
TRAC Theoretical Roman Archaeology Conference

www.trac.org.uk

Paper Information:

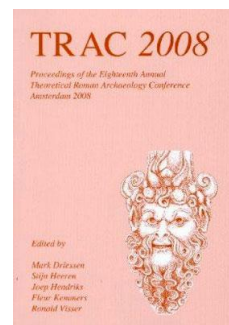
Title: Barley and Horses: Surplus and Demand in the civitas Batavorum

Author(s): Ivo Vossen and Maaïke Groot

Pages: 85–100

DOI: http://doi.org/10.16995/TRAC2008_85_100

Publication Date: 17 April 2009



Volume Information:

Driessen, M., Heeren, S., Hendriks, J., Kemmers, F., and Visser, R. (eds.) (2009) *TRAC 2008: Proceedings of the Eighteenth Annual Theoretical Roman Archaeology Conference, Amsterdam 2008*. Oxford: Oxbow Books

Copyright and Hardcopy Editions:

The following paper was originally published in print format by Oxbow Books for TRAC. Hard copy editions of this volume may still be available, and can be purchased direct from Oxbow at <http://www.oxbowbooks.com>.

TRAC has now made this paper available as Open Access through an agreement with the publisher. Copyright remains with TRAC and the individual author(s), and all use or quotation of this paper and/or its contents must be acknowledged. This paper was released in digital Open Access format in April 2013.

Barley and Horses: Surplus and Demand in the *civitas Batavorum*

Ivo Vossen and Maaïke Groot

Introduction

The incorporation of the Lower Rhine delta into the Roman Empire from the second half of the first century B.C. onwards resulted in the emergence of a substantial non-agrarian population – people who did not produce their own food. The presence of a large standing army must have laid a burden on the local population. This paper will focus on the rural economy in the *civitas Batavorum* and the role this area played in supplying the Roman army in the region with two specific products: barley and horses.

Recently, the theme of surplus production and supply to the Roman army has received a lot of attention, as can be seen from the appearance of an entire volume devoted to the subject (Stallibrass and Thomas 2008). Although this publication provides many new insights, the concluding chapter also highlights the need for more research. It calls specifically for more integrated research, drawing on different kinds of evidence. Although we cannot hope to include all evidence related to surplus production in the Batavian area, in this paper we will combine results from different lines of research based on written sources, landscape, settlement density, botanical remains, and animal bones. While these lines of research can add valuable insights by themselves, it is only by integrating them that we can begin to understand the complicated interaction between producer and consumer.

Our paper will be based on two principles: first, that supply will follow demand (where possible); and second, that the Roman army will have used the most efficient supply chain available. The latter does not always mean the shortest route between producer and consumer; other factors such as infrastructure and socio-economic structure will also have played a role. Following these principles, an examination of the agrarian economy in the Batavian area on the one hand, and of the specific needs of Roman forts on the other, will provide insights into the possibilities for surplus production and into local supply networks.

One of the reasons for our focus on barley and horses is that both products were produced in rural settlements in the Batavian region. Furthermore, the army had a need for both products. Finally, barley and horses are closely linked products, since barley is usually assumed to have been used as horse feed. Since there are few indications that the army was supplied with local products for the period before A.D. 70, we will focus on the period A.D. 70–270, the Middle Roman period in the Netherlands (Groenman-van Waateringe 1989: 101–102; Cavallo *et al.* 2008: 78). An added advantage is that by this time, the *limes* was well-established.

First, we will discuss the historical background for the region and earlier research into surplus production. Then, we will look at the indications for agrarian production in the Batavian area. Next, the needs of the Roman army will be described. Finally, we will discuss what the Roman demand for barley and horses was, and whether it could have been satisfied by local production.

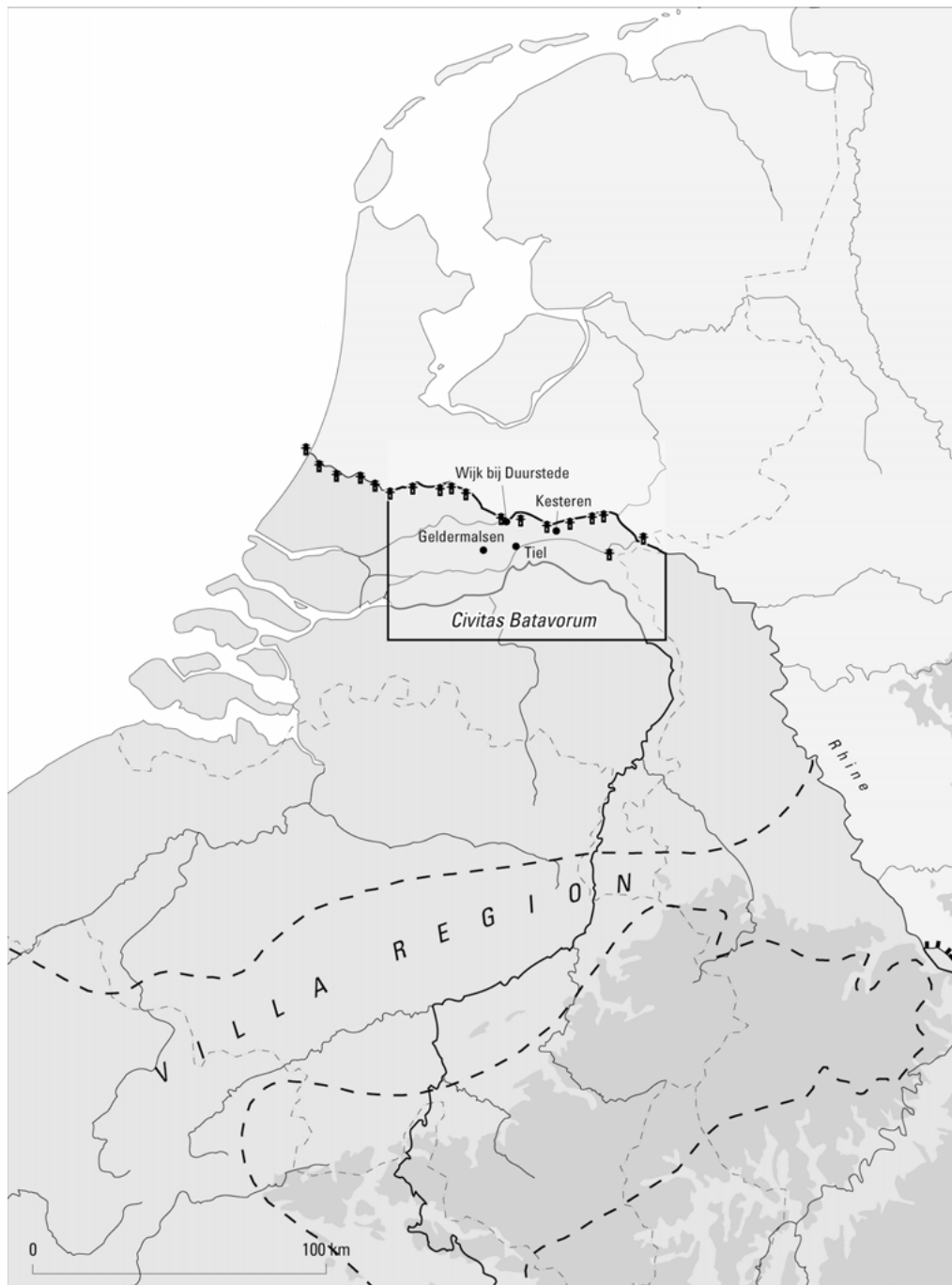


Figure 1: Location of the civitas Batavorum, the military sites along the Rhine and the four rural settlements discussed in this paper; and the villa region in Northern Gaul (Illustration B. Brouwenstijn; partly after Roymans 1996, Fig. 18).

Surplus production and regional diversity

The Batavian area consisted of the central and eastern River area, in what is now the central Netherlands (Fig. 1). The Roman army first reached the region around the middle of the first century B.C., but it was not until a hundred years later that a large number of soldiers were stationed in a line of army camps directly south of the Rhine. Until the arrival of the Romans, the area of the Batavian tribe was inhabited by self-supporting agrarian communities (Willems 1984: 203–204; Roymans 1996: 48–49). The presence of the Roman army caused a growing demand for food and other goods.

The most obvious supply area for cereals seems to be the loess region in northern Gaul, south of the Batavian area (Fig. 1). During the second half of the first century A.D. this region saw the emergence of villas: large farm complexes specialising in the large scale monoculture of bread and spelt wheat for the military and urban markets. The existence of villas was based on surplus production. By the second century A.D., the contrast in agricultural terms between the loess region and the Batavian area had become striking. The loess landscape was scattered with large villa complexes, while the Batavian area was dominated by small, rural settlements, consisting of a few farmhouses, and with an agrarian system based on mixed farming (Kooistra 1996: 125; Roymans 1996: 51).

Several reasons have been put forward to explain this contrast. The difference in landscape and its ability or failure to produce large quantities of wheat is the most obvious (Slofstra 1991, 159, 182; Roymans 1996: note 167). Loess soils are indeed very fertile and easy to cultivate. Although the clayish soils in the River area are also fertile, it seems that the fluctuating groundwater was a disturbing factor for large-scale wheat production (Kooistra 1996: 319–320, 361–362). Here few villas arose; there are also very few indications for the production of bread wheat. In addition to the landscape, Roymans has pointed to more cultural factors (Roymans 1996: 73). In the Batavian region, tradition, myth and landscape have developed a pastoral ideology with an agrarian economy primarily based on pastoral products, although this does not exclude the existence of a mixed farming tradition. So, a more or less reserved attitude to major changes in agricultural practice could have played a role as well.

The focus on this contrast between the Batavian area and the loess region and on the ‘failure’ of the Batavians to provide the bulk of the wheat the Roman army needed, could too easily lead to the conclusion that the Batavians did not play any significant role in surplus production at all. There is no doubt that the Batavians did not participate in supplying the bulk of bread and spelt wheat demanded by the market. However, these are not the only products that the Roman army needed. Furthermore, there are indications that a surplus was produced in the Batavian area. At rural settlements, even the most modest ones, we see an increase in imported products, such as pottery, metal ware, and non-local food. At the same time the use of coins became more common within the context of rural settlements (Aarts 2000: 62). Imported products and money must have been exchanged for locally produced goods (Willems 1984: 265). If not wheat, then what goods were produced in the Batavian settlements? Were these products the Roman army needed?

The rural settlements: production

Several large-scale excavations and analyses of organic remains have shed a light on the rural economy in the riverine area. The excavations at Tiel-Passewaaij, Wijk bij Duurstede-De Horden, Kesteren-De Woerd and Geldermalsen-Hondsgemet are the main sources for this paper (Van Es 1994a; 1994b; Hessing 1994; Sier and Koot 2001; Vos 2002; Heeren 2006; Roymans *et al.* 2007; Van Renswoude and Van Kerckhove forthcoming). These are well-excavated, large settlements with habitation covering the second and early third century A.D. that have provided botanical and zoological data (Lange 1990; Kooistra 1996; Laarman 1996; Kooistra and Van Haaster 2001; Zeiler 2001; Kooistra and Heeren 2007; Groot 2008a; Groot forthcoming; Kooistra forthcoming). All four excavations have revealed one or more rural settlements, consisting of up to five byrehouses in the second century. There are few indications for social inequality.

Most of the publications that cover the data from these four settlements are general excavation reports or specialist studies limited to one find category. Kooistra's study is a synthesis of botanical data for a larger region (including Wijk bij Duurstede-De Horden), but deals primarily with plant crops. While the present paper uses data from existing publications, it also includes new data on settlement density in the Dutch River area. We have used an interdisciplinary approach, combining data on landscape and settlement density with botanical and zoological data from these four settlements.

Landscape and settlement density

Although relief in the riverine area was not very pronounced, the flooding of the rivers Meuse and Rhine and their several branches in the winter season resulted in a concentration of habitation on the highest parts of the landscape: the river banks along active rivers, and even more on the numerous stream ridges, the residues of former river beds (Fig. 2). The settlements at Tiel-Passewaaij and Wijk bij Duurstede were situated on stream ridges, while Geldermalsen-Hondsgemet and Kesteren-De Woerd lay on top of so called crevasse splay deposits, formed when a river bank is breached during floods (Fig. 2).

The relative height and the consistence of the soil made stream ridges suitable for agriculture as well as habitation. Stream ridges, both of active and former rivers, are relatively elongated features in the landscape. Since habitation and agriculture competed for the same land, this reduced the area which could be used for agriculture. The stream ridges were flanked by low-lying areas: flood basins consisting of heavy clay, which flooded during the winter. Most parts of these flood basins were not suitable for agriculture, but they could be used as pasture for cattle, sheep and horses. In comparison to the stream ridges, the total surface area of flood basins was slightly larger.

The riverine part of the *civitas Batavorum* was densely populated (Fig. 3). Around 1000 rural settlements are known for the area, which equals an average of 0.4 settlements per square kilometre. When only the inhabitable area – the stream ridges – is taken into account, the average is 0.9 settlements per square kilometre. This means that the pressure on arable land must have been high. The stream ridges were covered by a series of settlements, with an average distance of 500-1000 metres between them. This uninhabited land was used for arable farming.

The excavations of rural settlements provide numerous indications, mainly based on archaeozoological and botanical data, for how the landscape was exploited. Demography and

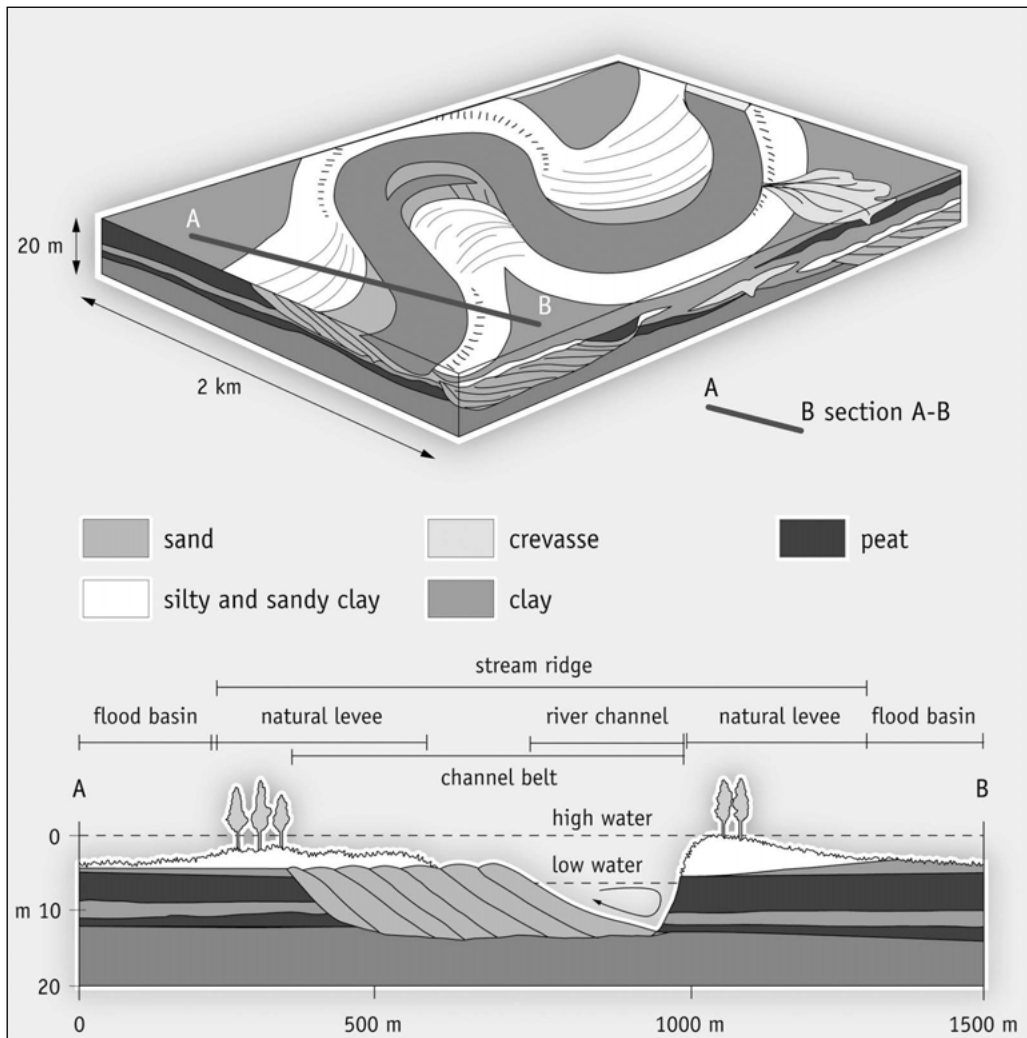


Figure 2: Schematic overview of the riverine landscape (Illustration B. Brouwenstijn, after Berendsen and Stouthamer 2001, Fig. 3.4).

structures such as storage facilities and stables provide additional information (Groot *et al.* forthcoming).

Barley

A broad spectrum of crops was grown in the settlements (Lange 1990; Kooistra 1996; Kooistra and Van Haaster 2001; Kooistra and Heeren 2007; Kooistra forthcoming). Cereals were the main crops, but pulses such as Celtic bean (*Vicia faba* var. *minor*) and oil-yielding crops such as rape (*Brassica rapa*) and gold-of-pleasure (*Camelina sativa*) were also grown. Vegetables such as

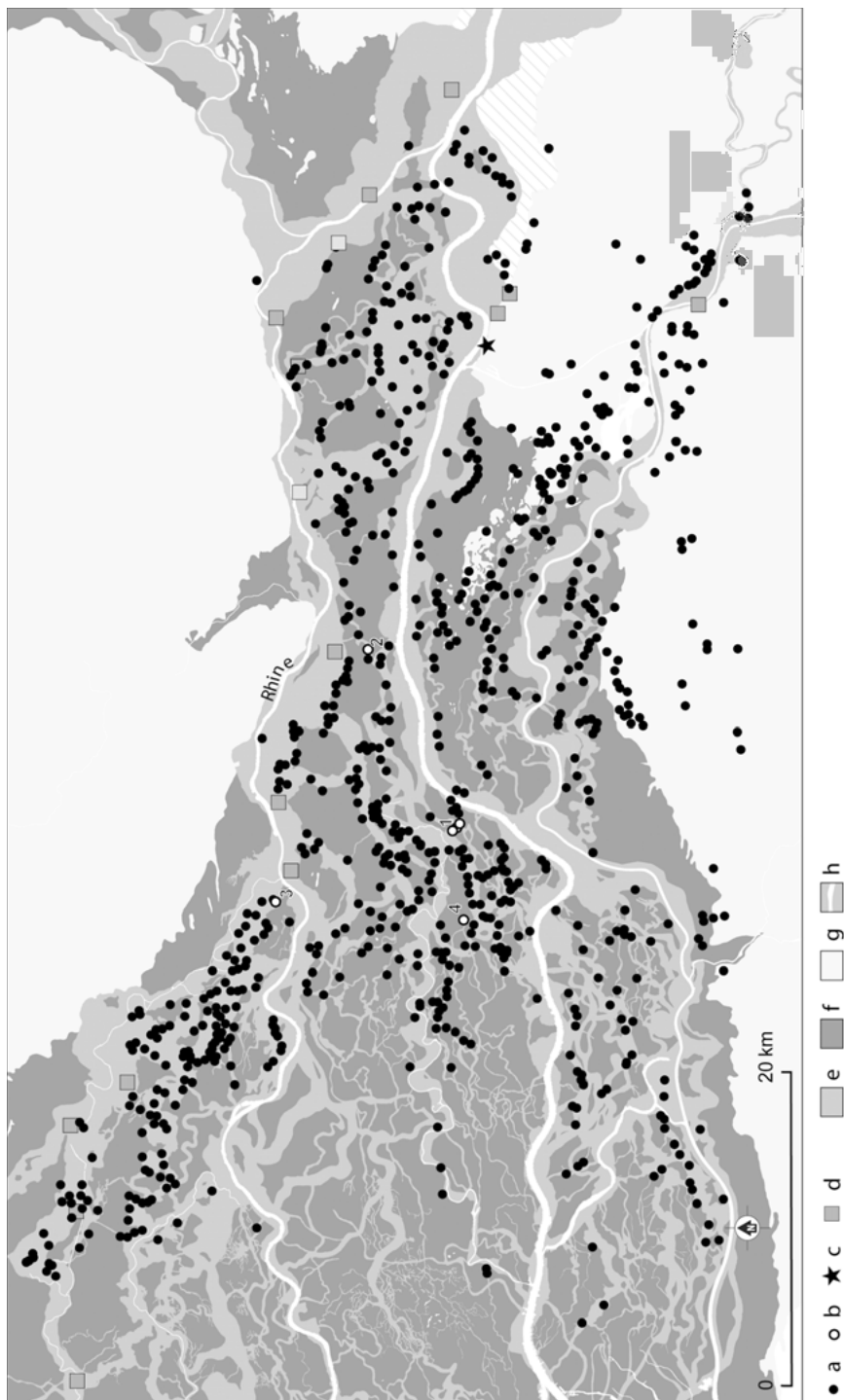


Figure 3: Location of settlements in the civitas Batavorum, Middle Roman period (after Vossen forthcoming). a. rural settlement; b. rural settlement mentioned in text; c. *Ulpia Noviomagus* (Nijmegen); d. military settlement (light grey; uncertain); e. stream ridge; f. flood basin; g. Pleistocene (non-riverine) deposits; h. current river course. 1. Tiel-Passewaaij; 2. Kesteren-De Woerd; 3. Wijk bij Duurstede-De Horden; 4. Geldermalsen-Hondsgemet.

beet (*Beta vulgaris*) and carrot (*Daucus carota*), and herbs such as dill (*Anethum graveolens*) and coriander (*Coriandrum sativum*) were grown in vegetable gardens within the settlements.

At production sites, we would expect to find not just the grains but also straw, awn fragments, chaff, and a variety of weed seeds. At consumption sites, chaff of hulled cereals may be present, but not awn fragments or chaff of free-threshing cereals (Kooistra 1996: 18). Cereals produced for trade would still leave behind evidence at their production sites, assuming that they were transported as grains and not as complete ears.

Within the cereals spectrum at our four settlements, barley represents the biggest share, followed by emmer wheat (Table 1). The sample from Tiel-Passewaaij is probably not representative for the entire site, since it derives from a single granary. However, it confirms production of barley and emmer wheat. Oats and millet are found in most settlements, but never reached the importance of barley and emmer wheat. Bread and spelt wheat are nearly absent, both as macro remains and in the pollen diagrams. Moreover, the fact that no by-products are found, makes the production of bread wheat unlikely. It seems there are no striking fluctuations in crops over time. In fact, the kinds of cultivated species as well as their ratios are more or less the same as in the Late Iron Age (Kooistra 1996: 125).

While the wheat from Tiel-Passewaaij could not be identified to species, it can only be emmer or spelt. Since all of the chaff found is from emmer wheat, it does not seem far-fetched to conclude that most if not all of the unidentified wheat is emmer (Kooistra and Heeren 2006: 169–170).

Table 1: Percentages of cultivated cereals for four rural settlements in the Middle Roman period; out of total number of identified macro remains (mainly seeds). The samples from Tiel-Passewaaij are from one feature (a granary). The non-specified wheat remains can almost certainly be ascribed to emmer wheat. For Geldermalsen-Hondsgemet, no percentages were available; instead, the numbers of samples in which cereals are present are included (Lange 1990; Kooistra 1996; Kooistra and Van Haaster 2001; Kooistra and Heeren 2007; Kooistra forthcoming).

	WdD- De Horden n=1831 (%)	Tiel- Passewaaij n=1811 (%)	Kesteren- De Woerd n=1060 (%)	Geldermalsen- Hondsgemet n=28 (n)
<i>Avena</i> (oat)	0	1	0	(2)
<i>Hordeum vulgare</i> (barley)	77	14	56	(11)
<i>Panicum miliaceum</i> (millet)	3	0	4	(0)
<i>Triticum aestivium</i> (bread wheat)	0	0	0	(0)
<i>Triticum dicoccon</i> (emmer wheat)	20	0	23	(4)
<i>Triticum spelta</i> (spelt wheat)	0	0	1	(0)
<i>Triticum sp.</i> (wheat)	0	85 (almost certainly emmer)	15	(1)

The arable fields must have been situated on the stream ridges. Fig. 4 shows the size of the area available to the inhabitants of Tiel-Passewaaij: 30 hectares. Some kind of rotation system was almost certainly used. A two-course system with one year of fallow means 15 hectares was available for growing crops. Since cereals formed the staple food, we can assume that most of the arable fields were used for growing barley and emmer wheat. To give some idea of the quantities involved, 15 hectares of land could have yielded about 12 tonnes of cereals each year (Kooistra 1996: 67; Vossen 2007: 42–43).

Compared to the estimated size of the population, surplus production of cereals was certainly possible for Tiel-Passewaaij. This is confirmed by the available storage capacity, which surpasses the local need for cereals (Groot *et al.* forthcoming). Since barley and emmer wheat were the dominant cereals in most settlements, most of this surplus will have consisted of these two cereals. For Tiel-Passewaaij, the estimated size of the possible surplus varies with the fluctuating population, but consists of up to half of the total harvest (Groot *et al.* forthcoming). Since Tiel-Passewaaij seems to have been an average settlement – even if somewhat larger than most – we can assume that other settlements also produced a surplus of barley and emmer wheat.

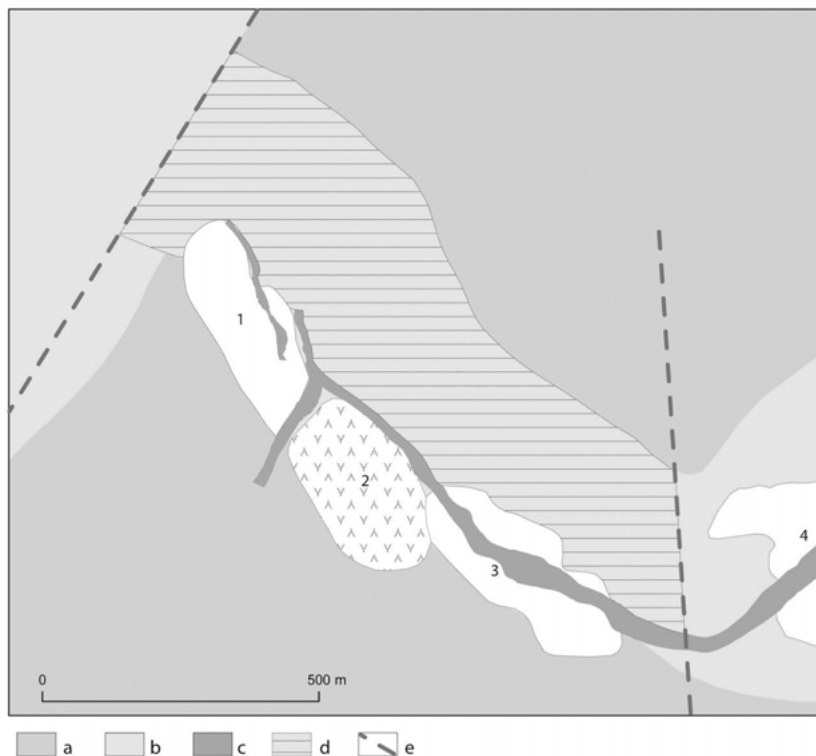


Figure 4: Landscape and land use on a local level, situation at Tiel-Passewaaij (after Vossen 2007, fig.7). a. flood basin; b. stream ridge; c. residual channel; d. area available for arable fields for the inhabitants of Tiel-Passewaaij; e. hypothetical borders between settlement territories. 1. Tiel-Oude Tielseweg settlement; 2. cemetery; 3. Tiel-Passewaaijse Hogeweg settlement; 4. Tiel-Zennewijnseweg settlement (another settlement territory).

Horses

Livestock formed the other aspect of the mixed farming regime. Livestock was exploited for several purposes and kept in various ways. The stable sections of byrehouses, sometimes with remains of stable boxes, indicate that cattle were stabled during the nights and/or winter. Even when they grazed outside during the day, they were probably kept close to the settlement, which made the collection of manure easier. The age distribution points to an overrepresentation of adult cattle. One could expect that the younger animals were sold at the market, but age distributions for consumption sites are also dominated by older cattle (Groot 2008c: 89–90; Groot 2008a: 73–76). This indicates that cattle were held primarily for other purposes than meat production, such as providing manure and traction. Thus, cattle exploitation supplemented arable farming. Nevertheless, due to their prominent position in the species spectrum and their large size, cattle also provided the majority of meat consumed.

Animal bone assemblages from rural settlements show variations over time. Cattle remained prominent throughout the Roman period. Pigs were kept in relatively small numbers in the settlements. Sheep were an important species in the Early Roman period. The high sheep proportion and age distribution indicates that wool was an important surplus product for the Roman military and urban market in the second half of the first century A.D. (Groot 2008c: 91–92, Fig. 6.4 and 6.5). Sheep show a marked decline from the late first century onwards, while the proportion of horse increased. High proportions of horse bones (over 20%) are found at many sites in the region during the second and third centuries A.D. (Groot 2008c: 93, Fig. 6.6). For our four settlements, the percentage of horse bones ranges between 25 and 35% during the Middle Roman period (Table 2).

Table 2: Percentages of horse bones for four rural settlements in the Middle Roman period, out of the total number of identified fragments for cattle, sheep/goat, pig and horse (Laarman 1996: 379; Zeiler 2001: 270–272; Groot 2008a: 50–55; Groot forthcoming).

Site	Phase	Date	% horse fragments	Total NISP
Tiel-Passewaaij	3.2–6	90–270 A.D.	24.5	1598
Kesteren-De Woerd	c–e	70–270 A.D.	25.2	1917
Geldermalsen-Hondsgemet	3–4	50–270 A.D.	25.6	1356
Wijk bij Duurstede-De Horden	Middle Roman	70–270 A.D.	34.8	2116

The high ratios of horse in the bone spectra imply that horses were not just kept to answer the local need for transport animals. Since horse meat was not a common part of the daily diet, the high proportion of horses reflects breeding for a market. The association between the Batavians and horses is well known. Although Tacitus may have romanticised the image of the Batavian horsemen, the fact remains that the Batavians provided qualified horsemen for the imperial bodyguard as well as for the famous *Ala Batavorum* (Tacitus IV, 12; Alföldy 1968; Bellen 1981). Furthermore, horse gear is found at almost every rural settlement (Nicolay 2007: 71, Fig. 3.3). This could be an indication that horses were not just bred in the settlements, but received a basic training there as well.

The riverine landscape is certainly suitable for breeding horses, especially for an extensive mode of exploitation, where horses were kept year round in the flood basins with a minimum of labour input. More than cattle, horses are suitable for grazing in wet areas, even all-year round. Once a year, young horses could be selected from the herd for training or selling. Parallels for extensive horse keeping are found in the Camargue during the eighteenth and early nineteenth century, where the French army controlled horse breeding, in medieval Limburg, and in the New Forest (UK), where horses are still kept extensively (Duncan 1992: 212–216; Renes 1999: 184). The age distribution of horses in Tiel–Passewaaij shows an underrepresentation of juvenile horses in the second and third centuries, when compared to the previous and later periods. This confirms the extensive management of horses for producing a surplus. Natural deaths occurred in the flood basins, explaining the lack of juveniles in the settlements of Tiel-Passewaaij and Wijk bij Duurstede—e Horden (Laarman 1996: 377 ;Groot 2008c: 94). Interestingly, young horses are not underrepresented at Geldermalsen-Hondsgemet during the phase with the highest proportion of horse bones, which suggests a different management system (Groot forthcoming).

How this horse breeding for the Roman army was organised is not yet clear. It seems unlikely that every rural settlement had a flock grazing in the flood basins. One would expect some kind of central organisation in exploiting these large common grounds: either by the Batavian elite or the Roman army. Recent evidence from Geldermalsen-Hondsgemet suggests that horse breeding was controlled by one household within this settlement, and instigated by a returned veteran (Groot 2008b). This could provide a clue to the organisation of horse breeding at settlement level, but more research is needed before further conclusions on the regional organisation can be drawn.

Although there is no doubt that all kinds of agrarian products were sold at markets, barley and horses formed two of the most significant products. The quantities per settlement may have been small, but because the density of settlements was high, a substantial surplus production for the entire region could be achieved. Now that we have a rough picture of the rural agrarian economy, we will look at the biggest consumer in the area: the Roman army.

The Roman army: demand

The appearance of the Roman army introduced a significant demand for food and other agrarian products. All kinds of luxury goods as well as bulk goods such as wheat had to be imported from outside the region. The Roman barge found at Woerden, loaded with what was probably emmer wheat, proves that wheat was imported from outside the region. The analysis of remains from wild plants that came along with the cargo shows that the wheat was grown on loess soils in present-day Belgium or South Limburg (Pals and Hakbijl 1992). This confirms the theory that the villa region supplied the Roman army in our region with wheat. Apart from cereals, the Roman army also needed meat and other animal products. Live animals, such as cattle, horses and mules, were used for transport.

Barley

Wheat formed the staple food of the Roman soldier. It is well known that the Roman soldier received a daily ration of food, which consisted of about 1 kilogram of wheat, most probably bread or spelt wheat (Davies 2002: 48). From this, the soldier had to make his own bread.

However, wheat was not the only cereal that the Roman army needed. In the military forts along the Rhine, several types of cereals are found. In the period up to A.D. 140, barley, emmer wheat and spelt wheat are found in nearly all investigated military sites in the Rhine delta (Knörzer 1970; Cavallo *et al.* 2008: 75, Table 5.2). Bread wheat, millet, oats and rye are found in some sites but not all. This shows that the army's demand for cereals was not restricted to bread and spelt wheat.

Of course, the presence of cereals says nothing about the intended consumer. Perhaps some cereals were animal fodder rather than the soldiers' staple food. Within the context of the Roman army, barley is usually seen as food for animals. Numerous horses – even as part of non-mounted regiments – and mules would have been kept in or around the army camps. Barley was well known since before Roman times as animal fodder. That barley was used for that purpose can be concluded from a military document where several deductions from a soldier's pay are written down (Cotton and Geiger 1989: no. 722). Both a deduction for food (*'in victum'*) is stated *as well as* a deduction for barley. This could imply that the barley was received as fodder for the soldier's horse or mule. In his *Histories* Polybius (VI, 39) also mentions payment of wheat *and* barley for soldiers in the cavalry.

Since barley was not highly favoured as human food from a Roman perspective, we would not expect to find it as food for soldiers. In fact, written sources mention that these cereals were used as a penalty or in case of shortage (Caesar III, 4; Livius XXVII, 13, 9; Vegetius I, 13), confirming the disdain with which it was regarded. However, it is questionable how many 'Roman' or even Mediterranean soldiers still served in the army in the second century A.D. A disapproval of cereals other than bread or spelt wheat should not be expected for local, or in any case non-Mediterranean auxiliaries. Soldiers from more northerly regions had grown up on a diet of barley and emmer wheat, and may have preferred them to bread and spelt wheat. Furthermore, there are some indications that Roman legionary soldiers also consumed barley (Knörzer 1970: 26; Vossen forthcoming). Even Columella tells us: *'barley is a better food for all farm animals than wheat and is more wholesome for humans than bad wheat'* (II, 9, 14).

The importance of barley for the Roman army – as food for man or animal – also follows from the frequency with which barley turns up in military documents from Vindolanda, Egypt and Dura Europos: as deductions on payments, deliveries of certain amounts of barley, or mention of soldiers sent out to collect barley (e.g. *Tab. Vindol.* 213, 1474 IV, 1478; Cotton and Geigner 1989: no. 722; *P. Dura* 82).

The brewing of beer is another application for the use of barley, perhaps one that should not be underestimated in parts of the Roman empire where there was no tradition of wine drinking. One of the Vindolanda documents mentions the delivery of more than 300 modii of *braces*, probably a local name for barley, a species which is normally used for making beer (Birley 2002: 90). A *serverarius* (brewer) is mentioned in another Vindolanda document (*Tab. Vindol.* II 182).

The quantity of barley that the Roman army in our region needed is difficult to estimate. If we concentrate on barley as fodder for horses alone, an amount of about 2860 tonnes would be needed on a yearly basis in the second century (Table 3). Could this be supplied from local settlements? Tiel-Passewaaij may have produced up to 6 tonnes of surplus cereals (partly consisting of barley) per year (see above; Groot *et al.* forthcoming). Another 476 settlements with a similar production would be needed to supply the demand from the army. Although Tiel-Passewaaij is probably larger than the average settlement, about 1000 settlements existed in the riverine part of the *civitas Batavorum* alone.

Although the figures used here are very rough, they do give an indication that local production could have provided a substantial contribution to supplying the army with barley. Considering the demand from the Roman army for barley and the possibility that the Batavian area could have satisfied this demand, we can see this as a clear indication that surplus production of cereals played an important role in this region.

Table 3: Yearly military consumption of barley as horse feed and yearly military demand of horses in the civitas Batavorum (after Vossen forthcoming), based on 7 kg barley per horse each day, and the number of horses needed each year (Groot 2008c: 93). The number of cohortes and alae is based on the proportion of alae and cohortes in the Roman Empire as a whole. The number of horses attached to cohortes (0), alae (560) and legions (120) is based on figures in Hyland 1990, Tab. 2.

Period	No. of forts		No. of fortresses	No. of horses	Amount of barley for horses (tonnes)	No. of horses needed each year
	<i>cohors</i>	<i>ala</i>				
70–105 A.D.	10	2	1	1240	3194	413
105–250 A.D.	10	2	-	1120	2860	373

Horses

While horse remains are found in almost all of the excavated military sites along the river Rhine, the proportion of horse bones is very small: less than 4% in Nijmegen-castra, Meinerswijk, Leidsche Rijn 31, Zwammerdam, Valkenburg and Bodegraven (Van Wijngaarden-Bakker 1970; Lauwerier 1988: 56, 87; Verhagen 1988: 108; Esser *et al.* 2004: 6; Lauwerier *et al.* 2005: 302). However, contrary to barley, horses were not used for food but as transport animals. Therefore, it is not surprising that the disposal of dead horses was different from that in the rural settlements. Indeed, a military horse cemetery was excavated in Kesteren (Lauwerier and Hensing 1992).

There was a broad range of sources where the army could acquire horses: purchase at local markets, tribute, or from specialized stud farms managed by civilians or the army itself (Davies 1969: 431, 453). These various means of acquisition demonstrate that the supply of horses was not organised centrally; army units were responsible for acquiring their own horses. Johnstone also states that horses for the army were supplied from local sources (2008: 138).

To give a rough estimate, the Roman army in the province of Germania Inferior needed over 1000 horses every year (Groot 2008c: 93). This number is based on an average of three years of service per horse, a figure Hyland derives from Late Roman laws and taxation (1990: 86). The number of horses for the army camps in the *civitas Batavorum* alone was much smaller: between 373 and 413 (Table 3). The high proportions of horses in the rural settlements in the *civitas Batavorum* suggest that horse breeding played a major role in the agrarian economy during the second and third centuries A.D. The Roman army must have been the main consumer of these horses. Considering that around 1000 settlements were present in the riverine part of the *civitas Batavorum*, and that the landscape was very suitable for horse breeding, the horses needed by army camps in the region could easily be supplied. Batavian horses may even have been traded over longer distances.

Conclusion

In this paper we have tried to make clear that the Batavians played a significant role in the supplying of the Roman army, within and perhaps even outside the borders of the *civitas Batavorum*. We approached the issue of supply and demand by integrating data from settlement density studies, botanical remains and animal bones. By combining data from consumption and production sites, it was possible to compare demand from the army and production by local, rural settlements. A regional geographical approach can highlight the potential of an entire area, whereas the focus on small, individual settlements can lead to pessimistic views on surplus production. However, it is the individual settlements that provide us with information on the crops that were grown and the livestock that were kept. Botanical and animal bone data not only show the presence or absence of certain species, but also the ratios.

Settlement density data indicate that the demand of the Roman army for certain products, such as horses and barley, could have been met by local production. It is precisely because of the high density of settlements that each individual one only needed to produce a small surplus. So although each settlement may only have produced a small surplus, the region as a whole was able to supply the Roman army with at least some of the products needed. Although we focused on just two products, this does not mean that other agrarian products were not produced as a surplus.

However, the mechanisms behind this supply – tax, purchase at markets, direct delivery to the forts, etc. – are still an object of research. Further research into the provenance of imported goods found in the settlements may help in clarifying supply mechanisms and trade networks. Quantification of the amounts of barley and horses that were needed and produced remains problematic, but it is essential to come up with some figures, however rough the estimates.

Ivo Vossen, Archaeological Centre VU University Amsterdam / Oranjewoud BV, Almere
Maaïke Groot, Archaeological Centre VU University Amsterdam

Acknowledgements

We would like to thank Stijn Heeren for organising the session *Supplying (or starving?) the army. The possibilities and limitations of surplus production in rural settlements* at TRAC 2008; Bert Brouwenstijn (Archaeological Centre VU University Amsterdam) for providing figures 1 and 2; and Laura Kooistra (BIAX Consult) for both information and inspiration.

Bibliography

Ancient sources

Caesar (Translated by J.M. Carter 1991), *The Civil War*. Warminster: Aris and Phillips.

Columella (Translated by H.B. Ash 1941), *On Agriculture*. London: Heinemann. Loeb Classical Library 361.

Livius (Translated by F. Gardner Moore 1970), *History of Rome*. London: Loeb Classical Library 381.

Polybius (Translated by W.R. Paton 1922), *The Histories*. London: Heinemann. Loeb Classical Library.

- Tacitus (Translated by C.H. Moore 1951), *The Histories*. London: Heinemann. Loeb Classical Library 249.
- Vegetius (Translated by N.P. Milner 2001), *Epitome of military science*. Liverpool: Liverpool University Press.
- P. Dura: Welles, C.B., Fink, O.R., and Gilliam, J.F. 1959. *The Excavations at Dura–Europos. Final report V, Part 1: The parchments and papyri*. New Haven: Yale University Press.
- Tab. Vindol.: Bowman, A.K., and J.D. Thomas, J.D. 1994. *The Vindolanda Writing Tablets. Tabulae Vindolandenses 2*. London: British Museum Press.

Modern sources

- Aarts, J. 2000. *Coins or Money? Exploring the monetization and functions of Roman coinage in Belgic Gaul and Lower Germany, 50 BC–AD 450*. Amsterdam: PhD Thesis VU University Amsterdam.
- Alföldy, G. 1968. *Die Hilfstruppen der römischen Provinz Germania Inferior*. Epigraphische Studien 6. Düsseldorf: Rheinland-Verlag.
- Bellen, H. 1981. *Die germanische Leibwache der römischen Kaiser des julisch-claudischen Hauses*. Wiesbaden: Steiner.
- Berendsen, H.J.A. and Stouthamer, E. 2001. *Palaeogeographic development of the Rhine-Meuse delta, The Netherlands*. Assen: Van Gorcum.
- Birley, A.R. 2002. *Garrison Life at Vindolanda. A Band of Brothers*. Gloucestershire/Charleston: Tempus.
- Cavallo, C., Kooistra, L.I., and Dütting, M.K. 2008. Food supply to the Roman army in the Rhine delta in the first century A.D. In S. Stallibrass and R. Thomas (eds.) *Feeding the Roman army. The Archaeology of Production and Supply in NW Europe*. Oxford: Oxbow Books: 69–81.
- Cotton, H.M. and Geiger, J. 1989. *The Greek and Latin Documents. Masada 2*. Jerusalem: Israel Exploration Society Hebrew University.
- Davies, R.W. 1969. *The supply of animals to the Roman army and the Remount system*. *Latomus* 28: 429–459.
- Davies, J.L. 2002. Land use and military supply in the highland zone of Roman Britain. In M. Aldhouse-Green and P. Webster (eds.) *Artefacts and Archaeology. Aspects of the Celtic and Roman World*. Cardiff: University of Wales Press: 44–61.
- Duncan, P. 1992. *Horses and Grasses. The Nutritional Ecology of Equids and their Impact on the Camargue*. Ecological Studies 87. New York: Springer.
- Es, W.A. van 1994a. Het begin van de Romeinse tijd. In W.A. van Es and W.A.M. Hessing (eds.) *Romeinen, Friezen en Franken in het hart van Nederland: Van Traiectum tot Dorestad (50 v. Chr. – 900 n. Chr.)*. Utrecht: Matrij: 36–47.
- Es, W.A. van 1994b. De Romeinse Vrede. In W.A. van Es and W.A.M. Hessing (eds.) *Romeinen, Friezen en Franken in het hart van Nederland: Van Traiectum tot Dorestad (50 v. Chr. – 900 n. Chr.)*. Utrecht: Matrij: 48–63.
- Esser, E., Beerenhout, B., and Kuijper, W.J. 2004. *De Wacht aan tafel. onderzoek aan dierlijke resten uit Romeinse wachttorens (Locatie Zandweg L31)*. Ossicle 85. Delft: Archeoplan Eco.
- Groenman-van Waateringe, W. 1989. Food for soldiers, food for thought. In J.C. Barrett, A.P. Fitzpatrick and L. Macinnes (eds.) *Barbarians and Romans in North-West Europe*. British Archaeological Reports International Series 471. Oxford: Archaeopress: 96–107.
- Groot, M. 2008a. *Animals in Ritual and Economy in a Roman Frontier Community. Excavations in Tiel–Passewaaij*. Amsterdam Archaeological Studies 12. Amsterdam: Amsterdam University Press.
- Groot, M. 2008b. *Choice and Specialisation in Animal Husbandry in a Roman frontier zone*. Paper presented at the 73rd Annual Meeting of the Society for American Archaeology, March 26–30, 2008, Vancouver.

- Groot, M. 2008c. Surplus production of animal products for the Roman army in a rural settlement in the Dutch River Area. In S. Stallibrass and R. Thomas (eds.) *Feeding the Roman Army. The Archaeology of Production and Supply in NW Europe*. Oxford: Oxbow Books: 83–98.
- Groot, M. forthcoming. Dierlijk bot en speciale deposities met dierlijk bot. In J. van Renswoude and J. Van Kerckhove (eds.) *Opgravingen in Geldermalsen–Hondsgemet. Een inheemse nederzetting uit de Late IJzertijd en Romeinse tijd*. Zuidnederlandse Archeologische Rapporten. Amsterdam: Archeologisch Centrum Vrije Universiteit.
- Groot, M., Heeren, S., Kooistra, L.I., and Vos, W.K. forthcoming. Surplus production for the market? The agrarian economy in the non-villa landscapes of Lower Germany. *Journal of Roman Archaeology* 2009.
- Heeren, S. 2006. *Opgravingen bij Tiel–Passewaaij 1. De nederzetting aan de Passewaaijse Hogeweg*. Zuidnederlandse Archeologische Rapporten 29. Amsterdam: Archeologisch Centrum Vrije Universiteit.
- Hessing, W.A.M. 1994. Wijk bij Duurstede–De Horden. In W.A. van Es and W.A.M. Hessing (eds.) *Romeinen, Friezen en Franken in het hart van Nederland: Van Traiectum tot Dorestad (50 v. Chr. – 900 n. Chr.)*. Utrecht: Matrijs: 226–230.
- Hyland, A. 1990. *Equus: the Horse in the Roman World*. London: B.T. Batsford Ltd.
- Johnstone, C. 2008. Commodities or logistics? The role of equids in Roman supply networks. In S. Stallibrass and R. Thomas (eds.) *Feeding the Roman army. The Archaeology of Production and Supply in NW Europe*. Oxford: Oxbow Books: 128–145.
- Knörzer, K.-H. 1970. *Römerzeitliche Pflanzenkunde aus Neuss*. Novaesium 4. Berlin: Mann.
- Kooistra, L.I. 1996. *Borderland Farming. Possibilities and limitations of farming in the Roman period and early Middle Ages between Rhine and Meuse*. Assen/Amersfoort: Van Gorcum/Rijksdienst voor Oudheidkundig Bodemonderzoek.
- Kooistra, L. forthcoming. Botanische materialen. In J. van Renswoude and J. Van Kerckhove (eds.), *Opgravingen in Geldermalsen–Hondsgemet. Een inheemse nederzetting uit de Late IJzertijd en Romeinse tijd*. Zuidnederlandse Archeologische Rapporten. Amsterdam: Archeologisch Centrum Vrije Universiteit.
- Kooistra, L.I. and Haaster, H. van 2001. Archeobotanie. In M.M. Sier and C.W. Koot (eds.) *Archeologie in de Betuweroute: Kesteren–De Woerd. Bewoningssporen uit de IJzertijd en de Romeinse tijd*. Rapportage Archeologische Monumentenzorg 82. Amersfoort: Rijksdienst voor Oudheidkundig Bodemonderzoek: 293–359.
- Kooistra, L.I. and Heeren, S. 2007. Het verhaal van een afgebrande graanschuur. In N. Roymans, T. Derks and S. Heeren (eds.) *Een Bataafse gemeenschap in de wereld van het Romeinse rijk. Opgravingen te Tiel–Passewaaij*. Utrecht: Matrijs: 167–176.
- Laarman, F.J. 1996. Zoological Material of the Bronze Age, Iron Age and Roman period from Wijk bij Duurstede–De Horden. In L.I. Kooistra. *Borderland Farming. Possibilities and limitation of farming in the Roman period and early Middle Ages between Rhine and Meuse*. Assen/Amersfoort: Van Gorcum/Rijksdienst voor Oudheidkundig Bodemonderzoek: 369–380.
- Lange, A.G. 1990. *Plant Remains from a Native Settlement at the Roman Frontier: De Horden near Wijk bij Duurstede. A numerical approach*. Nederlandse Oudheden 13. Amersfoort: Rijksdienst voor Oudheidkundig Bodemonderzoek.
- Lauwerier, R.C.G.M. 1988. *Animals in Roman Times in the Dutch Eastern River Area*. Nederlandse Oudheden 12. Amersfoort: Rijksdienst voor Oudheidkundig Bodemonderzoek.
- Lauwerier, R.C.G.M. and Hessing, W.A.M. 1992. Men, horses and the Miss Blanche effect: Roman horse burials in a cemetery at Kesteren, the Netherlands. *Helinium* 32 (1–2): 78–109.
- Lauwerier, R.C.G.M., Wouda, C., and De Groot, L. 2005. Bot uit Romeins Bodegraven. *Westerheem* 54(6): 300–306.
- Nicolay, J. 2007. Armed Batavians. *Use and Significance of Weaponry and Horse gear in non-military*

- Contexts in de Rhine delta (50 BC – 450 AD)*. Amsterdam Archaeological Studies 11. Amsterdam: Amsterdam University Press.
- Pals, J.P. and Hakbijl, T. 1992. Weed and insect infestation of a grain cargo in a ship at the Roman fort of Laurium in Woerden (Prov. of Zuid-Holland). *Review of Palaeobotany and Palynology* 73: 287–300.
- Renes, J. 1999. *Landschappen van Maas en Peel. Een toegepast historisch-geografisch onderzoek in het streekplangebied Noord- en Midden-Limburg*. Leeuwarden: Eisma.
- Renswoude, J. van and Van Kerckhove, J. (eds) forthcoming. *Opgravingen in Geldermalsen–Hondsgemet. Een inheemse nederzetting uit de Late IJzertijd en Romeinse tijd*. Zuidnederlandse Archeologische Rapporten. Amsterdam: Archeologisch Centrum Vrije Universiteit.
- Roymans, N. 1996. The sword or the plough. Regional dynamics in the romanisation of Belgic Gaul and the Rhineland area. In N. Roymans (ed.) *From the Sword to the Plough. Three Studies on the earliest Romanisation of Northern Gaul*. Amsterdam Archaeological Studies 1. Amsterdam: Amsterdam University Press: 9–127.
- Roymans, N., Derks, T. and Heeren, S. (eds.) 2007. *Een Bataafse gemeenschap in de wereld van het Romeinse rijk. Opgravingen te Tiel–Passewaaij*. Utrecht: Matrijs.
- Sier, M.M. and Koot, C.W. (eds.) 2001. *Archeologie in de Betuweroute: Kesteren–De Woerd. Bewoningssporen uit de IJzertijd en Romeinse tijd*. Rapportage Archeologische Monumentenzorg 82. Amersfoort: Rijksdienst voor Oudheidkundig Bodemonderzoek.
- Slofstra, J. 1991. Changing settlement systems in the Meuse-Demer-Schelde area during the early Roman period. In N. Roymans and F. Theuvs (eds.) *Images of the past. Studies on ancient societies in Northwestern Europe*. Studies in Pre- and Protohistory 7. Amsterdam: Albert Egges van Giffen Instituut voor Pre- en Protohistorie: 131–199.
- Stallibrass, S. and Thomas, R. (eds.) 2008. *Feeding the Roman army. The Archaeology of Production and Supply in NW Europe*. Oxford: Oxbow Books.
- Verhagen, M. 1988. Eten en gegeten worden; enige Opmerkingen over het Consumptiegedrag in het Castellum te Valkenburg ZH. In J.H.F. Bloemers (ed.) *Archeologie en Oecologie van Holland tussen Rijn en Vlie*. Studies in Pre- and Protohistory 2. Assen/Maastricht: Van Gorcum: 108–120.
- Vos, W.K. 2002. *De inheems-Romeinse huisplattegronden van De Horden te Wijk bij Duurstede*. Rapportage Archeologische Monumentenzorg 96. Amersfoort: Rijksdienst voor Oudheidkundig Bodemonderzoek.
- Vossen, I. 2007. Landschap, bewoning en landgebruik in de Romeinse tijd rondom Tiel. In N. Roymans, T. Derks and S. Heeren (eds.) *Een Bataafse gemeenschap in de wereld van het Romeinse Rijk. Opgravingen te Tiel–Passewaaij*. Utrecht: Matrijs: 33–44.
- Vossen, I. forthcoming. *Landschap en Bewoning in de civitas Batavorum. Een reconstructie en Interpretatie van het cultuurlandschap in het Nederlandse rivierengebied gedurende de Romeinse tijd*. PhD thesis VU University Amsterdam.
- Wijngaarden-Bakker, L.H. van. 1970. Dierenresten uit het castellum te Zwammerdam. Voorbericht over de opgravingscampagnes 1968 en 1969. *Helinium* 10: 274–278.
- Willems, W.J.H. 1984. Romans and Batavians. A regional study in the Dutch Eastern River Area, II. *Berichten van de Rijksdienst voor het Oudheidkundig Bodemonderzoek* 34: 39–331.
- Zeiler, J.T. 2001. Archeozoölogie. In M.M. Sier and C.W. Koot (eds.) *Kesteren–De Woerd. Bewoningssporen uit de IJzertijd en de Romeinse Tijd*. Rapportage Archeologische Monumentenzorg 82. Amersfoort: Rijksdienst voor Oudheidkundig Bodemonderzoek: 217–293.