located near prehistoric barrows and urnfields in the Meuse-Demer-Scheldt region (Roymans & Derks 2015, 9). Only at Uedem-Keppeln were excavations undertaken, but these were conducted as rescue excavations already in 1930/31 and did not encompass the complete cemetery (Petrikovits & Stampfuß 1940; Bridger 2007). The 96 graves that were investigated dated from around AD 70 to the beginning of the third century. Single finds suggest that graves of a later date

47. Brüggler 2016: At Uedem-Keppeln (Cat. U001) and on the Hees plateau (W011) and, a little further apart K005 on the Twistedener Feld, the Roman period graves were in the vicinity of Iron Age barrows. In the Niers plains, the graves W010, K004, K009 and K006 were located in the neighbourhood of Iron Age graves.

existed in areas that were not excavated. Of note were the combinations of Roman type pottery and Germanic pottery that have parallels with areas east of the Rhine.

Within the 295 km² research area, the 67 potential settlement sites throughout the Roman period would amount to 0.23 sites/km².

In other, more intensively researched areas with comparable natural conditions, settlement densities of 0.1 to 0.34 settlements per km² are surmised (cf. table 7). Large-scale studies often yield lower densities than those investigating smaller regions. This may be because the smaller-scale studies picture a more densely settled microregion which was for some reason favourable for settlement. The region around Weeze-Vorselaer seems to have been more densely populated with 16 settlements or settlement indicators within a 10 km² circle centred on Weeze-Vorselaer, amounting to a settlement density of 1.6 settlements/km² (cf. above). But considering the “WUKS” region as a whole, other parts were less favourable for settlements, so on the whole the settlement density must have been well below 1.6 settlements/km².⁴⁸

Name of area	Size km ²	Soil	Settlements	Settlements/km ²
WUKS	295	Pleistocene sand and loam	67	0.23
Kevelaerer Donkenland (Gechter und Kunow 1986)	237	Pleistocene sand and loam	38 (sites)	0.16
Niers-Kendel ⁵⁰	36	Pleistocene sand and loam	3/12	0.1/0.3
Kromme Rijn (Kooistra 1996; after Vos 2009, 215)	110	Holocene clays	120	1.1
Oostelijk rivierengebied (Willems 1984, after Vos 2009, 215)	1650	Holocene clays/Pleistocene sand	510	0.3
Regio Someren (Vos 2009)	72	Pleistocene sand	25	0.34
Regio Bladel (Vos 2009)	175	Pleistocene sand	40	0.22
Lower Rhine (including right bank), (Bridger 2000a)	2023,7	Holocene clays/Pleistocene sand and loam	227	0.1
Lower Rhine left bank (Bridger 2000a)	1253	Sand and loam	181	0.14
MDS-area (Creemers <i>et al.</i> 2015)	10 000	Sand	1142	0.1
Kempener Lehmplatte (Bridger 1994)	243	Loess	38	0.16
Hambacher Forst (Jeneson 24.01.2013)		Loess		3-4
Aldenhovener Platte (Lenz 1999)	35	Loess	69	2

Table 7. Regions within *Germania inferior* and their settlement density (after Vos 2009, 215, with additions).

MATERIAL EVIDENCE FOR AGRARIAN PRODUCTION (MB)

Apart from plant remains, archaeological finds and structures from the loess zone as well as the Lower Rhine Plain allow some conclusions as to the economic basis of the rural settlements.

In the loess zone, arable farming with the aim of surplus production formed the economic base. Therefore, large granaries were needed for storing the harvest before it could be transported to markets and consumers. These have been found in abundance during excavations of *villae*⁴⁹: the granaries of HA 206 and HA 127 (fig. 34) had an estimated storage capacity of 140 m³, the large horreum of WW 112 had about double that capacity (Gaitsch 2011, 290). At HA 132, too, several large buildings measuring about 250 m² were interpreted as granaries, one of which contained the burnt remains of spelt (Brüggler 2009, 54). Processing of cereal also took place on the sites, as millstones are found on a regular basis (Heimberg 2002-2003, 125). These often belong to the larger variant that had to be driven by animal- or water-power⁵⁰. Since it is unlikely that cereal was transported as flour, these must have been needed for the subsistence of the *villa* inhabitants. Processing of cereal – for example for beer-brewing – and other agricultural produce is also suggested by the appearance of drying kilns in the third century at several rural sites in the Cologne Bay (fig. 8; Heimberg 2002-2003, 125).

48. Riedmeier-Fischer 1998, 160 states that three of the sites are potential settlements. A re-check of her detailed catalogue allows in fact 12 sites to be classified as potential settlements.

49. Cf. now Schubert 2016 (unpublished); cf. Habermehl 2013, 148-152 for the estimation of storage capacities and development of granaries.

50. Brüggler 2009, 192. In the case of the Hambacher Forst, the use of water-power was restricted.

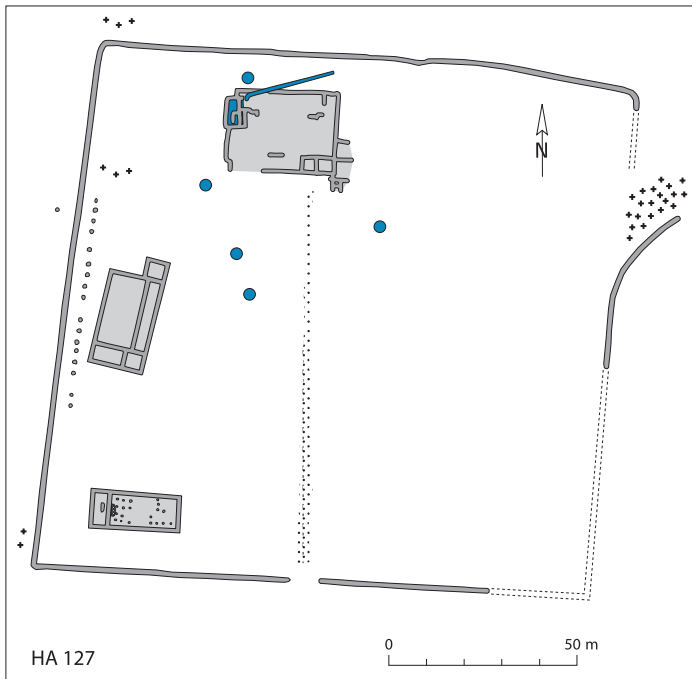


Fig. 34. *Villa rustica Hambach 127* (C. Duntze, LVR-Landesmuseum Bonn; reprint from Heimberg 2002-2003).

151-153, 222). Horses were also kept, as can be surmised from horse tackle that was found at HA 132. These were probably draught-animals (Brüggler 2009, 208). The share of animal husbandry in the economy of the loess zone is unclear; while Werner Eck generally rules out anything beyond the level of subsistence (Eck 2004, 431), Tünde Kaszab-Olschewski even established a shift of emphasis in the villa HA 512 from cattle husbandry to arable farming on the basis of functional interpretation of buildings (Kaszab-Olschewski & Knörzer 2006, 222).

Besides farming and animal husbandry, other activities took place in the villas of the loess belt: iron extraction⁵³ and smithying, wood-working and textile production (Heimberg 2002-2003, 125). But apart from iron extraction, all of these activities pertain to daily work that is needed to run a farm (Brüggler 2009, 209).

In the loamy and sandy areas, the artefact remains provide only little evidence of arable farming. Small four-post and six-post-buildings that may – besides other functions – have been used as granaries are known at Vorselaer. But in comparison to the sizes of granaries in the loess zone these are tiny structures, underlining the minor importance of arable farming in the loam and sand zones. Millstones are found on a regular basis here, too. Most of them can be attributed to hand-mills, but in Weeze-Vorselaer IV, one millstone must have been operated with a capstan because it is 80 cm in diameter. These millstones prove that cereal was processed, but most likely for subsistence only.

The material evidence for animal husbandry is slightly more conclusive. Unfortunately, as in the loess area, nothing is known of the animals themselves: since animal bones were not preserved in the weathered soils, no statements can be made as to what kinds of animals were kept, bred, or consumed. At Weeze-Vorselaer, an iron and a copper alloy bell were most likely

Even though arable farming played a more important role than animal husbandry in the loess zone, it can be concluded from the archaeological evidence that animals were kept for their products. Farms like HA 512 (fig. 13) and HA 132 (fig. 9) had large, one-aisled post-built structures or wooden buildings on stone foundations that are interpreted as stalls (Gaitsch 2010, 78; Gaitsch 2011; Brüggler 2009, 54). At HA 127 (fig. 34) and HA 130, buildings are interpreted as open stalls for livestock. Cheese production can be concluded from the presence of cheese press moulds (Gaitsch 2010, 78; 2011, 290). Moreover, large mortaria, which form part of the typical ceramic spectrum, may have been used in cheese production. At HA 132, two iron bells were probably used for cattle, given their size⁵¹; iron and bronze bells are also known from other sites in the loess zone (Gaitsch 1996; Kaszab-Olschewski & Knörzer 2006, 222). Animal bones were generally very poorly preserved in the decalcified, weathered soils, so it is hard to establish the overall extent of animal husbandry and species proportions. In special circumstances, animal bones have survived and point to a few conclusions⁵². Pigs were kept for their meat (Brüggler 2009, 208; Kaszab-Olschewski 2010, 96). At HA 512, a few bones from sheep suggest there may have been textile production (wool) (Kaszab-Olschewski & Knörzer 2006,

51. Brüggler 2009, 208, bells were also found on other sites such as HA 512, cf. Kaszab-Olschewski 2010, 96.

52. Kaszab-Olschewski & Knörzer 2006, 151-153; H. Berke in Brüggler 2009, 488-494; for an overview on the consumption of animal products in the Rhineland cf. Berke 2010

53. Kaszab-Olschewski 2010, 96; Kaszab-Olschewski & Knörzer 2006, 62-63; Heimberg 2002-2003, 126; Gaitsch 2015, 147.

used for animal husbandry (cf. fig. 23). They were usually worn by the leader of a herd and could have been used for cattle as well as goats, sheep, donkeys or horses. The size of the Vorselaer examples rules out goats and sheep (Brügglér 2012).

The main buildings of the farms were usually byre houses; this suggests that cattle must have been kept and also stalled. At Weeze-Vorselaer, one of the buildings dated to the beginning of the Common Era even gave evidence of cattle stall walls. The only reconstructable box is 1.5 m wide. According to the compilation of Harm Tjalling Waterbolk, cattle-boxes ranged between 0.67 m to just above 1 m in width in Roman times (Waterbolk 1975, 392). Most are between 0.85 and 0.94 m wide. The one from Weeze was then probably a double stall, i.e. for two cows. The three early Roman house-plans at Weeze-Vorselaer site V have byre sections of around 7, 9, and 10 m in length. Accordingly, 15, 18, and 20 cows could have been stalled within, if one takes an average width of 0.9 m per cow. Those houses of the second and third century in Weeze, Wachtendonk, and Kevelaer measured between 25 and 30 m in length, if half to two-thirds of this length was used as stabling, the herd sizes can be calculated at between 30 and 40 head. One of the houses in Kevelaer-Grotendonk may have had a deepened byre section. For similar structures in the south-eastern Netherlands, it is assumed that they were used to stall sheep, goats, and pigs, though cattle are not excluded⁵⁴.

As in the loess zone, mortaria are frequently found on the rural sites of the loamy and sandy areas. Since archaeobotanical evidence proves that Roman diet patterns were not adapted in the hinterland of Xanten, this type of vessel was surely not used for the mixing of sauces or moretum⁵⁵.

Other activities in the rural settlements include textile production, as is proven by finds of spindle whorls. A possible base for a vertical loom was identified in one of the houses of Weeze-Vorselaer IV (fig. 20.3). There is so far no indication of textile-production at anything more than subsistence-level⁵⁶.

Metal slag has been found with a few pieces in early Roman contexts in Weeze-Vorselaer V and in Wachtendonk-Meerendonkshof in second and third century contexts. They have not been analysed yet, but do attest to metal-working.

MARKETS AND TRANSPORT (KJ, MB)

In order to exchange agricultural produce, market places are needed as well as roads or waterways for transport. In general, *municipia* and *coloniae* automatically had the *ius nundinarum* (Petrikovits 1977, 96). In Germania inferior these are the *Colonia Claudia Ara Agrippinensis* and the *Colonia Vlpia Traiana* and the *municipia* at Tongeren and Nijmegen. For the purpose of trade in perishable goods, there must have been more markets. They may have been held in small towns, even without formal market rights⁵⁷. Markets can be difficult to recognize by archaeological means. In the towns, *fora* are easily identified, but markets may also have been held in the open air, perhaps just with tents as stands. Nor did they have to be restricted to settlements: since they were often held in connection with religious feasts, sanctuaries and temples could also have served as market places (MacMullen 1981).

In the loess zone between the Meuse and Rhine, markets were in all probability connected to the *vici* such as *Juliacum* (Jülich), *Aquae Granni* (Aachen), *Coriovallum* (Heerlen), and *Traiectum* (Maastricht). In the northern zones, no market has yet been excavated so far – or even detected – in any small town on the Lower Rhine (Heimberg 2000, 202). Only very few *vici* existed, and research is still minimal: Pont, Aldekerk and Wachtendonk-Wankum are often named in older literature, but their identification as *vici* is still insecure. Geldern-Pont is identified as the *Mediolanum* of the *Itinerarium Antonini* according to Cüppers (Cüppers 1960, 96). Here, a cemetery was excavated and many Roman objects can be found in the vicinity in private collections (Cüppers 1962, 60). Wachtendonk-Wankum may have been a *vicus* or a road station (Cüppers 1960, 90). The *vicus*

54. van Enckevort & Hendriks 2014, 244. Other: Hiddink & Roymans 2015, 59 who attribute them to cattle-stalling.

55. In view of the contrary archaeobotanical evidence, i.e. no adaption of Roman food patterns, the conclusion by Kyritz 2014, 245 (probably based on Baatz 17/18) that mortaria – and other ceramic containers – are proof of the adaption of Roman dietary habits must be contradicted.

56. As for example in north-western France and around Trier (Roymans & Derks 2011, 18).

57. Some were later granted to it by the senate or the emperor, Petrikovits 1977, 96.

of Mönchengladbach is situated at the loess-sand/loam transition and half-way between Neuss on the Rhine and the Meuse (Hupka 2011; Erkelenz 2012).

It is not inconceivable that markets were held in the *vici* of the military forts along the Rhine. Their importance as market places can be seen along the Upper German Limes: no civilian *vici* are found here, since the military *vici* obviously functioned as (market) centres (Sommer 1994, 94; Sommer 1988, 589ff.). These *vici* also played an important role in cross-border trade with the Germanic peoples in *Germania magna* (Sommer 1988, 593).

Bulk transport is most easily effected by water. Here, the two large rivers Rhine and Meuse bordering the Rhineland in the east and west have to be mentioned in the first place. How far the minor rivers Rur, Erft and Niers or even smaller streams could have been used for transport is less clear. Rather than being transport routes, these minor streams and their oxbows constituted obstacles, especially in the wet season (Hiddink & Roymans 2015, 51).

Major roads ran beside the Rhine and Meuse rivers. The road along the Rhine was part of the Limes, connecting the forts and enabling troop movements. But it was surely also used for trade. In recent years, efforts have been made to locate its exact course (Becker 2007; Berkel & Obladen-Kauder 2016).

The main arterial road that connected the *vici* in the *Limes* hinterland ran in a straight line from Cologne to current-day Rimbürg on the Dutch-German border. From Rimbürg this road, that is depicted on the *Tabula Peutingeriana*, followed the relief of the land and crossed the Meuse at current day Maastricht, where it went on to the municipium town of *Atuatuca Tungrorum* (Tongres) in Belgium. This road, indicated by its modern name of *via Belgica*, was the main transportation route of the loess zone, and it cannot be a coincidence that it runs more or less exactly down the middle of the zone between the Meuse and Rhine. From *Atuatuca Tungrorum* the road ran southwest to *Bagacum* (Bavay in northern France) from where main roads ran in five directions, including one towards the North Sea coast at *Bononia* (Boulogne-sur-Mer).

This road has been identified at several locations in Dutch Limburg and the German Rhineland. In the lignite mining area a long stretch of the *via belgica* was excavated together with settlements, burial sites and cult places that were located next to the road. Here the main body of the road consisted of a hardened surface of gravel of 8 to 9 m wide, flanked on both sides by unhardened paths of the same size, with v-shaped ditches forming the edge of the road, that thus measured nearly 25 m in width. In Dutch Limburg too the main body of the road consisted of a gravel-packed surface of 7 to 9 m, although the adjoining paths were not found here. Dating evidence of the road in the Hambach area points to the early Roman period, which seems to indicate that the road was originally constructed as a supply line to the army camps on the Rhine, transporting cereal produced on the loess soils of current-day France and Belgium to the Limes.

Another main road connecting the loess zone between Meuse and Rhine to a major Roman town on the Limes is the one running from *Aquae Granni* via *Coriovallum* to *Colonia Vlpia Traiana*. Although not depicted on the *Tabula Peutingeriana*, this road is mentioned as a route in the *Itinerari Antonini Augusti* and has been excavated at several locations in Dutch Limburg. In fact, this road still connects the two towns of Aachen and Heerlen and recent excavations have shown that the Roman road lies exactly beneath the current day road. Unfortunately, its trajectory north of Heerlen remains to be located, although a straight line towards the current day village of Tüddern east of Sittard seems to be the logical course. Further north from Tüddern, this road can be followed in some sections even today in the digital terrain model (Berkel & Obladen-Kauder 2016), while other sections are less clear. Heinz Cüppers thinks it may have had pre-Roman origins (Cüppers 1960, 98).

In the loess zone, secondary roads connecting the villa settlements to the main road are also lacking from the current dataset for the region, with the notable exception of one such road that was excavated in the Hambach region. Far from its straight counterpart, this 4 m wide secondary road followed a more fluid course, connecting several villas to the *via Belgica*. It is evidence of a situation in which every surplus-producing farmer would have needed to be connected to the main transportation routes and thus to the main markets. Reconstructing this network of secondary roads remains an important research focus.

For the northern regions, still less is known of this secondary road network. Hagen already surmised other roads: a north-south link along the tectonic elevations parallel to the Meuse and one from the auxiliary fort at *Burginatum* in a south-

westerly direction through Weeze to the Meuse⁵⁸. Another secondary road can be assumed leading along the south-western edge of the Reichswald elevation, i.e. from northwest to southeast, maybe connecting to the Xanten-Tongeren road. Off this road, a dam can be followed near the burgus of Goch-Asperden and also at Uedem in the digital terrain model running parallel to the slope and past a large Iron Age cemetery at Kalbeck⁵⁹. Stampfuß (1937, 295-299) already mentions this dam; he dug a trial trench, though, and did not think that the dam was of Roman date. But remains of Roman roads on the Lower Rhine are often very poorly preserved (Berkel & Obladen-Kauder 2016), so that Stampfuß may have been mistaken. A number of recent archaeological detections of secondary and local roads in the Netherlands show that there must have been a road-network on this scale⁶⁰.

It is hard to determine whether or not the *vici* alongside the main roads functioned as market towns, in particular for the *vici* in the loess zone, as despite a research history of over 100 years there are many open questions about the nature and function of these unofficial towns. In *Coriovallum*, strategically located on the crossroads of the *via Belgica* with the road from *Aquae Granni* to *Colonia Vlpia Traiana*, evidence of trade has been found in the form of weights and scales, and the town's pottery industry, with more than 50 pottery kilns found so far, also points towards a central function for the region's trade. In Roman Maastricht a large bridge over the Meuse, the proximity to *Atuatuca Tungrorum*, the civitas capital of the *Tungri*, and the possibility of bulk transportation of goods over the Meuse, all point towards excellent trade possibilities and it seems logical that it had a central function in the regional trade network, if not as a market, then at least as a harbour. In *Aquae Granni* recent finds of several fragments of altar stones erected by *beneficarii* point towards specific trade functions and the natural occurrence of iron and lead would have provided ample opportunity for interregional trade. *Juliacum* was also located at a crossroads, with a main road running off the *via Belgica* to the northeast towards *Novaesium* (Neuss) on the Rhine and possibly another route connecting the town to Roman Aachen. Of course, this town was also located on the banks of the River Rur, which in Roman times must also have been used for some form of bulk transportation.

New research in recent years has shown that in addition to the *vici* known from the *Tabula Peutingeriana* and the *Itinerarium Antonini*, there were many other forms of nucleated settlement connected to the Roman main road system in the loess zone. The *vicus* at the Wurm crossing was already known, but new geophysical research has resulted in a clear picture of a typical roadside settlement consisting of long and narrow houses on both sides of the road, on both sides of a wooden bridge over the River Wurm. Excavations in the Hambach area near Eschweiler unearthed a small roadside settlement and geophysical research of the region between Rimburg and Jülich indicated another such settlement near the current-day village of Baesweiler. Whether these towns functioned as markets or not has yet to be determined, but these new discoveries show that the urban component of the loess zone between the Meuse and Rhine may have been much more diverse than previously assumed.

THE LOWER RHINE PLAIN: PRODUCTION FOR A SUSTAINABLE FRONTIER? (MB)

The hinterland of the Lower German *Limes* is thought to have been incapable of yielding a surplus to sustain the town and fort populations and the military staff of the *Limes*⁶¹. The reasons for this are the poor quality of the loamy and sandy soils compared to those of the loess areas to the south and the limited number of (known) settlements, at least for the part lying in modern Germany. Furthermore, those rural settlements that were excavated seem to point to continuity of Iron Age subsistence-farming⁶² rather than being aimed at generating a surplus of cereal (Roymans & Derks 2011, 21). Recent Dutch research, however, concludes that the rural population was fully integrated into the Roman economic world despite the fact that it lived in byre houses (Heeren 2009; Vos 2009; Kooistra *et al.* 2013, 6).

58. Hagen 1931, 228, 233.

59. Thanks to Georg Hüttner, Kleve, for pointing out this feature.

60. Hiddink & Roymans 2015, 49-50. Stream valleys with their wet environments have even yielded evidence of Roman bridges along these secondary roads.

61. Cf. Kooistra *et al.* 2013, 6 with older literature; Schalles 2000, 439f.

62. Cf. Roymans 1997; Roymans 1996 on society and economy of the Lower Rhine in the late Iron Age and early Roman period.

Was it theoretically possible for the local rural population on the German Lower Rhine Plain to sustain the town and fort populations, who are assumed not to have been involved in the primary production of food? Was the carrying capacity of the land for food sufficient? Of course, many questions remain open concerning the actual size of the town and military populations. The settlement density in the rural areas is not known either. Still, waiting for enough data to show up is not the answer to our questions. Therefore, a theoretical model is needed to help find these answers. Laura Kooistra and Marieke van Dinter pursued these matters for the Lower Rhine delta (Kooistra *et al.* 2013; van Dinter *et al.* 2013). The conditions on the German Lower Rhine Plain and the Rhine delta being to a certain extent comparable (see below), the model presented by Kooistra was adapted to answer these questions for our research area.⁶³ I am aware, of course, that the following remarks are to a large extent hypothetical. However, the results may prompt a rethink of existing models of production possibilities.

The research area (fig. 44) comprises the loamy and sandy soils of the Lower Rhine Plain, i.e. the hinterland of the Limes zone between the Roman town of Nijmegen and the fort at Krefeld-Gellep. To the west, the boundary is the Meuse. It can be considered that agrarian products were also acquired on the eastern bank of the Rhine, where Roman products – mainly pottery – are found on a regular basis in rural settlements (Kempa 1995; Kyritz 2014; Bridger 2015). But more importantly, the exact bed of the Rhine in Roman times and with it the border has not been identified everywhere. Therefore, a 5 km-wide strip on the east bank of the (modern) Rhine is taken into account. The research area covers 3,200 km². The time section is the first half of the second century, after the establishment of the province of *Germania inferior* in the late first century, the founding of the *Colonia Vlpia Traiana*, and the withdrawal of the tenth legion from Nijmegen. The second century in most studies shows an optimum of rural population sizes, while military personnel were not present in as large numbers as in the first century (Willems 1981; Willems 1984; van Enckevort 2000, 361). The scenario should therefore be in favour of sustainability. If it was ever possible to feed the non-agrarian inhabitants on what was produced in the hinterland, it would have been during this period.

In the following section, I try to assess the population size and its aggregated demand for food in cereal and cattle. The carrying capacity of the land and the production capacity of the rural population shall be estimated.

Population size and calorie demand. Military staff and their civilian associates

In order to assess the size of the military population in the first half of the second century, we would need to know which troops were stationed in the research area. This is impossible, however, with the historical sources at hand. Estimations for the number of soldiers in *Germania inferior* are about 35,000 soldiers at the end of the first century (Alföldy 1968, 149-152); the diploma of Elst in AD 98 mentions six *alae* and 25 cohorts, which amount to 3,000 mounted troops and 15,000 infantry of auxiliary troops alone (Haalebos 2000, 37/66). Then the troops were reduced to 21,000 soldiers within the first half of the second century (Alföldy 1968, 149-152). By 152 AD, 15 cohorts and one legion were stationed in the province (Haalebos 2000, 37/66). These numbers apply to the province of *Germania inferior* in total. But since we are looking at a time span of 50 years and it is not the aim of this paper to give a compendium of the exact troop movements, a rough account is enough for our purpose. In order to calculate the number of military personnel, the existing *castella* sites and sizes are combined with what is known of the type of troops stationed there⁶⁴.

In the first half of the second century, there was a legionary camp at Xanten, while auxiliary units were stationed at Krefeld-Gellep, Alpen⁶⁵, Altkalkar, Till-Steincheshof, Arnhem-Meinerswijk (Hulst 2006), Herwen, and Looward⁶⁶. At Moers-Asberg, the unit had already been withdrawn by the end of the first century, therefore only the *vicus* population is counted. Wesel-Büderich is often viewed as a fort, but as yet no archaeological proof has been found; finds suggest at least a (military?) *vicus*.

63. For details on the model cf. van Dinter *et al.* 2013.

64. Cf. Bödecker *et al.* 2015 79 for a short summary on *castella* and their dates. Cf. also Bridger 2006 for calculations on the number of soldiers in the Roman period on the Lower Rhine.

65. Unpublished site, pers. comm. Steve Bödecker.

66. van Dockum 1995; for Driel and Huissen, other presumed fort sites, the evidence remains too thin; pers. comm. M. Polak after a reassessment of the Dutch sites.

Van Dinter surmises that the *castella* were not fully manned and calculates 350 soldiers per auxiliary fort (*ca.* 70%) (van Dinter *et al.* 2013, 11). In order to compare our study with the one by Kooistra, here too a garrison of 350 soldiers for the auxiliary forts and 3,500 for Vetera II has been calculated in the minimum calculation.

Civilian settlements, the *canabae* and *vici*, were to be found in the immediate vicinity of the *castella*. These are proven for Krefeld-Gellep, Moers, *Burginatum*, and Till-Steincheshof, even though their size and population numbers are often unclear. We assume that all the forts had civilian settlements and – together with Kooistra (Kooistra *et al.* 2013, 14) – that their size equalled that of the garrison⁶⁷.

Castrum	Unit	Unit min	Unit max	Vicus min	Vicus max	Sum min	Sum max
Xanten, Vetera II	Legio	3,500	5,500	3,500	5,500	7,000	11,000
Krefeld-Gellep	Ala quingenaria equitata	350	720	350	720	700	1,440
Moers-Asberg	Ala quingenaria	0	0	350	480	350	480
Alpen	cohors miliaria	700	1,000	700	1,000	1,400	2,000
Kalkar (Burginatum)	Ala quingenaria	350	480	350	480	700	960
Till-Steincheshof	Cohors quingenaria equitata	350	600	350	600	700	1,200
Meinerswijk	Cohors quingenaria equitata	350	600	350	600	700	1,200
Wesel-Büderich	?	0	0	350	480	350	480
Herwen-Bijlandse Waard	Cohors quingenaria equitata?	350	600	350	600	700	1,200
Looward	Cohors quingenaria?	350	480	350	480	700	960
Sum		6,300	9,980	7,000	10,940	13,300	20,920

Table 8. Military units and their sizes.

This table (table 8) indicates that the number of soldiers was between *ca.* 6,300 and 10,000. The estimated maximum number of soldiers is slightly lower than the number deduced from epigraphic sources for the middle of the first century (Haalebos 2000, 37, 66). Together with civilian associates, the military personnel amounts to a minimum of 13,300, while the maximum number can be given as 20,920.

The daily calorie demand – according to van Dinter *et al.* (van Dinter *et al.* 2013) – for a soldier is taken as 3,300, for civilians as 2,200 kcal. Fodder for animals, i.e. especially the horses of the military units, is not calculated in this model⁶⁸. Of the daily calorie demand, it is assumed by van Dinter *et al.* that 67.5% were consumed in the form of cereal products and 22.5% in meat⁶⁹. The remaining 10% were consumed in other foods. Therefore, the calorie demand per annum for our research area for cereals was a minimum of 8,916,311,250 and a maximum of 14,043,867,750 kcal for the military personnel and civilian associates. In meat, a minimum of 2,972,103,750 kcal and a maximum of 4,681,289,250 kcal were needed.

67. Wendt & Zimmermann (2008, 15) calculate 1.5 civilians per soldier. In order to make both Kooistra *et al.* 2013 and our study comparable, we assume a ratio of 1:1.

68. Marcus Junkelmann calculates 0.5 kg barley, 10 kg hay, and 3 kg straw per horse per day in winter, in summer 1 kg of barley (Junkelmann 2008, 111). Around 2 kg of barley per horse and day can be deduced from a manuscript from Carlisle, if the conjecture is correct that the sum of 669 *modii* barley for an ala is a three-day provision, cf. Stauner 2004, 52. Junkelmann supposes 800 horses for an *ala quingenaria*. This number may be slightly too large, since Roman military records (cf. Stauner 2004, 43 and Fink 1971, 340-344) imply one horse per soldier. With at least three alae in the research area, at least 1,500 horses needed to be fed, excluding pack animals and the horses of the *cohortes equitatae*.

69. This assumption may be a little too low and other authors calculate 0.9 kg grain per soldier per day, cf. Habermehl 2013, 136, which would amount to 2,790 kcal and equal 85% of the daily calorie demand.

Civilian population in towns and civilian *vici*

Apart from the military staff, inhabitants of civilian towns and *vici* must have constituted a large part of the population in the research area. The largest town was the *Colonia Vlpia Traiana*. The number of 10,000 inhabitants that is occasionally given is an estimation based on the number of persons that could be seated in the amphitheatre⁷⁰. In this paper, we estimate *ca.* 8 000–15 000 inhabitants, about the same number as is surmised for *Augusta Raurica* (Bossart *et al.* 2006). The *Municipium Noviomagus* as the second largest town is thought to have housed 5,000 inhabitants⁷¹. For the other civil settlement agglomerations, very little is known and no substantial recent research has been carried out⁷². The exception is Cuijk (NL) for which the size of around 10 ha can be given (van Enckevort & Thijssen 2002, 29). An estimation on the basis of *vici* sizes, let alone house plans, as has been carried out in more intensively researched *vici*, is therefore impossible for the Lower Rhine Plain (Wendt & Zimmermann 2008, 16–20). We assume 200–300 inhabitants for Qualburg, Pont, Wachtendonk, Aldekerk, Venlo, and Holdeurn⁷³. For the *vici* of Cuijk, the population was probably a little larger: it covers the same area as Euskirchen–Billig (loess landscape), whose population is calculated as 800 inhabitants⁷⁴. This adds up to a total of 2,000–2,600 inhabitants for the civilian *vici*⁷⁵. Together with the populations of the *Colonia Vlpia Traiana* and Nijmegen this amounts to between 15,000 to 22,600 people.

Their calorie demand per day is put at 2,200 per person by van Dinter *et al.*, the same as is estimated for the non-military inhabitants of military *vici*. As above, for this calculation it is assumed that 67.5% of their diet is consumed in cereals, 22.5% in meat. This amounts to the following sum of calories by cereal per annum: a minimum of 8,130,375,000 kcal and a maximum of 12,249,765,000 kcal, while in meat a minimum of 2,710,125,000 kcal and a maximum of 4,083,255,000 kcal were consumed.

Rural population

The settlement density has to be assessed by analogy. For other areas with similar natural conditions that have been more intensively investigated settlement densities between 0.1 and 0.34 settlements/km² are assumed. I have worked with a minimum of 0.22 settlements/km² and a maximum of 0.34 settlements/km². I think that 0.1 settlements/km², which is given for some areas dealt with above, is too small: whenever more intensive research into certain areas is carried out, the number increases. The figure of 0.22 settlements/km² also comes close to the density for the immediate hinterland of Xanten of 0.23 settlements/km² (cf. above), which is part of the research area and it is therefore hoped that it gives a realistic picture. This is the total settlement density in the Roman period and does not take chronological variance into account. Considering that an uncertain number of settlements has not been identified (yet) and that the first half of the second century is thought to be a population maximum, I have taken the overall number of Roman sites and simply concluded that this more or less reflects the density in the first half of the second century.

The number of farms per settlement cannot be assessed for the research area either. I therefore – together with van Dinter *et al.* – assume an average of one to two farms per settlement.⁷⁶ The number of people per farm is equally surmised as 5–8 persons and per settlement unit as 10 persons (van Dinter *et al.* 2013, 39).

For the research area of 3,200 km², a population density of 0.22 settlements per square kilometre amounts to 704 settlement units, 1,056 farms and 7,040 inhabitants, while 0.34 settlements per square kilometre results in 1,088 settlement units, 1,632 farms and 10,880 inhabitants as a maximum. With a daily demand of 2,200 kcal, of which 67.5% were consumed in cereal and 22.5% in cattle products, their calorie demand per annum would be in total 5,653,120,000 – 8,736,640,000 kcal, of which 3,815,856,000 – 5,897,232,000 were cereals and 1,271,952,000–1,965,744,000 meat.

70. Heimberg *et al.* 1998, 58. As Bossart *et al.* have argued, the sizes of theatres or amphitheatres are not a sound basis for population estimation, Bossart *et al.* 2006, 70.

71. Willems & van Enckevort 2009, 74 after Brunsting 1937.

72. Elst: cf. Willems & van Enckevort 2009, 86.

73. For *vici* in the Rhineland in general cf. Heimberg 2000.

74. *Ibid.* 216

75. Wendt & Zimmermann 2008, 15 (after pers. comm. T. Fischer) assume 500 inhabitants on average.

76. i.e. 1.5, cf. van Dinter *et al.* 2013, 39.

These considerations show one thing very clearly: a rural population of 7,040 to 10,880 inhabitants, i.e. people who were involved in primary agrarian production, would have had to sustain 28,300 to 43,520 consumers. This yields a producer: consumer ratio of 1:6 in the worst case, or, 1:2.5 in the best case.

Production of cereals and cattle

After having established the demand, we now need to look at the production. How much cereal and cattle was the local population able to produce?

Van Dinter *et al.* assume that 9.5 ha of arable land are necessary for each settlement to produce a surplus. The total size of the arable land including what is needed to produce cereals for one's own consumption is 12.8 ha. They calculate a yield of 1,000 kg cereal per hectare and an output of 3,100 kcal per kilogramme of cereal. The annual cereal production with a minimum of 704 and a maximum of 1,088 settlements can therefore be calculated as follows⁷⁷:

Settlements	Surplus (x 9.5 ha x 1000 kg x 3,100 kcal)	Total (x 12.8 ha etc.)
Min. 704	20,732,800,000 kcal	27,934,720,000
Max. 1088	32,041,600,000 kcal	43,171,840,000

Concerning cattle production van Dinter *et al.* assume that each farmstead had a cattle stock of 50 head⁷⁸, each herd giving a yearly calorie output of 3,800,000 and – after subtracting the needs of the rural population – a surplus of 2,000,000 kcal. Van Dinter *et al.* calculate 16 ha of pasture and 10.1 ha of meadows, therefore altogether 26.1 ha of land needed for cattle (Van Dinter *et al.* 2013). If one includes grazing on fallow land, the need for pasture land is reduced to 12.7 ha, i.e. 22.8 ha altogether. The yearly calorie output per 1 km² is therefore 16,666,666.7 kcal. The calorie production per annum can be calculated as:

Farms	Surplus	Total
Min. 1,056	2,112,000,000 kcal	4,012,800,000 kcal
Max. 1,632	3,264,000,000 kcal	6,201,600,000 kcal

The total amount of land needed to cultivate all the cereal consumed on the Lower Rhine Plain comes to between 167 and 262 km². These numbers are based on a calculation taking the need for calories in cereal⁷⁹. They are therefore derived from the consumers' point of view. We arrive at roughly the same results, when taking the producers' point of view: in the calculations of van Dinter *et al.*, one settlement unit could cultivate 3.3 ha of arable land to satisfy its inhabitants' own needs for cereal (Van Dinter *et al.* 2013, 39-50). One man could harvest this area in a two-week period. It is assumed there were 3.66 men per settlement unit, who would have been able to harvest 12.8 ha. Subtracting the land needed to grow the cereal for themselves, 9.5 ha would have been available for surplus production. The total land demand needs to be doubled, because a fallow year has to be allowed for. Cereal production to satisfy the needs of the rural population and urban/military population and including fallow land requires 171 km² - 263 km².

For cattle production, the required area differs depending on whether we look at demand or production: to produce enough calories to feed the population, between 417-643 km² were needed. The surmised number of farms, each keeping a cattle stock of 50, would have required much less land, only 241-372 km².

The amount of land naturally available for agrarian production was lower for several reasons. Land that potentially could have been used for agriculture was taken up for settlements, military installations and cemeteries⁸⁰. All in all, this land

77. After van Dinter *et al.* 2013.

78. The excavated byre houses in the research area are somewhat small for such a large herd. A herd of 50 head could only have been stabled in the largest houses with the minimum-sized cattle-boxes. Otherwise, the herd size would have been between 30 and 40 head. Therefore, either the size of the herds calculated is too high or the entire herd was not stabled in winter.

79. If one assumes, as van Dinter *et al.* 2013 do, that only 50% of the cereal was produced locally, these areas can be halved.

80. Van Dinter *et al.* 2013, 39 also calculated this factor but dismissed it as insignificant.

only amounts to around 30 to 40 square kilometres, i.e. just over one percent of the area investigated that could not have been used agriculturally⁸¹. Its size is therefore negligible. To conclude, enough land was available on the Lower Rhine Plain for arable farming and animal husbandry to meet the demand of the surmised population. Its soil quality was even sufficient to cultivate demanding crops such as spelt wheat, as will be shown below.

Demand and production

After this calculation, the total demand for cereal could be met – just about – by the rural population on the Lower Rhine Plain.

Total calorie demand in cereal	Surplus
20,862,542,250 – 32,190,864,750 kcal	20,732,800,000 – 32,041,600,000

But according to this model, not enough meat would have been produced for the local rural population itself and those persons not involved in agriculture.

Total calorie demand in cereal	Surplus cattle
6,954,180,750 – 10,730,288,250	4,012,800,000 – 6,201,600,000

To sum up: adapting the model by van Dinter *et al.* leads to the conclusion that the local rural population was in theory able to sustain itself plus the inhabitants of forts, towns, and *vici* with cereal. It was in theory even able to supply a full 100%, not only 50% as in the model by van Dinter *et al.*⁸². Surprisingly, it was not able to supply enough cattle. This is a somewhat irritating answer in view of the assumption that the region in question was supposed to have specialized in animal husbandry rather than arable farming.

We have now established that the army and the town populations in the Lower Rhine Plain could have been fed by the hinterland at least in cereal. However, both were not provisioned from local sources but rather obtained their food elsewhere⁸³. This is an important difference if it was impossible to produce a surplus or if one or both partners – consumers and producers – did not exploit the full potential. Still, farms in the hinterland of the Lower Rhine *Limes* did interact economically with the towns/*Limes* zone, as can be seen by imported products. Even though we cannot see indications of wealth such as luxury goods and large stone buildings, economic growth in the middle Roman period can still be inferred from the building of larger byre houses and increased settlement density (Roymans & Derks 2011, 18). We may encounter difficulties in estimating economic power, because wealth and status can be expressed in ways which leave few traces in the archaeological record, e.g. in large herds of cattle (De Clercq 2011, 253).

81. The *Colonia Vlpia Traiana* was ca. 74 ha in extent, with the necropolises and surrounding built-up area this area can be at least doubled. At Nijmegen, the civil and military settlements including their necropolises even amounted to around 6 km² – a rough estimation from the map presented in Willems & van Enkevort, 2009, 25. The *castra* Vetera II probably covered 26 ha and its *canabae* presumably took up at least the same area again. The site of the former *castellum* Vetera I was probably not used agriculturally; together with its *canabae* and necropolis this amounts to ca. 155 ha. The auxiliary forts required an area of ca. 3-4 ha each, including ditches and a construction-free zone. The military *vici* and the space for necropolises have to be added to that (4 ha, van Dinter *et al.* 2013, 39). The *vicus* of Cuijk covered 10 ha (cf. above), the *vici* at Moers/Asciburgium and Kalkar/Burginatum together with their necropolises took up an area of 38 ha and 35 ha (from database LVR-Heritage Service for the Rhineland, BoDeOn). The *Limes*-road is calculated by van Dinter *et al.* (2013, 39) as taking up a strip of 20-30 m in width, with a total length of roughly 100 km within the research area, this amounts to 2-3 km². Around the *Colonia Vlpia Traiana* large areas, taking up around 17 km² on the left bank of the Rhine, and at least 1 km² on the east bank were used as military training camps (Bödecker 2013). Not calculated is land that the legion itself may have cultivated, cf. Petrikovits 1991. In this model, this possibility is ignored. Also the Iron Age necropolises were obviously left intact and therefore have to be subtracted from the available land. They amount to 1.5 km².

82. van Dinter *et al.* 2013, 18: this 50% of the cereal supply equals the total supply of emmer and barley. Bread wheat and spelt were imported.

83. See below part II.

RESEARCH PERSPECTIVES (MB, KJ)

Overall it can be said that, although a great deal of progress has been made since the early days, many research topics are yet to be addressed.

Development trajectories have to be looked at. The beginning of the Roman period, i.e. the late Iron Age up to the establishment of a fully developed Roman countryside, is in need of further considerations. One of the questions is that of continuity or complete change with the late Iron Age population, namely the Eburones genocide by Caesar. Was the Cologne Bay totally depopulated? Or was there a remnant population? But even if a part of the Iron Age population – however small – remained, it is still not understood where the rural population that caused a boom in rural settlements one hundred years later came from; was it general population growth of a remaining native populace, settlers from inner Gaul, settlers from *Germania magna*, or veterans⁸⁴ – or all of them? The decline of the flourishing loess landscapes in the third century is not fully understood either. When exactly did it take place and what caused it? Was there a complete, imperially directed resettlement of the populace in the Rhineland, as Stijn Heeren surmises for the neighbouring MDS region (Heeren 2015)?

For the northern zone (Lower Rhine Plain) especially, an interesting field of study would be the interaction of the native settlements with the army or their relations with the *Colonia Vlpia Traiana*. To what extent were the native settlements integrated into the Roman economic world? Were they oriented towards the Rhine zone or more towards the Meuse and more western zones?

Even for the Cologne Bay, where an abundance of data has been accumulated, many questions remain. Many of the sites excavated in the lignite-mining areas have yet to be published. More synthesizing work has to be done. Outside the area of the open-cast lignite mines, commercial archaeological companies are paid only to carry out excavations, and – in Germany – are not paid to publish their results, let alone to do synthetic research. Apart from the main buildings at villa sites, little is known about other aspects of the rural world, such as the average size of the field systems. Is there a hierarchical structure of different settlement types⁸⁵? There is obviously a difference between axial villas with large, multi-roomed main-buildings on one side and smaller structures on the other, as has been examined above. But often lines cannot be clearly drawn. This poses a methodological question: Do the houses directly reflect their owners' status⁸⁶? No attempt has yet been made to use the entire dataset available to produce one coherent reconstruction of the entire Roman villa landscape between the Rhine and Meuse rivers. Parts of the region have been the subject of work of a synthetic character⁸⁷, but an all-encompassing study utilizing every contemporary element in the landscape has yet to be undertaken. The religious aspect – e.g. cemeteries, sanctuaries, Jupiter columns – of the rural landscape has been studied in a piecemeal manner but not synthetically (Roymans & Derks 2011, 30).

Large parts of the road network are not yet known; only the major roads connecting the larger towns are at least partially identified, but very little is known of minor local roads connecting the rural settlements to the main roads.

It seems then that villa archaeology in the Rhineland has advanced with every opportunity when development has taken place, whether through large-scale rescue excavations or expansion of the research focus beyond the villa compound to Roman settlement patterns and reconstructions of economic activities. Obviously a qualitatively and quantitatively rich dataset is available at least for parts of the research area, adding to the urgency for new research that will put it to good use.

84. Gaitzsch 2015, 147 interprets a scabbard as proof of the *villa* HA 127 belonging to a veteran.

85. In general cf. Habermehl 2013; Roymans & Derks 2011; Jeneson 2011 and above.

86. Cf. Derks 2011 on a small villa at Ravensbosch with inscriptions of a decurio, critically Brüggler 2012-2013.

87. In particular in the State-funded research project 'Roman villa landscapes in the North. Economy, Culture, Lifestyles' carried out in 2006-2010 at the VU University in Amsterdam, under professor N. Roymans.

Part 2

Were Soil Characteristics the Main Trigger for Land Use in the Roman Period in the Rhineland? The Geoarchaeological and Archaeobotanical Evidence

Renate Gerlach, Jutta Meurers-Balke, Tanja Zerl and Michael Herchenbach

Agricultural productivity is reliant on the soil conditions of a landscape. In the following sections, we will discuss the agricultural potential of the different landscapes within the Rhineland and its relation to cultural development. Soil data and archaeobotanical results are combined to elucidate the agrarian potential of the study area. In order to understand the basic principles of agricultural land use in the Roman period, both geoarchaeological and archaeobotanical data are discussed at “landscape level”: this means that the single features merge into a large-scale picture of agrarian production in the Roman period.

THE AGRICULTURAL POTENTIAL OF SOILS IN THE IRON AGE AND THE ROMAN PERIOD

Genesis and characteristics of the parent material

Here, as in the archaeological part of this paper, we concentrate on the two main natural landscape units of the Rhineland that are: the Lower Rhine Plain in the north with its Roman capital *Colonia Vlpia Traiana* (CUT) and the Cologne Bay with its capital *Colonia Claudia Ara Agrippinensium* (CCAA).

The Lower Rhine Plain is built predominantly of sediments of the River Rhine (fig. 2, 1). During the last Ice Age (Weichselian Glaciation), the braided river sedimented what is called the Lower Terrace. It is characterized by alternating deposits of loam, sand, and gravel, just as they were replaced by the permanently shifting braided riverbeds of the glacial streams.

The riversands were often blown into aeolian sand and piled up into dunes on the vegetationally poor glacial steppe. Abandoned river channels silted up with clay or loam and glacial floods deposited high flood loam over the sand and gravel sediments. The contrasts among the different sediments and the alternating wet depressions (“Kendel”) and dry elevations (sg. “Donk”, pl. “Donken”) resulted in small-scale variation of soil-type units and soil fertility (soil value classes) (fig. 35; 37).

Because the Lower Terrace was the deflation zone for loess (a silt-dominated aeolian glacial sediment), the deposits themselves are free of loess. But where relics of older terraces (Middle and Main Terraces) occur near the surface in the Lower Rhine Plain, they were covered with loess as in the more southerly parts of the Rhineland (Cologne Bay). They therefore have the same properties as soils in the loess zone. The same is true of the deposits from the inland ice sheet of the last-but-one glacial period (Saale Glaciation), which reached the Rhineland and formed the push moraines of the Klever Reichswald (D)/Hoge Veluwe (NL). These elevations, too, were partially covered by loess.

Another formative element on the eastern rim of the Lower Rhine Plain is the Holocene floodplain of the River Rhine, which cuts a few metres deep into the glacial Lower Terrace. This floodplain was formed by the meandering, more or less single-branched river since the beginning of the Holocene (ca. 9,000 BC). The river shifted its course across the floodplain over time. The floodplain is also found in the Cologne Bay, but it is far narrower here than further downstream, measuring ca. 7 km wide around Duisburg and 12-14 km wide from Kalkar northwards to the German-Dutch border. At the modern state-border the river splits to form the Rhine-Delta and the Holocene floodplain becomes the dominant feature of the landscape.

The Roman Rhine flowed across this floodplain and at the same time formed the border of the Roman Empire. In all but a few sections, we do not know exactly where the Roman Rhine beds lay or how the river course changed over the 500 year long Roman period. Therefore, the entire floodplain must be considered as one wide border zone. It is very likely that at least those parts of the floodplain that lay on the left bank of the Roman Rhine were used for agriculture by the inhabitants of the province. Probably parts of the floodplain to the east of the river were also used agriculturally, although mainly for animal husbandry because of the risk of flooding.

In the Roman period, the Rhine was not such a deep, single-branched stream as it is today. The modern situation was caused by straightening in the nineteenth century in order to make it navigable without interruptions. Before this, the river was much shallower, wider and often interspersed with sandbanks and islets, dividing it into two or three river branches (Gerlach 1995). Furthermore, in Antiquity the discharge was not so high due to water retained in woodlands and huge bogs in the catchment area. The problem the Romans faced was not so much flooding as the danger of low water levels (Roggenkamp & Herget 2014; 2015). Seasonally the river Rhine was easily passable and only of limited use as a natural border. The whole floodplain should be envisaged rather as a wide border zone that needed to be controlled.

The fertile loess soils of the Cologne Bay (fig. 2,2) have provided optimal conditions for agriculture throughout (pre-) history. The loess overlies the older fluvial deposits of the Middle and Main Terraces. To the west, the Rhenish loess zone merges into the Dutch-Belgian loess belt. The loess plain (fig. 2, 2a) is structured by valleys, which were formed during the last Ice Age, but acted as dry valleys with only ephemeral flows long into the Holocene – in fact until the Iron Age (Gerlach & Meurers-Balke 2015b). To the east lay the loess-free Lower Terrace and the Holocene floodplain of the River Rhine (fig. 2, 2b), which, at up to 4 km wide, was far less dominant than further downstream.

Status and alteration of soil types since the Iron Age and the Roman period

Modern soil maps show the present-day status, which differs from that in Antiquity. Therefore, current soil types cannot be projected directly into former periods. There are both constant factors, such as grain size composition, and variable factors: in the Cologne Bay and the Lower Rhine Plain these are essentially influences of floods, alterations in ground-water levels, and direct and indirect anthropogenic influences on soil genesis.

To describe the soil types, we use the soil names of the World Reference Base (WRB) 2014 from the Food and Agriculture Organization of the United Nations (FAO 2015)⁸⁸. Where differences are found between the FAO nomenclature and the German Soil Classification, we have added the German name of the soil type⁸⁹.

In terrestrial soils, productivity is mainly governed by grain size composition. On sediments that are mainly made up of silt, such as the loess layer in the Cologne Bay, extremely fertile Luvisols developed. Luvisols also developed on the silty, glacial high flood loams on the Lower Terrace and the loess-isles in the Rhenish lowlands.

In the lowlands on the fluvial sediments of the Lower Terrace and the glacial deposits of the push moraines, Cambisols are predominant. Their soil value class – and thus their fertility – can vary according to grain size from high (loam = clayey-silty) to low (sand). Pure sand, as in aeolian sand and dunes, invariably forms Podzols poor in nutrients with a low yield potential. We therefore differentiate between very sandy Cambisols, which together with the Podzols are counted as low productivity soils, and Cambisols with loamy grain sizes, which are more suitable for agriculture. Cambisols of different values are also common on the bedrock of the low mountain areas.

The Fluvisols of the floodplain are predominantly very nutrient-rich and also have a favourable grain size combination, but the constant danger of flooding was a limiting factor before the construction of the dykes along the Rhine, which started in the thirteenth century (Wegener 2006). Gleysols possess unfavourable properties for arable farming due to a high ground-water level which impairs the root zone. They develop in low-lying depressions and valleys.

88. <http://www.fao.org/3/a-i3794e.pdf>.

89. AG Boden 2005, Bodenkundliche Kartieranleitung, KA 5.

The 1:50,000 digital soil map of the Geological Service of Northrhine-Westphalia (Geologischer Dienst NRW) serves as a basis for reconstructing the former soil qualities. The detailed corresponding database allows relevant factors to be combined and mapped for specific geoarchaeological analyses.

Soil value classes

One of the evaluation possibilities of the digital soil map allows the agricultural productivity or potential to be estimated by means of the soil value, the official German “Bodenwertzahl” for tax purposes. The value is determined through coring and test-trenches, systematically covering large areas. Soil texture, geological origin of the parent material and status of soil development are assessed (Liedtke & Marschner 2003). Soil values of 0 to 100 – where 100 stands for the highest productivity – can be classified into groups of “very low” to “very high”.

Soil value classes				
<18	18-35	35-55	55-75	>75
very low	low	middle	high	very high

Even if the status of soil development 2,000 years ago differed from today, these basic assessments of agricultural potential can be used (fig. 35). Soils with a “very high” and “high” value are optimally suited for arable land, even for the cultivation of demanding crops; soils with medium values can be used for cultivating less demanding crops; soils with low values are usually used as meadows and pastures. The “very low” category is agriculturally unproductive.

For the geoarchaeological evaluation we have modified the modern soil value classes in two respects:

1. The “low” and “very low” groups were merged, because the agriculturally unproductive soils with a “very low” value (fens, pure sand) only make up 0.4% of the whole research area.
2. The “high” category includes the large mass of the Fluvisols. However, before the construction of dykes there was a very high risk of flooding, which led to their limited suitability for the cultivation of crops. We have therefore downgraded the fertile Fluvisols into the “middle” group. The figures 35 and 36 clearly show the significant differences in soil values between the northern (Lower Rhine Plain) and the southern parts (Cologne Bay) of the research area. The attribution to soil value classes is itself already a higher-level combined step of evaluation. In order to judge the influence of Iron Age and Roman agriculture on soil genesis itself, single soil types have to be examined.

Soil type units in the Iron Age and the Roman period

On the digital soil map, many different subtypes of the main soil types are mapped. We have therefore grouped them into larger soil type units on the basis of the above-mentioned variable factors (fig. 37; 38; 39).

1. *Fluvisols*

This group of soils is situated in the floodplain and consists of floodplain sediments, which are sometimes more, sometimes less clayey or sandy. They are generally nutrient-rich – because they are regularly fertilized by floods – and therefore possess high agricultural potential. However, they are prone to flooding and are also often affected by high ground-water levels. It is to be assumed that the floodplain was regularly flooded before the construction of dykes; the floods were generally not so high as today, but they affected larger areas (Gerlach 1995).

Traditionally the floodplains were used as pastures and meadows (Schwerz 1836, 9). Nowadays, after the dyking and the lowering of the ground-water level they are eminently favourable for arable farming due to their grain size and nutrient content. This means that today many Fluvisols (75%) are classified in the “high” value soil group. In Antiquity the floodplains may also have been arable land, depending on the distance to the river. But they would probably have been used for cultivating spring sown crops in order to minimize the risk of flooding between November and April, when the Rhine carried the largest masses of water.

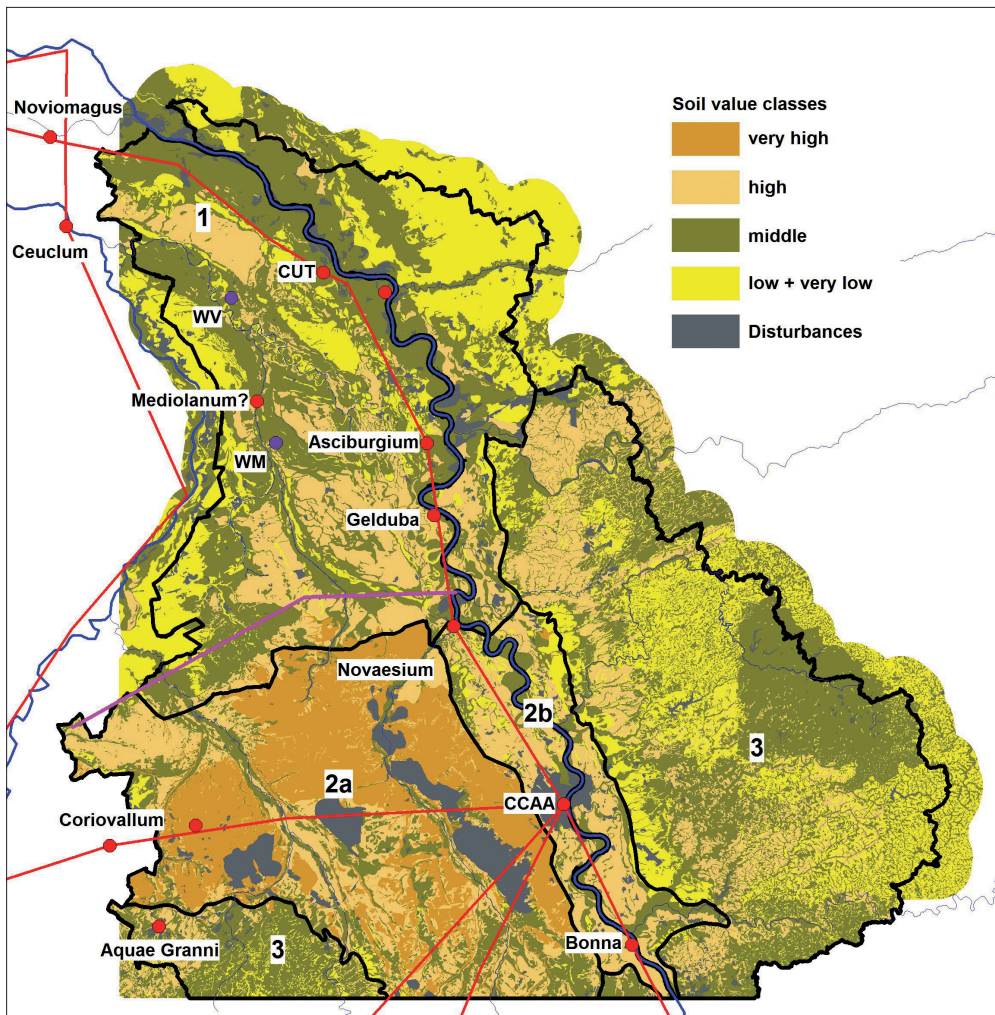


Fig. 35. Soil value classes, pink line: northern border of the villa landscape (S. Groten, LVR-ABR, modified after Digital Soil map 1:50,000, Geologischer Dienst NRW, pink line after Heimberg 2002-2003).

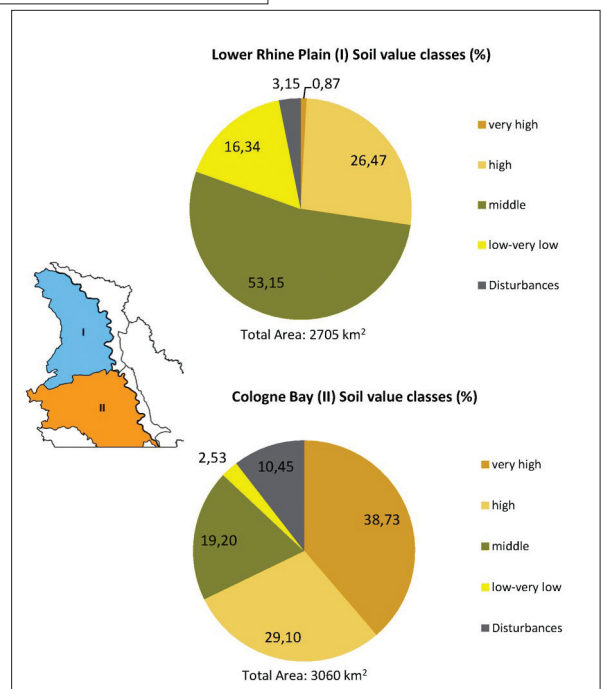


Fig. 36. Percentages of the soil value classes in I) Lower Rhine plain and II) Cologne Bay to the west of the Rhine (S. Groten, LVR-ABR).

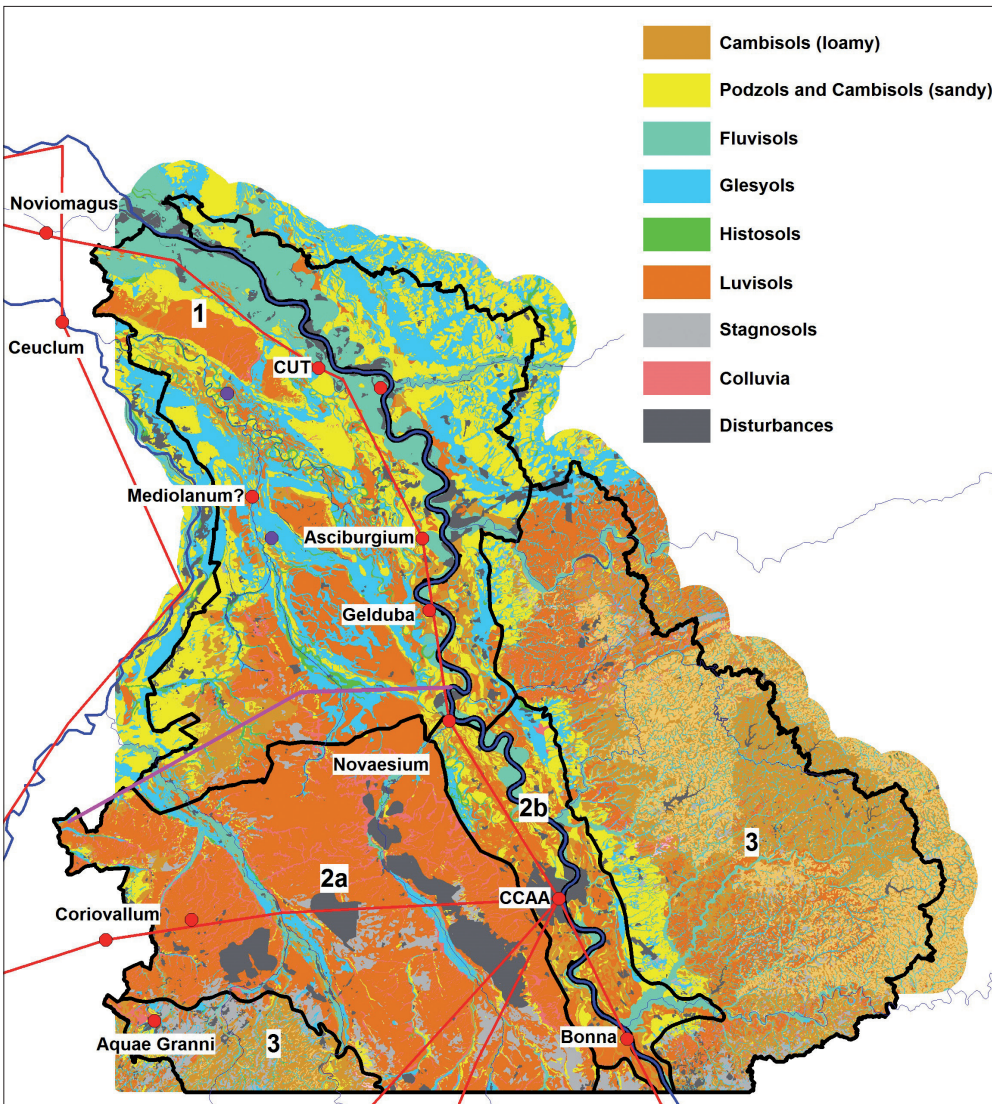


Fig. 37. Soil type units for the Iron Age and the Roman period; pink line: northern border of the villa landscape (R. Lubberich, LVR-ABR). Modified after Digital Soil map 1:50,000, Geologischer Dienst NRW, pink line after Heimberg 2002-2003).

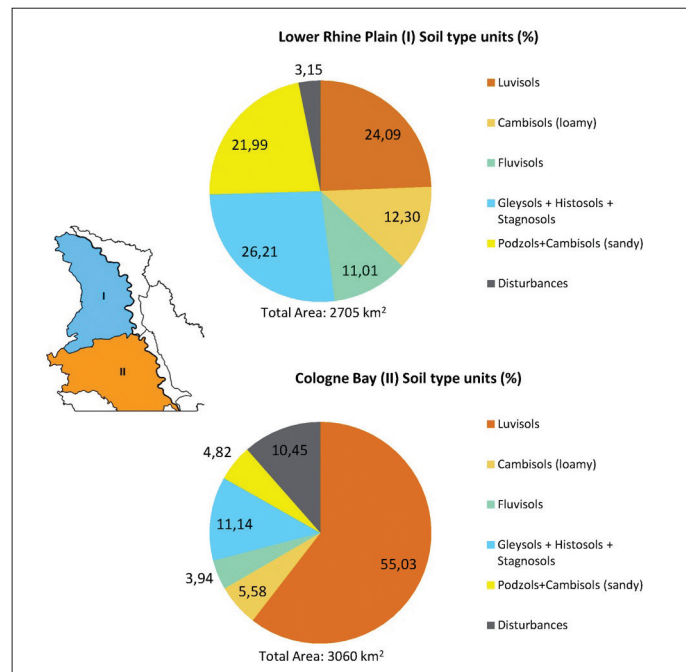


Fig. 38. Percentages of the soil type units in I) Lower Rhine plain and II) Cologne Bay to the west of the Rhine (S. Groten, LVR-ABR).

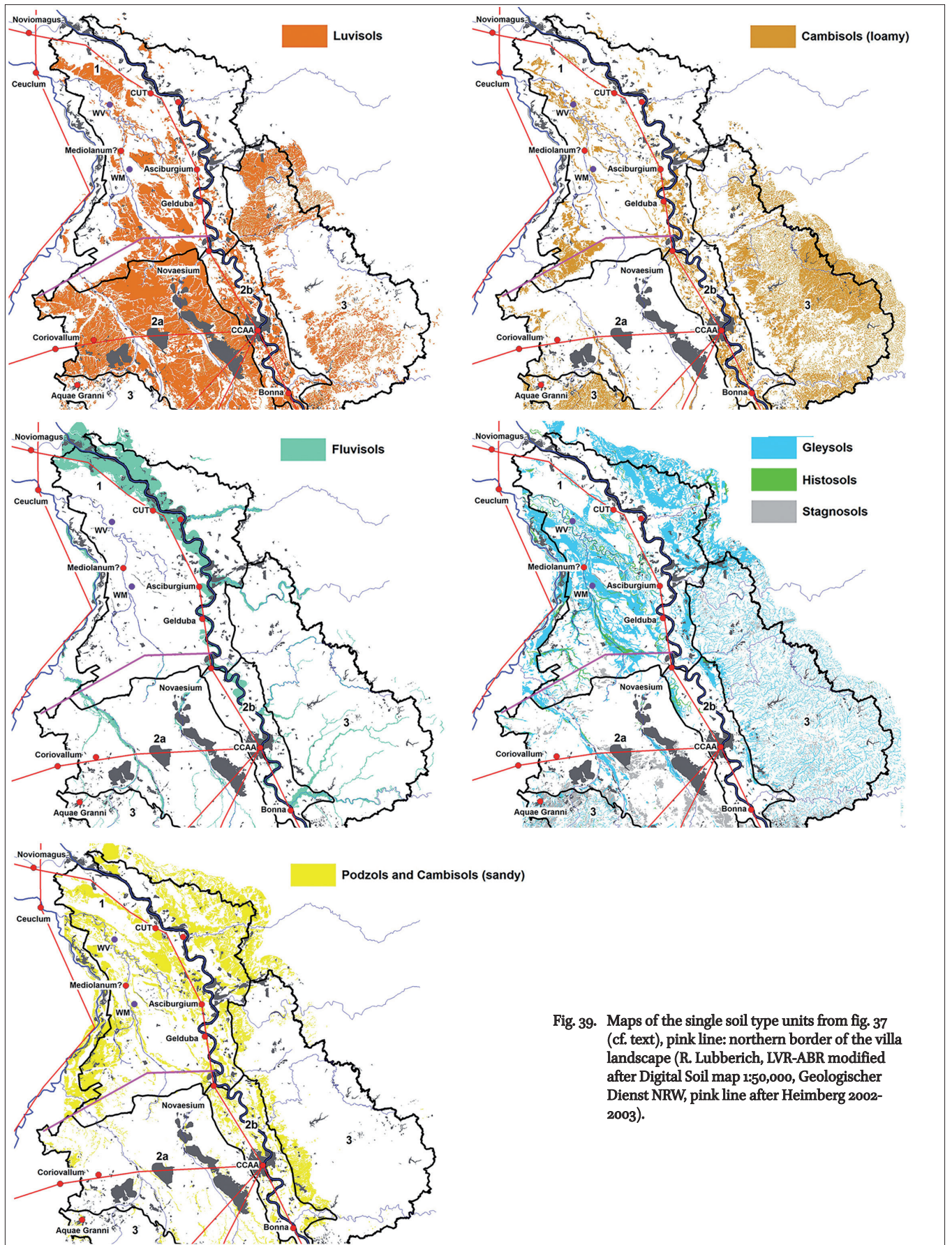


Fig. 39. Maps of the single soil type units from fig. 37 (cf. text), pink line: northern border of the villa landscape (R. Lubberich, LVR-ABR modified after Digital Soil map 1:50,000, Geologischer Dienst NRW, pink line after Heimberg 2002-2003).

2. Luvisols

This soil type developed mainly on loess or other silty sediments. Luvisols possess a high to very high agricultural potential and are therefore used as arable land. They are suited to the cultivation of demanding crops such as bread wheat (*Triticum aestivum*) and spelt (*Triticum spelta*) and are therefore categorized into the “high” and “very high” soil value classes.

When cleared and in use, they are threatened by erosion, because silt, the grain size predominating in loess, is highly prone to being washed away by rain on bare ground. As a result, different states of eroded soils appear on the slopes, from eroded Luvisols to Cambisols up to fully eroded Calcaric Regosols (“Pararendzina” in the German Soil Classification), where the unweathered chalky loess came to the surface, developed from the original Luvisols. The washed-out material accumulated at the bottom of the slopes forming a Colluvium.

3. Cambisol on sandy parent material and Podzols

Cambisols on sandy parent material have middle to low soil values. Arable farming is possible on the more loamy-sandy soils (middle), especially if less demanding crops like barley and millet are cultivated. Through clearing and usage, Cambisols on loamy sand can permanently transform into the less favourable Podzols.

The sandier the sediment, the less nutrient-rich and the drier it is; this is where Podzols develop. These areas were presumably only used as extensive pastures. Improvement through fertilizing by plaggen was not used in the Iron Age and the Roman period on the Lower Rhine Plain. The earliest fertilization by plaggen took place in the tenth century (Burow 2010). Therefore, all Plaggic anthrosols of the modern soil map are grouped with sandy soils. These are categorized in the “low-to-very low” soil value classes.

4. Cambisols on loamy parent material

This soil unit is mainly common on the fluvial sediments of the Lower Rhine Plain (and in the low mountain ranges). It has high agricultural potential, although not as high as the Luvisols on loess. Even so, these soils are suitable for cultivating demanding cereals and are therefore categorized into the “high” soil value classes.

5. Gleysols, Histosols and Stagnosols

Gleysols are characterized by a high level of ground-water. The parent materials of Gleysols are mainly sediments in depressions, which are often clay-rich, but they can be made up of all grain sizes from clayey to loamy to sandy. The wet root-zone reduces their potential for arable farming; they therefore have only limited productivity and are used as meadows and pastures to this day.

The high level of ground-water is indeed not fixed. It can be influenced artificially. Today’s level has generally fallen considerably due to extraction of ground-water for households and industry, as well as extensive drainage measures in recent history. The level was much higher in the Middle Ages and Early Modern Times meaning gleyification was therefore intense and far more widespread. In prehistory, however, ground-water levels were far lower over thousands of years, because much water was retained in woodland and bogs (Gerlach & Meurers-Balke 2015b). The Iron Age was a period of change when water levels rose due to more extensive clearance of woodland and new Gleysols could develop.

Because Histosols develop where ground-water permanently rises to the surface and plant material accumulates under reducing conditions, we have grouped these together in the same soil unit. These can only be used as wet meadows, after the wet alder-woods that often grow on these soils are cleared and drainage measures have been taken. They are in general agriculturally unproductive.

Stagnosols (“Pseudogley” in the German Soil Classification) suffer from stagnant water. Their agricultural suitability, especially for crop production, is limited, because in the wet season they are too wet, while in dry climatic conditions they are too dry.

Loess landscape and less-loess landscape

As can be seen from the maps, the main differences between the two natural units are soil properties and quality. While the southern Rhineland (Cologne Bay) to the west of the River Rhine is dominated by a closed loess layer with very good soil properties, the Lower Rhine Plain in the northern lowlands exhibits more diversity. There is a small-scale alternation between different soil types and in total the values of the different soil types were less suitable for a more demanding cereal-based agriculture.

As a simplification, one can speak of a loess landscape (Cologne Bay) and a less-loess landscape (Lower Rhine Plain), because there are some loess islands also in the northern part. This natural divide is virtually identical with the delimitation of the distribution of *villae rusticae* and divides the Rhineland into a southern villa landscape and a northern non-villa landscape (Heimberg 2002-2003).

Man-made soil alterations in the Iron Age and the Roman period

During the Iron Age and the Roman period, three man-made factors of influence were relevant, which had an impact on soil value and soil type: erosion, the rise of ground-water levels and podzolization.

1. Erosion: It is almost only extant in the loess zone of the southern Rhineland. Here, several factors contributed to man-made soil degradation: silt as the main grain size, the configuration of the land with many small valleys and intensive arable farming. In the lowlands, the soils are in much less danger of erosion. This erosion resistance is due to the mixture of grain sizes such as fluvial loam with a portion of cohesive clay or sand, which is not so easily erodible due to its weight. In addition, the relief is much less marked. But erosion only has negative effects on arable farming when the sands and gravel of the older deposits come near to the surface and deteriorate conditions of growth in the root zone. The extent of soil degradation is geologically recognizable from the erosion sediments, the Colluvia at the foot of the slopes. Because erosion and the development of Colluvia are part of the same process, this process is also called Colluviation. The process started during the Neolithic, caused by the first forest clearances on the loess soils, but only on a small scale; Colluvia of the Neolithic are found in local depressions only (Gerlach & Eckmeier 2012). The slopes were first affected by erosion during the Bronze Age; since then Colluvia have been preserved in the valleys. During the Iron Age, erosion intensified and had an effect all along the loess valleys (Schulz 2006; Becker 2005). It then increased with every intensive phase of use during the Middle Ages, late and post medieval times and especially in Modern Times (fig. 40). By the end

Kulturstufe	Kolluviation nach SCHULZ (2007) Seitental Elsachtal (Otzenrath) und Aitdorfer Delle (Inden)	Kolluviation nach FISCHER (2010) Einzugsgebiet des Gilbaches	Kolluviation Einzugsgebiete des Elsachtals (Otzenrath) und Indetals (diese Arbeit)	Pollenzonen nach KALIS & MEURERS-BALKE in BRUNOTTE et al. 1994
Spätmittelalter - Neuzeit	E		E B	Subatlantikum
	RG 2		E B(?) S(?)	
Hochmittelalter	D	M ₃	E	
	RG 1		S B	
Frühmittelalter	Bodenbildung	M ₂	E	
	C		S B	
Römerzeit	Bodenbildung		E S B	
	Späte Kaiserzeit	Dodenbildung ?	E S B	
	Mittlere Kaiserzeit		E S B	
	Frühe Kaiserzeit	B	E S B	
Metalzeiten	Bodenbildung		E S B	Subboreal
	A	M ₃	E S B	
Bronzezeit	Bodenbildung		E S B	
			E S B	
Neolithikum	geringfügige Kolluviation möglich	(M)Bht	Hiatus	Atlantikum
Mesolithikum	keine Kolluviation	keine Kolluviation	B E	Boreal

Fig. 40. History of Colluviation in the Cologne Bay: A-E = colluvial units (after Schulz 2006); M = Colluvia (after Fischer 2009); E = erosion (sheet erosion), B = soil; S = stability (after Protze 2014). Modified after Protze 2014, 125, Tab. 8.

of the Roman period, 30% of the Colluvia in the loess valleys had already been deposited. Geoarchaeological research of Colluviation processes reveals a differentiated picture of erosion in the loess zone in the Roman period: the first century, a time of transformation of agricultural systems, was characterized by visible erosion with colluvial sedimentation. These phenomena were observable again during late Antiquity. For the heyday of the Roman *villae*, i.e. the middle Roman period, no new Colluvia could be found in the valley bottoms. However, we know from archaeobotanical records that erosion must have occurred. It is quite probable that the Romans took preventive measures against Colluviation by digging ditches or other sediment traps (cf. below). These measures prevented the Colluvia from reaching the valley bottoms.

Some 70% of the Colluvia developed after the Roman period and half of that (i.e. 35% of the total) within the last 200 years (Schulz 2006, 89 ff.). This also means that those soil types, which are newly developed because of the erosion process, must be mainly products of post Roman times, i.e. Pararendzina (Calcaric Regosols) on the slopes and Colluvia in the valley bottoms. However, there is geoarchaeological as well as archaeobotanical evidence for soil erosion in Roman times.

2. Man-made rise of ground-water levels: this was caused by woodland clearances from the Iron Age onwards and had effects on the valleys of the loess landscape as well as on the sand-loam landscapes (Lower Terrace, floodplain) (Gerlach & Meurers-Balke 2015b). In the flat lowlands of the Lower Rhine Plain with its many wide depressions and channels, where ground-water levels were high, the man-made increase in gleyification must have had a considerable negative effect.

3. Podzolization: The degradation of sandy Cambisols to Podzols is primarily a phenomenon typical of the lowlands with their sandy sediments. In the southern parts, it may have affected the sandy deposits in the Lower Terrace and the aeolian sand belt on the eastern side of the Rhine, i.e. outside the Roman Empire. Theo Spek reported that sandy Cambisols with a clay-silt content of 10-25% degraded into Podzols as a result of clearance and agricultural utilization in the sandy areas of Drenthe (NL). In addition, the soils acidified due to the growth of heath and pine (Spek 2006). Therefore, large expanses of nowadays existing Podzols originated in prehistoric clearance, nutrient-depletion (pasturing, heath vegetation) and modern reforestation with pine. That these soil transformations actually happened in the Iron Age and the Roman period can indeed be proven by archaeobotanical research.

VEGETATION AND LAND USE FROM THE IRON AGE TO THE ROMAN PERIOD

By the Iron Age the landscapes of the Lower Rhine Plain and the Cologne Bay were dominated by agriculture. The woodland of the preceding periods had been more or less cleared; at times, it was even less widespread than today. Landscapes of “bristling forests” as Roman historians describe (Tac., *Germ.*, 5,1) them do not paint a true picture, at least not for our research area.

This can be deduced from the “Kleefsche Beek” pollen diagram (fig. 41a, b) that encompasses the period from the Neolithic to the Early Modern period. This diagram comes from a site located on the floodplain of the Meuse near Gennepe (NL) and can be taken as representing the vegetation history of the whole of the Lower Rhine-Meuse region. The Iron Age pollen spectrum already reveals a high proportion of herbaceous plants and grasses; the apparent predominance of arboreal pollen in the diagram is due to the fact that this derives from wind-pollinating trees and shrubs which have high pollen productivity and pollen which is dispersed by wind across a wide area. We have to surmise that vast woodland no longer existed by the Iron Age; rather, some copses, groups of trees and bushes were scattered among the fields and pastures. Pollen proportions of 20-40% of herbaceous plants point to a largely open, cultivated landscape, a development that had started in the late Bronze Age.

The decline of tree pollen and at the same time the rise of pollen of grasses (Poaceae indet.), dock (*Rumex* sp.) and ribwort plantain (*Plantago lanceolata*) indicate that large expanses of cleared land were used as meadows and pastures. The increase in pollen of heather (*Calluna vulgaris*) and sheep's bit (*Jasione montana*), as well as spores of bracken (*Pteridium aquilinum*) prove the development of heathland. Obviously, with the Iron Age, animal husbandry had changed significantly. It was no longer predominantly based on wood pasture and leaf-foddering, but on grazing on meadows instead. This led to the development of grass vegetation and – on nutrient-poor sandy soils – to the development of heathland. At the same time the area used for arable farming was probably expanded; this can be seen by the rise in cereal pollen in the diagram. When the Romans occupied the Rhineland, they encountered landscapes that were dominated by fields and pastures.

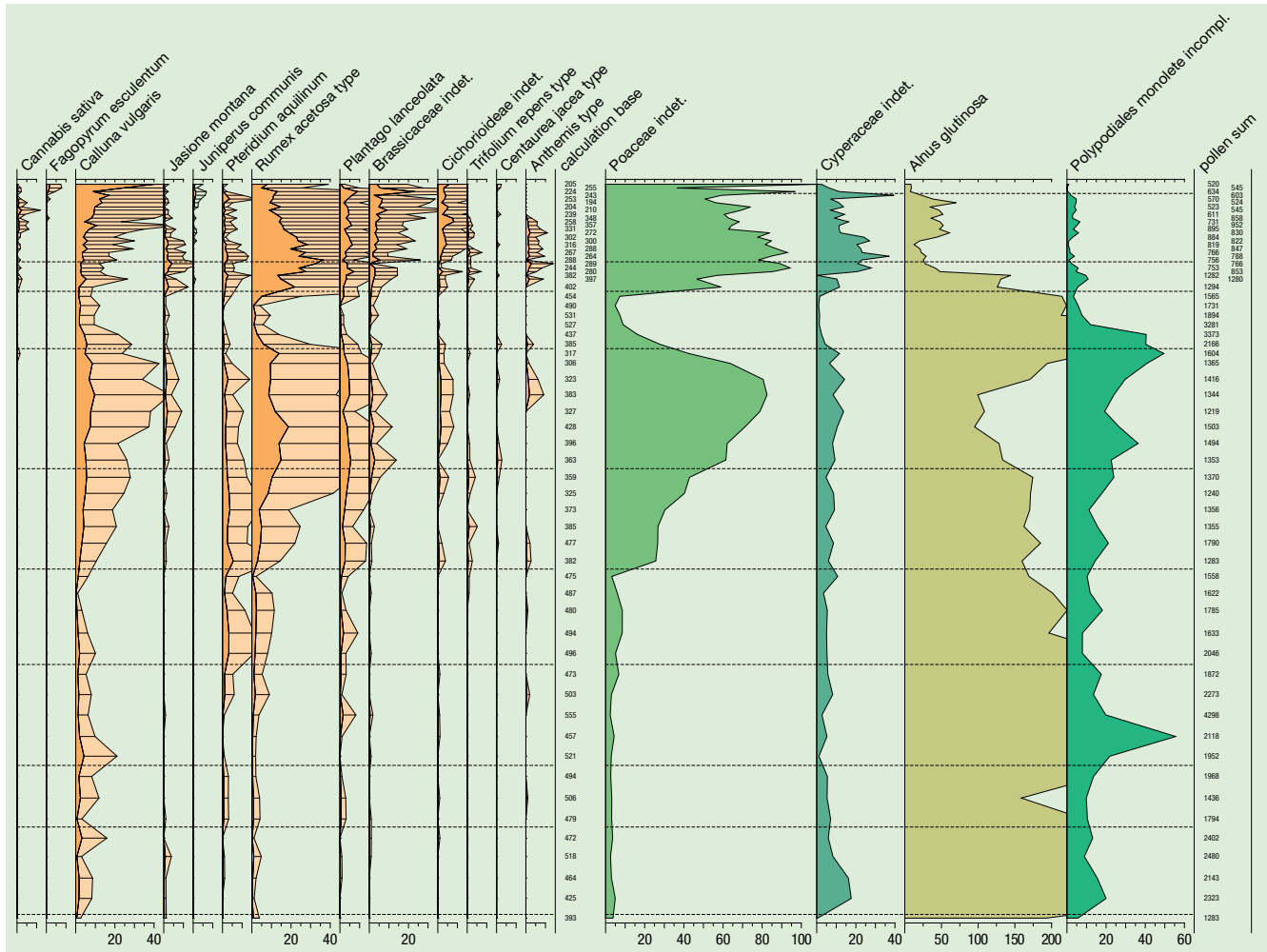
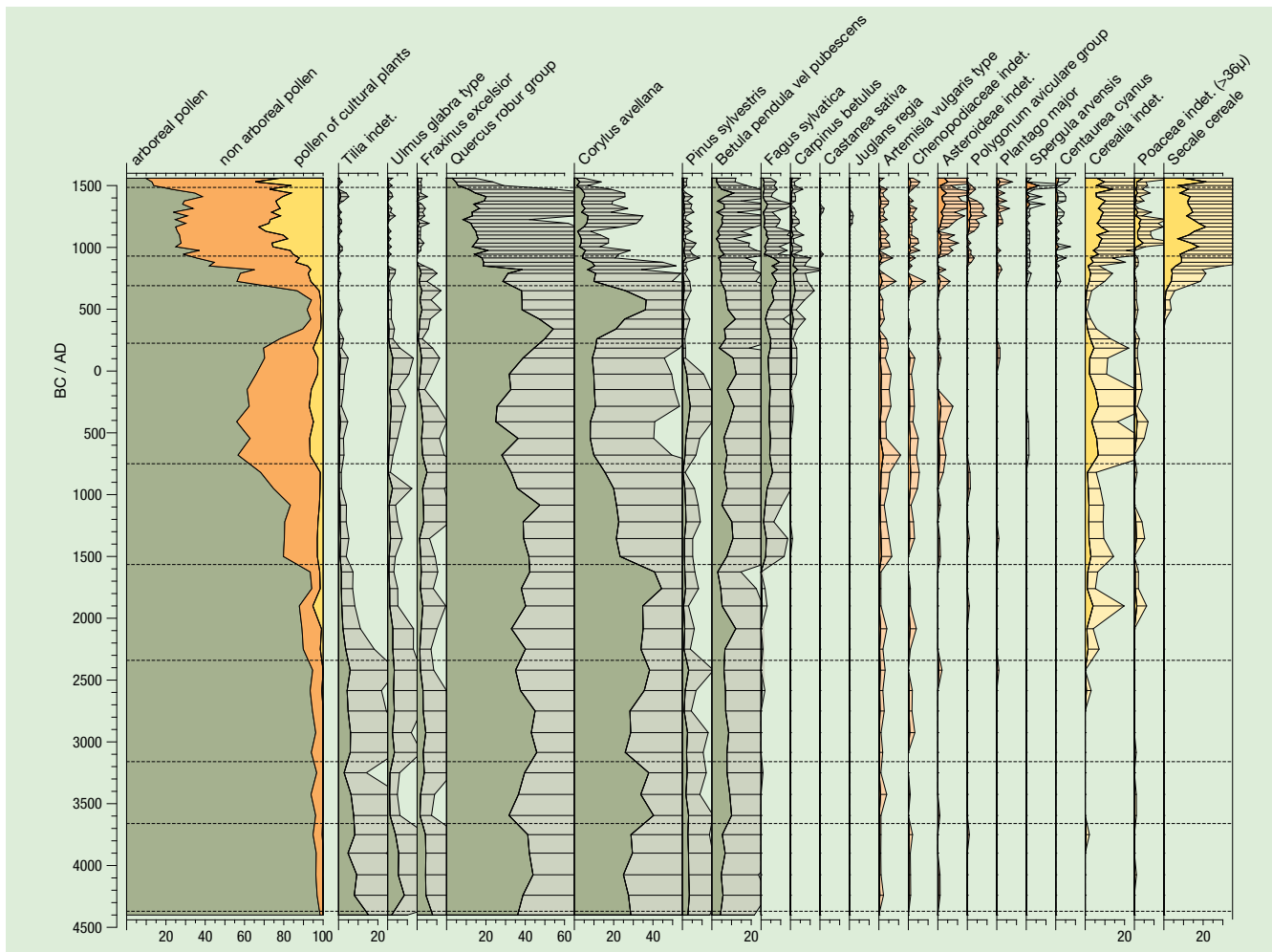


Fig. 41a et b. Meuse Valley Heijen. Pollen diagram Kleefsche Beek (Kalis *et al.* 2008). Analysis: H. Teunissen-van Oorschot 1985.

This kind of agriculture probably had negative effects on the less productive and resilient soils of the Lower Rhine Plain, at least in parts. Both the opening of the landscape on a supraregional level as well as the clearances on a local scale caused a rising ground-water level (cf. above). In fact, there is now considerable archaeobotanical and geoarchaeological evidence of higher ground-water levels (Gerlach & Meurers-Balke 2015a). On this account many of the small valleys in the loess zone were newly activated (for the first time in the Holocene) with brooks. It has to be assumed that the already existing Gleysols became wetter due to clearance by Iron Age farmers.

Heathlands developed on the dry sandy soils as a result of the grazing of sheep and goats. Together with the increase of *Calluna vulgaris* pollen, the *Pinus* curve also rose; when these soils were under less grazing pressure, pines spread on the nutrient-poor sandy soils. Both plant species produce acidic remains (needles, leaves etc.), leading to further acidification of the soil. It can therefore be assumed that Podzols now developed on an increasing scale from sandy Cambisols, which had a much lower agricultural potential than the former Cambisols.

With the beginning of the Roman period, no striking changes can be seen in the pollen diagram. Obviously, an Iron Age system of agriculture continued. Looking closer, two new aspects can be pointed out.

In the Roman period, the Poaceae curve decreases and the proportion of *Alnus* pollen increases. This indicates that on the wet soils with high ground-water levels (Gleysols), meadows and pastures were given up and alder-woods expanded again. Moreover, marginal areas on poor sandy soils were apparently given up, as can be seen by the decrease in the *Calluna* curve. Apparently, husbandry of sheep and goats was no longer as important as in the preceding Iron Age. We therefore conclude that human impact on the development of both soils influenced by ground-water as well as on Podzols receded. The influence of “Roman culture” on these soils can thus be described with terms like “efficiency” and “sustainability”.

In the Roman period, farming generally continued on the same lines as in the Iron Age, but evidence suggests concentration and intensification, since marginal areas were obviously given up. In this context, it is notable that for the Roman period population density is estimated to have been three times that of the Iron Age (Zimmermann *et al.* 2009).

The Iron Age tradition also in Roman times is apparent in the spectrum of cultivated crops, as archaeobotanical analyses of macro-remains (fruits and seeds) show.

This system of agriculture was characterized by a large diversity of cultivated plants: each Iron Age farm grew about a dozen different crops. This allowed a more effective organization of work, since different crops ripened at different times of the year. It also secured supplies even if some crops failed. But first and foremost this system of agriculture was best suited to the various qualities of the soils: whereas wheat needs fertile soils, millet can also grow on sandy and dry soils (Zerl in print).

Many of the Iron Age settlements that have been analysed so far are situated in a less-loess landscape, such as Westphalia east of the Rhine, or on the loess-free zones of the Lower Terrace. One could say that the Iron Age farmers practised a kind of “precision farming”, a specific cultivation depending on soil quality and nutrient content. This diversified system of farming worked fine in the uniform loess landscape but was also well-suited to the heterogenous mosaic-like landscape of the north.

Until a few years ago we did not know much about farming in Roman times on the Lower Rhine Plain for lack of excavated sites and therefore archaeobotanical data. Recently, the Weeze-Vorselaar and Wachtendonk-Meerendonkshof sites from the hinterland of the *Colonia Vlpia Traiana* (CUT) have provided new evidence. Both settlements exhibit a spectrum of cultivated plants that very much resembles that of Iron Age sites (fig. 42): barley (*Hordeum vulgare*) predominates, broomcorn and foxtail millet (*Panicum miliaceum*, *Setaria italica*) were also important; emmer (*Triticum dicoccon*) and sporadically spelt (*Triticum spelta*) have been found. A few pulses occur, such as lentil (*Lens culinaris*), bitter vetch (*Vicia ervilia*) and probably also celtic bean (*Vicia faba*); flax (*Linum usitatissimum*), too, is found. Likewise, the weed flora correlates to that of the Iron Age; taxa typical of Roman farming on the loess are absent. This is true for the cultivated crops as well. There are no indications of vegetables, spices and cultivated fruit, apart from two stones of sweet cherry (*Prunus avium*) from a well in Wachtendonk-Meerendonkshof (cf. above). Although they lived close to the Roman town (*Colonia Vlpia Traiana*), the farmers of the hinterland kept to a traditional (Iron Age) food pattern.

	CCAA	CUT	settlements, loess (villae)	settlements, non loess
Cereals				
spelt (<i>Triticum spelta</i>)	●	●	●	•
emmer (<i>Triticum dicoccon</i>)	●	●	●	•
barley (<i>Hordeum vulgare</i>)	•	●	●	●
millet (<i>Panicum miliaceum/Setaria italica</i>)	•	○	○	●
free-threshing wheat (<i>Triticum aestivum vel durum</i>)	○	○	○	
einkorn (<i>Triticum monococcum</i>)	•	•	•	•
Pulses				
lentil (<i>Lens culinaris</i>)	•	○	•	•
pea (<i>Pisum sativum</i>)	•	•	•	
celtic bean (<i>Vicia faba</i>)	•	○		(+)
common vetch (<i>Vicia sativa</i>)	•	+	•	
bitter vetch (<i>Vicia ervilia</i>)			•	•
Oil and fibre plants				
flax (<i>Linum usitatissimum</i>)	●	●	•	+
poppy (<i>Papaver somniferum</i>)	●	●	•	
gold-of-pleasure (<i>Camelina sativa</i>)	•	•	•	
Spices				
dill (<i>Anethum graveolens</i>)	●	●	•	
celery (<i>Apium graveolens</i>)	●	●	•	
coriander (<i>Coriandrum sativum</i>)	●	●	•	
summer savory (<i>Satureja hortensis</i>)	●	●	•	
fennel (<i>Foeniculum vulgare</i>)	•	•	+	
anise (<i>Pimpinella anisum</i>)	(+)	•	•	
rue (<i>Ruta graveolens</i>)	+	+		
cumin (<i>Cuminum cyminum</i>)	+	(+)		
Fruits				
sweet cherry (<i>Prunus avium</i>)	●	●	•	+
apple (<i>Malus domestica</i>)	●	●	•	
pear (<i>Pyrus communis</i>)	●	●	•	
cultivated vine (<i>Vitis vinifera</i>)	●	●	•	
walnut (<i>Juglans regia</i>)	●	●	•	
bullace plum (<i>Prunus insititia</i>)	●	●		(+)
plum (<i>Prunus domestica</i>)	•	•	+	
peach (<i>Prunus persica</i>)	•	•	+	
cornelian cherry (<i>Cornus mas</i>)	•	+	+	
black mulberry (<i>Morus nigra</i>)	•	+	+	
cucumber (<i>Cucumis sativus</i>)	•	+		
medlar (<i>Mespilus germanica</i>)	•	(+)		
sorb apple (<i>Sorbus domestica</i>)		+		
Import				
fig (<i>Ficus carica</i>)	●	●	•	
date (<i>Phoenix dactylifera</i>)	○	•		
pomegranate (<i>Punica granatum</i>)	•	+		
caper (<i>Capparis spinosa</i>)	+	•		
pepper (<i>Piper nigrum</i>)	+	+		
olive (<i>Olea europaea</i>)	+	+		
stone pine (<i>Pinus pinea</i>)	+	+		

● dominant
● frequent in larger quantities
● frequent in small quantities
○ sporadic in larger quantities
• sporadic
+ single find
(+) uncertain

Fig. 42. Crop plants in the *Colonia Vlpia Traiana* (CUT) and the *Colonia Claudia Ara Agrippinensium* (CCAA), in rural settlements in the Cologne Bay (loess) and the Lower Rhine Plain (less-loess).

In contrast, the diet in the *Colonia Vlpia Traiana* differed considerably. Thanks to extensive archaeobotanical research over many years, we have quite a detailed picture of the food plants consumed as well as of the vegetation in the Roman town. The most important cereal for bread was spelt (*Triticum spelta*); many other cereals were also present, but not as common. Only barley (*Hordeum vulgare*), which could also have been used as fodder, especially for horses (Herchenbach & Meurers-Balke in prep.), is relatively frequent. Pulses are represented by lentil (*Lens culinaris*), pea (*Pisum sativum*), celtic bean (*Vicia faba*), and common vetch (*Vicia sativa*). Characteristic is the occurrence of spices like celery (*Apium graveolens*), dill (*Anethum graveolens*), coriander (*Coriandrum sativum*), summer savory (*Satureja hortensis*), fennel (*Foeniculum vulgare*), anise (*Pimpinella anisum*), rue (*Ruta graveolens*), as well as cultivated fruits and nuts such as apple (*Malus domestica*), sweet cherry (*Prunus avium*), pear (*Pyrus communis*), cultivated vine (*Vitis vinifera*), walnut (*Juglans regia*), bullace plum and plum (*Prunus insititia*, *P. domestica*), peach (*Prunus persica*), cornelian cherry (*Cornus mas*), cucumber (*Cucumis sativus*), black mulberry (*Morus nigra*), medlar (*Mespilus germanica*) and sorb apple (*Sorbus domestica*). In addition, remains were found from plants imported from the Mediterranean, such as fig (*Ficus carica*), date (*Phoenix dactylifera*), pomegranate (*Punica granatum*), caper (*Capparis spinosa*), pepper (*Piper nigrum*), olive (*Olea europaea*) and stone pine nuts (*Pinus pinea*). Comparing the archaeobotanical evidence from the hinterland with the long list of food plants consumed in the *Colonia Vlpia Traiana*, we must come to the conclusion that the Roman settlements in the Lower Rhine Plain were not supplied exclusively by the (so far analysed) rural settlements in its immediate hinterland (fig. 42). In particular, the much appreciated wheats for bread (*Triticum spelta* and *Triticum aestivum*) had to come from the loess belt. Interestingly, a part of the loess belt in the vicinity of *Coriovallum* (Heerlen) actually belonged to the territory of the *Colonia Vlpia Traiana* (cf. above).

The spectrum of food plants from the *Colonia Vlpia Traiana* is strikingly similar to that from the *Colonia Claudia Ara Agrippinensium* (fig. 42).

Cologne – in contrast to the *Colonia Vlpia Traiana* – was indeed supplied by the loess zone immediately to its west. Almost everything that grows in the middle European climate can be cultivated on its fertile soils.

Like the Lower Rhine Plain, the Cologne Bay was a landscape already dominated by agriculture before the Roman period; several pollen diagrams from this well-researched area illustrate this: the pollen diagram from the Malefinkbachtal (fig. 43) shows a ratio of woodland pollen to pollen of cultivated land of 2:1 just as in the less-loess landscapes. Between the

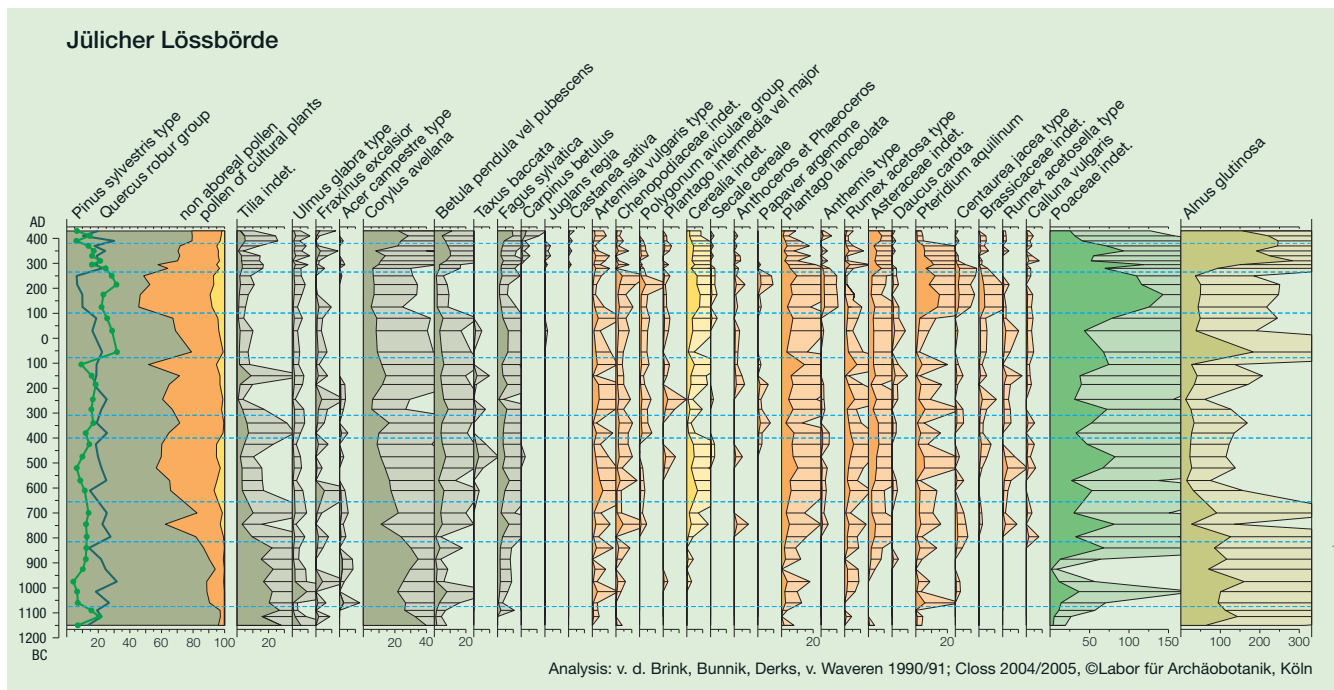


Fig. 43. Pollen diagram Malefinkbachtal near Boslar (Meurers-Balke & Kalis 2006).

Iron Age and the Roman period there is no noticeable difference in the extent of cultivated land. It is hard to observe distinct signs of anthropogenic soil degradation in the pollen diagram. This was to be expected given the high fertility of the Luvisols of the loess region.

However, we know from geoarchaeological research that during the Iron Age and the Roman period Colluviation took place on the loess; taking a second look, this can also be seen from the pollen diagram. Towards the end of the Iron Age, the pine (*Pinus*) curve increases slightly, which can only be explained by soil erosion on the loess. Due to erosion on steeper slopes, the loess layer thinned and the underlying gravel and sand reached the surface zone. Here, the sandy-gravelly nutrient-poor areas favoured the growth of pine (Meurers-Balke *et al.* 1999, 40).

During the Roman period another botanical indicator of increased soil erosion can be added: from about the mid-first century AD onwards new weeds appeared (Knörzer 1971): large-flowered orlaya (*Orlaya grandiflora*), nigella (*Nigella arvensis*), dwarf spurge (*Euphorbia exigua*) and spreading hedge-parsley (*Torilis arvensis*) are weeds that grow on calcareous soils. It was long assumed that these weeds occurred because of Roman marl fertilization. However, it seems impossible to generate such a plant community through fertilization with lime, because of its short-time effect. In addition, all those archaeological features which so far have been interpreted as Roman marl pits are in fact post-medieval marl pits (Gerlach *et al.* 2008) or pits with other functions such as loam extraction or drainage. So where does the calcareous soil come from? We think that erosion accounts for this phenomenon. Erosion was intensified during the Roman period, laying bare the hitherto covered limy loess (C-horizon). Thus, a new soil type developed in the loess area: former Luvisols started to turn into anthropogenic Calcaric Regosols (“Pararendzina” after the German Soil Classification). This development later considerably intensified up to the modern era. The cause of this development was the new Roman agrarian system in the loess zone that brought about a clear break with Iron Age traditions.

As mentioned above, in times of transformation, i.e. at the beginning and at the end of the Roman period, Colluvia reached the valley bottoms. They are missing at the zenith of the Roman *villae* system. In the light of the occurrence of calciphilous weeds, which point to continuous erosion, the lack of Colluvia need not necessarily mean that there was none. It is also possible, that Colluvia did not reach the valley bottoms and were preserved there until the present day (cf. above). We know of ditch systems of the second century in the Hambach 59 *villa rustica* (cf. fig. 10; 12) and also from other sites (e.g. HA 132 [fig. 9], HA 133, HA 488) that divided agrarian land, but could also have retained erosional deposits (Gaitzsch 1990; Knörzer & Meurers-Balke 1990; Brüggler 2009, 57-59).

By the mid-first century at the latest, together with the establishment of *villae rusticae*, the agrarian economy was oriented towards surplus production to supply the towns and military installations. It was specialized on spelt (*Triticum spelta*); alongside it, barley (*Hordeum vulgare*) and emmer (*Triticum dicoccon*) as well as occasionally free-threshing wheat (*Triticum aestivum* vel *turgidum*) and broomcorn millet (*Panicum miliaceum*) were cultivated (fig. 42).

Spelt was the main cereal for bread, not only in the Rhineland but in the northern provinces in general (Körber-Grohne 1987, 74; Knörzer 1991, 199; Wiethold 2012, 317). In Italy, free-threshing wheat was preferred, whereas spelt was almost unknown. Although there is some evidence for spelt from northern Italy, it was not as important as further north (Castelletti *et al.* 2001).

Looking at the cereal spectrum in the Germania inferior, it is conspicuous that there are quite a few mass finds of free-threshing wheat from the first century⁹⁰. Assuming that the early settlements and forts were supplied with imported foodstuffs, this import of “italic” cereal is not surprising. Besides bread wheat (*Triticum aestivum*, a free-threshing wheat), emmer and spelt were also imported for supplies; the latter especially points to a provenance of the cereal from a “glume wheat region” such as Gaul.

In the course of the Roman occupation, spelt was used increasingly as the main cereal north of the Alps. Are there reasons for this preference in the transalpine regions? One of the reasons could be that cultivation of free-threshing wheat in the Germanic provinces was deemed insecure by the Romans for climatic reasons. Another could be that one of the traditionally

90. Neuss, *Novaesium*: Knörzer 1970; Haltern: Wittmack, in: Koepf 1901, 69; Köln, Alteburg: Sieben 2004 [2005]; Köln, CCAA: Knörzer 2001; Xanten, CUT: Knörzer 1989; Maastricht: van Zeist 1968 [1970]; Ouddorp: van Zeist 1968 [1970]; Valkenburg: van Zeist 1968 [1970].

cultivated cereals in Gaul, and also in the loess zone of the Rhineland, before the Roman occupation was spelt and therefore varieties already existed that were better suited to the soil and climatic conditions.

In view of the importance of *villae* as producers for the supply of towns and military installations, one has to assume that the agrarian economy was effective and oriented towards surplus production. Here, cultivation of winter crops like spelt is more productive than spring sown crops. Surplus production on a large scale demanded efficient cultivation and harvesting methods. It is striking that the *vallus*, a machine for harvesting cereals, is so far only known from the Gaulish regions, among others western Germany (Trier), France (Reims) and Belgium (Arlon, Buzenol)⁹¹. This device was used from the first century AD until the Late Roman period and ancient authors underline that the *vallus* was especially used in the large level areas in Gaul (Plin., *Nat.*, 18.296; Pall., *Agric.*, 7.2.2-4). In addition, the machine was indeed perfectly suited for reaping spelt (Wiethold & Zech-Matterne 2009). The reason was presumably the morphology of this special glume wheat: unlike the much smoother ears of emmer, those of spelt are much stronger and slightly splayed, so that they could be caught more easily by the teeth of the *vallus*, gripped better, and then cut off as a whole. However, the *vallus* was unsuitable for harvesting free-threshing wheat because too many grains would be lost during this mechanical harvesting-process.

It has to remain an open question whether pulses – lentil (*Lens culinaris*), pea (*Pisum sativum*), bitter vetch (*Vicia ervilia*) and common vetch (*Vicia sativa*) – that were grown in the *villae rusticae* were also used for the supply of towns and military installations. This also applies for oilseeds such as gold-of-pleasure (*Camelina sativa*), flax (*Linum usitatissimum*) and poppy (*Papaver somniferum*) (fig. 42). Orchards (*pomaria*) surely belonged to *villae rusticae*, in which presumably sweet cherry (*Prunus avium*), apple (*Malus domestica*), pear (*Pyrus communis*) and probably cultivated vine (*Vitis vinifera*) were grown (Meurers-Balke 2010). Whether these along with walnut (*Juglans regia*) were cultivated for sale cannot be answered by archaeobotanical means. It is also questionable whether herbs and spices were cultivated for local markets; it has to be assumed rather that dill (*Anethum graveolens*), coriander (*Coriandrum sativum*), summer savory (*Satureja hortensis*) and celery (*Apium graveolens*) were grown for domestic requirements in kitchen gardens in towns and in the country.

Some inhabitants of the *villae* could even afford to import exotic indulgences; this is proven by seeds of fig (*Ficus carica*), which have been found repeatedly. It is not known whether those species that were only occasionally found, like plum (*Prunus domestica*), peach (*Prunus persica*) or black mulberry (*Morus nigra*), were grown in the orchards of the *villae*. These finds demonstrate that the inhabitants of the *villae rusticae* in the Rhenish loess zone of the Cologne Bay oriented themselves towards Roman style consumption habits and would not miss out on precious Roman foodstuffs on their rural estates.

DISCUSSION

Summing up the now available geoarchaeological and archaeobotanical results, we come to the following conclusions:

Concerning food-plants, human diet within the two *coloniae* (CAA and CUT) was strikingly similar. We observe the same preferences for cereals, pulses, vegetables, spices and fruits. Most of these were cultivated locally in and around the *coloniae*. Only some fruits, nuts and spices like figs, pine nuts and pepper had to be imported from afar.

Even though both Roman towns were very similar from an archaeobotanical point of view, their direct hinterlands display great differences in many respects: first of all, we notice a difference in the agricultural potential of the predominant soils of the north and south. The soil type units and soil value classes differ between a more uniform loess-covered landscape in the Cologne Bay and a more heterogenous mosaic-like landscape in the Lower Rhine Plain.

The differences become even more apparent when we take a look at the plant remains found in the rural settlements in the hinterland of the CAA and of the CUT. While the plant spectrum of the *villae rusticae* in the loess landscape resembles that of the two towns, the plant spectra from two rural settlements in the Lower Rhine Plain are quite different. In fact, they remind us very much of the typical Iron Age set of cultivated plants: in the hinterland of the CUT, agrarian traditions seem to have lived on. The inhabitants of the hinterland built, farmed and ate traditionally.

91. E.g. Müller 1996, for depictions on reliefs cf. Kaszab-Olschewski 2007, 179f.

The contrast between the two agricultural systems in the north and south cannot be in total explained by differences in soil quality in the Cologne Bay and the Lower Rhine Plain alone. The loess landscape is most suitable for the cultivation of demanding crops like spelt; the “very high” and “high” soil value classes make up more than two-thirds of the area. It seems as if the Romans appreciated the advantages of the loess landscape as a wheat producing region: the uniformity of the loess zone probably allowed the use of very effective techniques in tillage, manuring, and harvesting, such as the *vallus* for harvesting spelt. The uniformity and fertility of the loess landscape supported the pragmatic decision to establish an effective *villa* system here with people who built, farmed, and ate Roman.

Even though the “very high” soil value class is missing from the less-loess landscape of the Lower Rhine Plain, more than a quarter of “high” quality soils were still suitable for the cultivation of nutrient-demanding cereals like the favoured Roman spelt. As calculated above in part I, the total amount of land needed to cultivate all the cereal consumed – for a research area lying within the Lower Rhine Plain (fig. 44) – amounted to a maximum of 263 km². The soils suitable for the production of spelt within this area, however, already covered 657 km² (fig. 45). Therefore, the size of suitable wheat-producing areas would

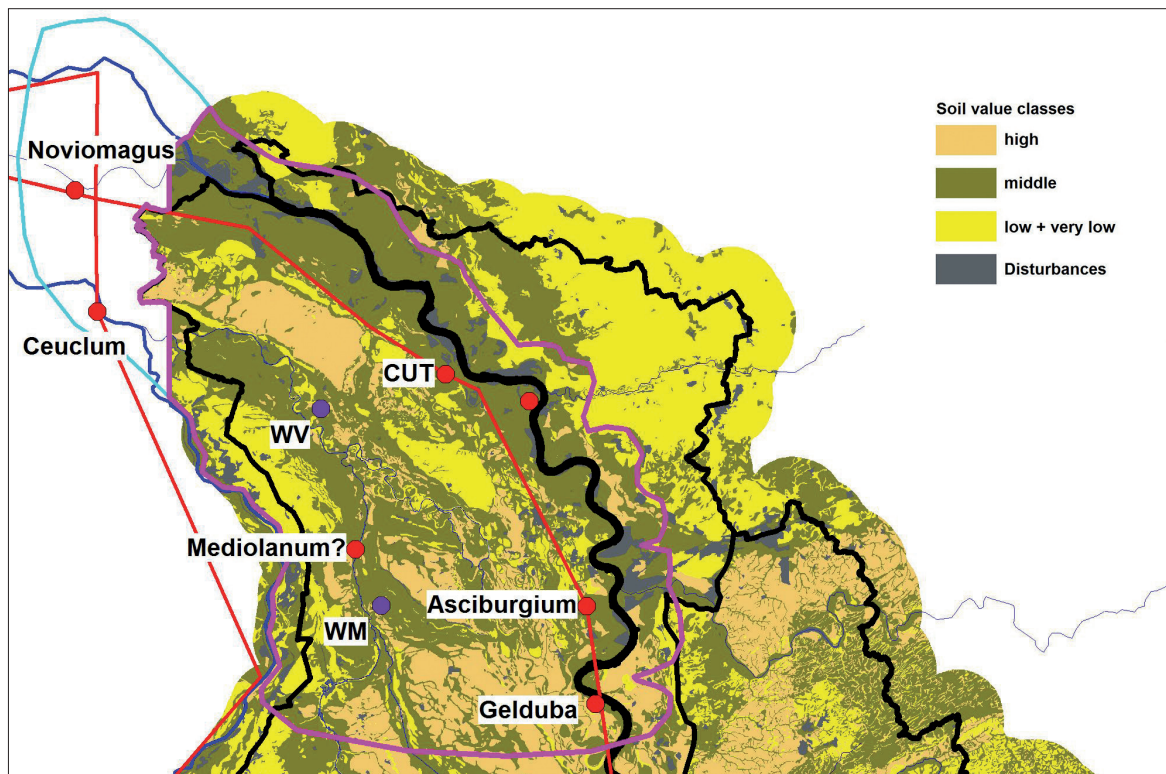


Fig. 44. Section from fig. 35, soil value classes. Pink: research area in Germany; blue: research area in Germany and the Netherlands (R. Lubberich, LVR-ABR, LVR-ABR, on the basis of Bodenübersichtskarte 1:50,000 Geologischer Dienst NRW)

Soil value classes (GD NRW)	Research area 3,200 km ²		km ² research area (D+NL)	Suitable for		
	km ² (D)	%		demanding cereals	less demanding crops	livestock
very high	0.00	0.00	0.00	+	+	+
high	547.80	20.55	657.6	+	+	+
middle (incl. Fluvisols)	1,418.10	53.19	1,702.1		+	+
low and very low	482.90	18.11	579.52			+
Disturbances	218.20	8.18	261.76			
Total	2,666.00	100.00	3,200.98	-	-	-

Fig. 45. Percentages of the soil values classes in the research area (3,200 km², cf. above, part I). These estimations could only be carried out for the German part (D) of the research area (fig. 44), since we only had the soil map and data of the Geological Service of Northrhine-Westphalia at our disposal. Because the same landscape with similar sediments and soil properties exists beyond the modern state border, the percentages of the soil value classes are taken as given also for the Dutch part (NL) of the research area.

have allowed enough spelt to be cultivated to feed the inhabitants of the whole *colonia* territory. However, the available archaeobotanical data from the rural settlements of the Lower Rhine Plain, although sparse, indicate that spelt played a minor role as a cereal. The wheat-compatible soils were obviously not exploited to their full potential.

Thus, we can conclude that the different agrarian usages of the areas were intentional ones. Concerning the usage of the rural landscape of the Lower Rhine Plain there are two options:

– Either less demanding crops (like barley and millet) were cultivated on soils of “high” and “middle” value classes.

– Or – considering the possibility of livestock breeding – it can be assumed that cattle (and horses) were not only grazing on soils of the “low” value class, but also on soils of the higher classes.

Maybe both options are true; unfortunately, in the current state of research, we cannot come up with final fixed numbers on the significance and proportion of cereal and meat production in the hinterland of the CUT.

And to come up with an answer to this chapter’s question: Were soil characteristics the main trigger for land use? Of course, the soil characteristics were important; but the development of a *villae* system with an emphasis on the cash-crop spelt was presumably guided by a cost-benefit ratio of economic management, encouraged by the uniformity of the loess landscape. According to the current state of research, a *villae* system was not “installed” in the Lower Rhine Plain. However, it seems that the Roman influence on traditional agriculture still led to greater efficiency and sustainability. Changes in the vegetation show that marginal areas were given up in the Roman period, although at the same time the population increased significantly.

REGION SUMMARY (Marion Brüggler, Karen Jeneson, Renate Gerlach, Jutta Meurers-Balke, Tanja Zerl and Michael Herchenbach)

This chapter deals with archaeological, geoarchaeological and archaeobotanical results concerning the Roman rural landscape in the Rhineland. Even though this region comprises three landscape units typical for the Gaulish provinces – namely the low mountain ranges, the loess belt and the Pleistocene and Holocene loam and sand landscapes – we concentrate on the last two.

Part I presents a summary of recent archaeological results on rural sites, settlement distribution, and settlement density within the loess zone of the Cologne Bay on the one hand and the loamy and sandy Lower Rhine Plain on the other. Whereas the loess zone has been intensively researched, especially within the lignite mining area, the northern part of our research area is still at the beginning of archaeological investigations with only a handful of extensively excavated rural sites. However, the first results show a good compatibility with those from the more intensively researched adjacent sand and loam landscapes of the Netherlands.

A fully developed *villa* landscape existed in the loess zone with Roman style buildings, infrastructure and consumption patterns. The rural population of the northern areas continued living in byre-houses making use of traditional hand-made pottery. Here, too, already at the beginning of the Roman period there are some artefacts showing an influence of Roman culture. This influence increases in the 2nd century when hand-made pottery is totally replaced by wheel-thrown vessels.

In part II we look from a geoarchaeological and archaeobotanical perspective on both landscapes, facing similar differences in research intensity; nevertheless, the evaluation of pollen diagrams and soil conditions enable us to work on a more regional scale. Surplus production of spelt wheat was the aim of the *villae rusticae* in the loess belt, whereas no surplus in cereal seems to have been generated in the loamy and sandy areas of the north. Here, too, archaeobotanical data reflect changes in land use, but in summary they rather point to a continuation of Iron Age subsistence farming. Furthermore, the plant-food consumed in the *villae* is decidedly Roman, i.e. cultivated fruit, vegetables and spices, while evidence in the northern rural settlements points to more traditional dietary patterns.

In contrast to the countryside the inhabitants of both *coloniae*, *Colonia Claudia Ara Agrippinensium* (CCAA, Cologne) in the loess region and *Colonia Vlpia Traiana* (CUT, Xanten) in the northern sand and loam region, consumed the same kind of plant food: spelt as main cereal supplemented by a broad spectrum of cultivated fruit, spices and imported goods, such as

olive, dates and figs. The CCAA was supplied with spelt from its hinterland, the loess zone. In theory, the CUT could also have been supplied by its hinterland. Our model calculation reveals that the size of arable land, its soil values and the available manpower should have been sufficient. However, the archaeobotanical results show that those farmsteads investigated so far only produced spelt on a very low scale. It was definitely not enough to supply the CUT and military installations of the Limes. Moreover, the weed flora found in storages of spelt within the CUT proves its provenance from calciferous loess soils typical for the loess belt.

Even though there are manifest natural differences between both landscapes, they alone cannot explain the different agrarian economies. Therefore, other reasons must have existed for the different developments. Conceivable are economic factors such as a higher effectivity when growing crops on a large scale within the more uniform loess zone rather than on the small-spatially structured soils in the north. Cultural factors may have played an important role, concerning for example the willingness of interaction of the different agents. Future studies will have to concentrate especially on these aspects.

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