An open strip-field system at its tipping point in the German-Dutch river Dinkel catchment

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Abstract

Three questions were addressed. Firstly, where in pre-19th century landscape did farmers hold strips, camps, meadows and shares in commons? Secondly, did farmers each own strips and camps or were some specialised strip and others exclusively camp farmers? Finally, can we corroborate or reject one of the alternative hypotheses: strip-field-first versus camp-first. The area of interest is the current cadastral district cum medieval parish Epe at today's German-Dutch border as pars pro toto for the surrounding area of about 100 kilometer diameter in the NW European cover sand belt. Our key data source was the 1827 A.D. cadastre complemented by the historical topographic map and geological, soil and elevation maps. For population estimates, we used six tax registers from 1499-1750 A.D. All parcels per farmstead were identified in the cadastral registry, farms located on parcel maps and hamlet territories delineated as the aggregate of its farms. The following farm features were extracted from the cadastre and averaged per settlement: number of strips and strip-fields, parcel type, farm size, tenure, number of meadows, oak camps, crop camps and pasture camps. Next, the following landscape features were identified from the map set per settlement: farmstead pattern, type of settlement, commons, strip-field, soil and watercourse. We presented the historical context, followed by a description and discussion of farm and landscape features of settlement categories. Finally, we synthesised our findings and discussion, concluding with a hypothetical narrative consistent with our findings, and provided answers to our research questions.

KEYWORDS

Strip-field, manorial tenure, historical farming systems, spatial analysis, agrarian tenure history, Plaggic Anthrosol, commons, cultural landscape

Introduction

General targets

The 1827 A.D. cadastral map of Gronau, Westphalia (Dickel and Mietzner 1999) displays a variety of hamlet, farmstead and open strip-field patterns. Ground checks in 2016/17 confirm the existence of open linear hamlets open fields, relic strip parcels, anthropogenic plaggic soils and relic wetland commons. The patterns cannot be fully explained by existent literature on open strip-field systems. Therefore, we combined three fresh perspectives to understand the patterns. Firstly, we selected village and hamlet as the central spatial unit of analysis in the nested hierarchy of territorial governance of parish-hamlet-farm-parcel, equivalent in our case with landscape – farmer's community – farm household – parcel. Hierarchy Theory (e.g. Wiens

1989) suggests that different processes and time scales may operate at each hierarchical level. Secondly, we analysed land tenure at its tipping point, just after the Napoleonic abolition of manorial tenure in 1808, and shortly before the implementation of the Prussian partition of the commons. Thirdly, we contextualised the study by the landscape ecology of the northwest European Neolithic agrarian package.

The open strip-field system

Concepts and terminology in English, German, Dutch and Low Saxon have been provided in a glossary (Supplemental online material S1). We adopted 'open fields' as used by Slicher van Bath (1976, pp. 63-5) in his overview of agrarian medieval Western Europe, including England as well as our narrow and wider area of interest (hereafter AOI; Fig.1); open fields are defined by three spatial features: openness, strip parcellation and off-strip farmsteads. To distinguish our research object from various strip-field and open field systems, we inserted -strip- into the label. The open strip-field system was historically practiced throughout southwest Eurasia (Slicher van Bath 1976, pp. 63-4). Its European distribution ranged from the Balkan, Iberian and Apennine peninsulas to Scotland, England, southern Sweden, Denmark and eastward over Poland/Slovakia to the Urals. Apparently, strip systems occurred at flat terrain within the broadleaf deciduous forest biome under rainfed farming conditions (Hempel 1957; Dahlman 1980, p. 36; Vasudevan 1988; Inalcik and Quataert 1994, pp. 156-158; Spek 2006, p. 223; Manzi 2008, 2013/pp. 10-11, 2016/pp. 51-2, p. 64; Rennes 2010; Guzowski 2015, p. 71; Krnáčová *et al.* 2016, p. 49; Renes 2016). It was absent from the evergreen-mediterranean and boreal-coniferous biomes. Its history covers at least one and a half millennium including the early medieval to early modern periods (Stroink 1962, pp. 85-7; Hoskins 1985, pp. 185-9; Hooke 2010; Renes 2010, 2016). The first comprehensive, cartographic evidence of parcellation of open strip-field hamlets appears in the early modern period (e.g. Ellenberg 1963, p. 56; Spek 2004, p. 29; Kaune 2016). In England, the strip system was found to be spatially correlated with (Hoskins 1985, p. 45; Hall 2014, pp. 134-74), but not necessarily founded (Hooke 1981, p. 62) during early medieval Anglo-Saxon settlement. During antiquity in Italy, strip-fields may have been preceded by and co-existed with latifundia (Rackham 1980, p. 131; Hoskins 1985, p. 45; Campbell 1996; Manzi 2013, pp. 51-2). In northwest Europe, strip-fields were preceded by celtic fields (Hoskins 1985, p. 54; Verlinde 2004; Spek 2004, p.151; Groenewoudt *et al.* 2008). The small square celtic fields were ploughed by ard, the long strips by mouldboard plough (Nightingale 1953; Bloch 1966, pp. 48-56; Hoskins 1985, p. 83; Spek 2004, p. 469; Oosthuizen 2006, p. 14; Arnoldussen and Scheele 2014; Nielsen and Dalsgaard

2017). In northwest continental Europe, sod technology was practiced across historical field systems: celtic fields, strip and camp (Bergmann 2006; Giani *et al.* 2014; Groenman-van Waateringe and Geel 2017; Nielsen and Dalsgaard 2017). Cumulative use of sod fertilization over several centuries has resulted in Plaggic Anthrosol in Northwest Europe, with an increased utilization of sod technology since the early medieval period (Blume and Leinweber 2004). At the latest by the end of the medieval period open strip-fields in the wider AOI were associated with Plaggic Anthrosol and known as essen/Esche (Slicher van Bath 1976, pp. 63-4; Spek 2006). In the European lowlands, the open strip-field is historical, however it continues across the Alps and central Apennines in sites with flat terrain (Manzi 2008, 2013/pp. 10-11/, 2016/pp. 51-52, p. 64; Gils *et al.* 2014). In southwest Asia, the strip system occurred up to Iran and Pakistan (e.g. Planhol 1968, p. 431; Hütteroth 1974; Beaumont *et al.* 1976, p. 145; Keddie 1980, p. 186; Heller and Hanewinkel 1990; Inalcik and Quataert 1994, pp. 156-8).

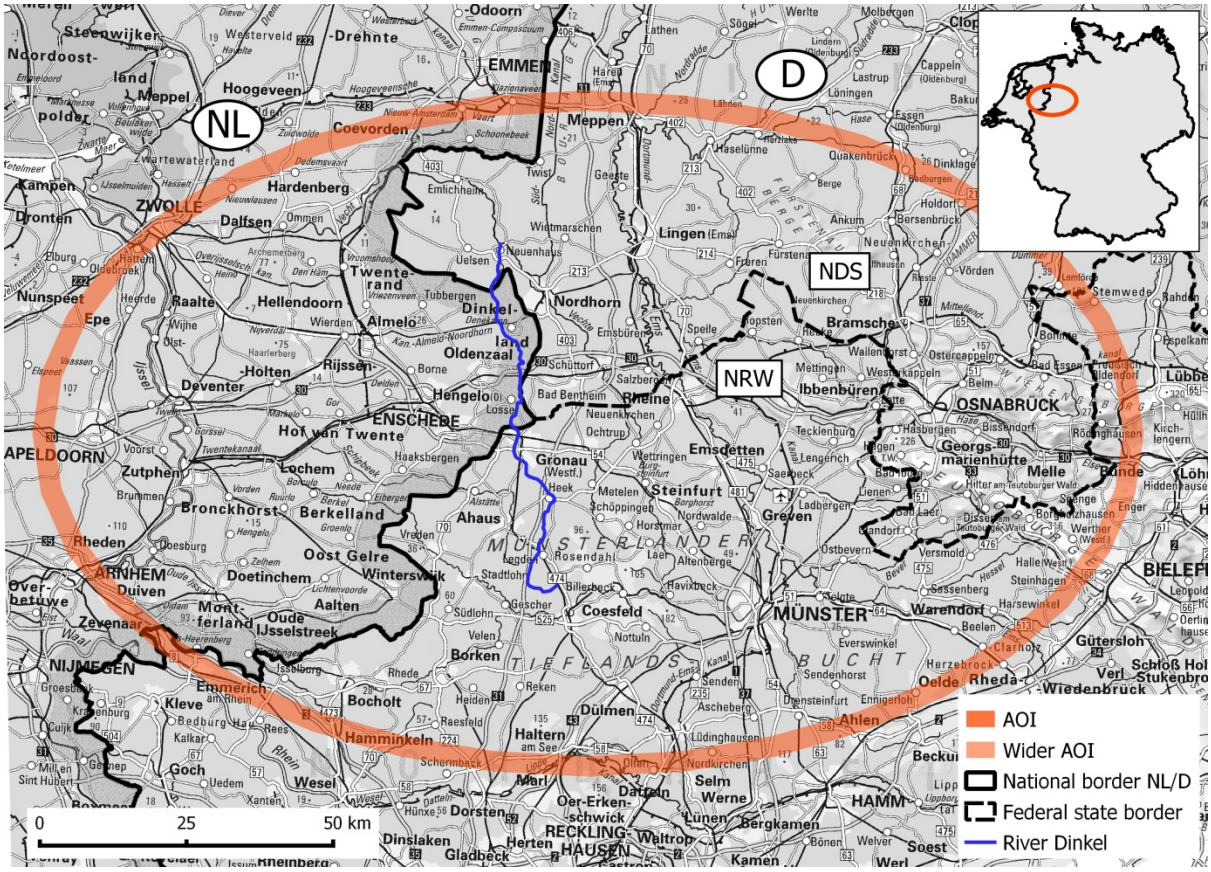

Fig. 1. Area of Interest (AOI) and wider AOI. NDS: Federal state Lower Saxony (Niedersachsen), NRW: federal state North Rhine-Westphalia (Nordrhein-Westfalen). Basic geodata: © GeoBasis-DE / BKG 2018.

The open strip-field system (hereafter strip system) contains villages and hamlets, farmsteads, open strip-fields and commons. The strip system was agro-sylvo-pastoral (Gils *et al.* 2015). Each strip parcel was cultivated by a household during the crop season. The strip system was a family farming system, in contrast to latifundia, self-provisioning monasteries, kolkhozes and corporate farming. The strip-field is laid out as a nested hierarchy of long strips known as furrow long or furlong (200 by 5-20 meters), often in blocks at right angles (e.g. Slicher van Bath 1976, pp. 64-5; Ellenberg 1978, p. 56; Spek 2006, pp. 668-74; Strotdrees 2017, p. 29). 'Open' refers to parcel boundaries without barriers such as hedge, wooded bank, drystone wall, ditch or barbed-wire fence, and the absence of farmsteads and trees. However, the entire open strip-field was enclosed on its perimeter (Historische Atlas Overijssel; Strotdees 2017, p. 17) in the wider AOI, but elsewhere occurred also with an open perimeter (Hütteroth 1974; Manzi 2008, p.11). The 'open' implies a cultivated area several times the size of the cropland of a single farm. Openness and strip parcellation enabled mouldboard ploughing with ox and horse span (Bloch 1966, pp. 48-56; Hoskins 1985, p. 83). Beyond ploughing, strip parcellation was a method used by small groups of settlers to subdivide and distribute open, unploughed land for cultivation (Hütteroth 1974; Kreyenschulte and Spannhoff 2017). Further, aggregation of strip parcels serves economies of scale in drainage (Matzat 1988; Heller and Hanewinkel 1990; Oosthuizen 2006, p. 14), road infrastructure, sharing ox, horse and plough between households, herding livestock on stubble and fallow as well as in perimeter enclosure (Sieverding 1986; Heller and Hanewinkel 1990). Similarly, the common allows for economies of scale in herding, but implies higher transaction and transport costs. In addition, dispersed strip ownership within the field and undivided commons spread the risks of local crop or forage failure due to drought, flood, fire or other hazards and the advantages of better sites among shareholders (Vries 1976, p. 43; Mc Closkey 1989; Winterhalder 1990).

The commons component of the strip system was the unploughed land covered by wood, scrub, heath, grass, peat, bare ground or combinations thereof (Renes 2010; Gils *et al.* 2015). Beyond pasture, use rights in the common may have included pannage (oak/beechnut mast for hogs; e.g. Cate 1972, p. 190; Pott and Hüppe 1991; Gils *et al.* 2008), estover (fuelwood), turbary (turf), plaggen (sod cutting), quarrying, logging, hunting and other (e.g. beekeeping, fishing, bird trapping). Use rights may have been transferable (e.g. Löw 1829; Cate 1972, p. 122; Gils *et al.* 2014; Dertwinkel 2015, p. 65).

Although the system may have provided autarky, associated cottage industries traded in cheese (Pöll 2015), textile (Slicher van Bath 1976, pp. 96-7; Pöll 2015), cured pork meats (Cate 1972,

p. 196), grain (Müller-Wille 1952) and turf (Dertwinkel 2015). Linen export was facilitated in the wider AOI by the Hanseatic League from the mid twelfth century. Prior to utilising mineral (P/K/Ca) plus synthetic (N) fertiliser in the twentieth century, organic fertiliser was essential for replenishment of soil nutrients depleted by harvesting, ploughing, burning and grazing (Esselink and Gils 1994). Replenishment was achieved by stubble grazing, pasture/crop rotations, manure, leaves, litter, sods and combinations thereof (Dickel and Mietzner 1999; Kokhuis 2000, p. 104; Spek 2006). Manured sod fertilisation was practiced in the wider AOI, improving drainage by raising parcels to about a meter above the pre-cultivation surface (Giani *et al.* 2014).

The farmstead owner was a shareholder in a closed agrarian corporation. A share consisted of a bundle of use rights to the common pro rata parte to the arable holding (Grimm 1854, pp. 494-531; Dahlman 1980; Oosthuizen 2011; Gils *et al.* 2014; Head-König 2015). Rights and duties of shareholders were stipulated in written regulations from high medieval times (Löw 1829, pp. 13-8; Grimm 1854, pp. 494-531; Ault 1972; Kokhuis 2000, p. 30; Brakensiek 2002; Mölder 2009; Gils *et al.* 2014; Dertwinkel 2015). Duties may have included livestock branding (Cate 1972, pp. 120-122; Dertwinkel 2014) and synchronised strip-field cultivation (Slicher van Bath 1976, p.70). The magistrate in the commons held executive and judicial powers. The position was held either by the territorial lord, his appointee, a manorial landlord or an elected representative of the shareholders depending on regional regulations and the historic period. Often the magistrate position was hereditary (Klöntrup 1799, pp. 184-8; Löw 1829, pp. 126-43; Agterbosch *et al.* 1998; Brakensiek 2002; Dertwinkel 1915). The shareholders met annually. Decisions were taken by simple or two-third (Middendorff 1927; Dertwinkel 2015) majority vote, weighted by the size of the share as in today's commons (Gils *et al.* 2014) and shareholding companies.

The open strip-field vs. the enclosed-field system

The antonym of the open strip-field system is the enclosed-field system. The individual parcel (enclosure) is known in the wider AOI as '*Kamp*' (plural '*Kämpe*'). '*Kamp*' is the most frequent toponym in the AOI, widespread in the wider AOI and recorded in Westphalia from the early medieval era onward (Slicher van Bath 1944; Dickel and Mietzner 1999; Spek 2004, p. 661; Strotdees 2017, p. 23). The parcel (hereafter camp) may have been enfolded at a strip-field, common or terra nullius (Hoskins 1985). Settlers from the wider AOI (e.g. Herzog 1938, pp. 125-7) carried this term to South Africa were '*camp*' remains in use to describe a fenced portion of the veld for grazing ('*veld camp*') or cropping (e.g. Branford 1987, p. 61). A camp

may an asymmetric polygon that organically follows the topography or squarish in homogenous terrain. Each camp, whether ploughed, grazed or forested may be enfolded against the trespass of people, livestock and wildlife. However, pre-historical and historical enfolding was rarely comprehensively identified. A toponym that may assist in identification and dating of ancestral (600 A.D.) farmsteads is '*Woorte*' (Old English: '*worth*') (Dickel and Mietzner 2002, p. XXVII; Althuis 1967 as cited by Spek 2004, p. 614; Strotdees 2017, p. 15). The farm in the camp system consists of a farmstead with contiguous camps (house camps hereafter), a share in the common, and locally, hay-meadows.

Strip and camp systems occurred contemporaneously and in close proximity from at least the early medieval era (e.g. Hambloch 1960; Krenzlin and Reusch 1961; Uhlig 1961; Albers 1966, p. 144; Slicher van Bath 1972; Hütteroth 1974, p. 39; Hoskins 1985; Riepenhausen and Schüttler 1986, pp. 3-9; Kreyenschulte and Spannhoff 2017). Regions of predominantly strip-fields (e.g. Hoskins 1985; Spek 2006) or camps (Hoskins 1985) are reported. Both may persist within the same municipality today (e.g. Manzi 2008, 2013/pp. 10-11, pp. 51-2). However, tenure patterns of strip versus camp systems have not been studied to the best of our knowledge. Alternative theories on the historical sequence of strip and camp within the same area have been proposed. The strip-field-first theory of the wider AOI is known as '*Eschkern*' (strip-field core or nucleus)/'*Uresch*' (archetypical strip-field) theory (Niemeier 1944; Hersping 1963, p. 78; Thirsk 1964; Riepenhausen and Schüttler 1986, p. 64-5; Boer *et al.* 1992, p. 175; Dickel and Mietzner 1999; Bergmann 2006; Dertwinkel 2015). The camps-first theory refers to the wider AOI (Kreyenschulte and Spannhoff 2017) and further to continental Western Europe (Slicher van Bath 1944; Hambloch 1960; Thirsk 1964). In Anglo-Saxon England, the choice of strip or camp depended on historic-geographical conditions (Hoskins 1985, pp. 54-5) as it did in southwest Asia (Hütteroth 1974, p. 44).

From the high medieval era onward, European strip and camp systems have been enfolded bottom-up through consensus among shareholders or agreement between the agrarian corporation and the landlord. For clarity sake we avoid the use of '*enclosure*' for camps only, because it may have referred to three elements in isolation or combination, namely consolidation of scattered and/or small fields (camp and/or strip) and re-distribution among owners, partition of commons among shareholders, and sale or expropriation of communal land. Consensual partition was recorded since the high medieval era in portions of England, lower Austria and the Low Countries (Slicher van Bath 1963; Postan 1972, p. 53; Mc Closkey 1989; Brakensiek 2004). Comprehensive partition was initiated or enforced from the mid-

eighteenth century onwards in England, the Low Countries, parts of Prussia and the continental Guelph territories (Middendorff 1927; Riepenhausen and Schüttler 1986, p. 113; Overton 1996, pp. 133-92; Brakensiek 1992/2004; Mölder 2016). Expropriation of commons occurred, among others, in the southern Netherlands under the 1648 A.D. Treaty of Westphalia; in 1855 A.D. Spain; in Leninist Russia in the early twentieth century; in South Tyrol post WWI, and in communist-ruled territories post WWII. In the latter two areas, restitution of commons was a component of restored autonomy (Pechlaner 2015; Premrl *et al.* 2015).

Strip and camp systems share the Neolithic agro-pastoral species package of small-grain as staple crop; pulses for proteins; flax for fibre and linseed oil; cattle for draught, dairy, hides, meat and saving bank; sheep for meat and wool; goat for milk and meat, and hogs for meat. These species were domesticated broadly ten millennia ago at the hill flanks in southwest Asia's Neolithic Arc. The horse was included in the wider AOI since the roman imperial period (Finke 1990, Wilming 1998, Grünewald 2005) and the potato since the mid-eighteenth century. The Neolithic agro-technology included torch, dog, yoke, ard plough, cart, axe, sickle, spindle and mortar; the mouldboard plough since the Iron Age (Verlinde 2004, Thomas *et al.* 2016) and the watermill from antiquity onward. Whether tenure or parcel systems migrated with this Neolithic agrarian package or was re-invented in manifold locations seems to have not been investigated.

Strip system studies are frequently concerned with a single system component. For example, Allan (2004) provides an analysis of the crop component, while Hardin (1968) and Gils *et al.* (2014) consider only the pastoral common. Compartmentalisation by language and modern nation state is a further feature of such studies. Moreover, comparatively few strip system studies have been published in international, peer-reviewed journals (Renes 2010). An extensive grey literature remains buried in publications of local social history societies, conference proceedings and inaccessible monographs. Further, strip system research is often based on surviving sales contracts or registries of feudal estates unlikely to represent an unbiased sample. For example, registries of literate monasteries may be over represented (Ault 1972). Consequently, shape, pattern, location and ownership are not provided for all parcels. Therefore, our set of scale-compatible maps (section Materials) offers an opportunity for a fresh and comprehensive spatial perspective on the open strip-field system.

Concrete research questions

The broad question that we address through this analysis of spatial data is how hamlet, farmer, open strip-fields, camps and common were linked in space, time and tenure. Our spatial unit

of analysis was the hamlet, the lowest territorial governance unit of use rights and duties in the strip system. Three questions are addressed. Firstly, how and where did the farmers settle? Where did the farmers hold strips, camps, meadows and shares in the common? Secondly, did farmers each own both strips and camps or were some specialised strip and others exclusively camp farmers? Finally, can we corroborate or reject one of the alternative hypotheses: strip-field-first vs. camp-first. These questions have not been answered comprehensively for the wider AOI at the early nineteenth century tipping point of manorial to modern land tenure to the best of our knowledge.

Materials and Methods

Geographical setting

The AOI is the current cadastral district Epe, the southern portion (fifty kilometers square) of Gronau municipality (eighty kilometers square) in Nord-Rhine Westphalia, Germany. The wider AOI consists of the Sandmünsterland, Grafschaft Bentheim, Tecklenburg, southern Emsland and Osnabrück regions in contemporary Germany and the Achterhoek, Twente and Veluwezoom regions in today's Netherlands (Fig. 1). Until the eighteenth century, the wider AOI was a distinct economic, religious, cultural, linguistic and architectural region (Kremer 1979, pp. 37-76).

The AIO is located in a fluvio-glacial plain at about forty-meter a.s.l. (Burrichter 1970); the wider AOI in the northwestern portion of the European peri-glacial aeolian cover sand belt. The mean annual precipitation is about 800 millimeters and the mean annual temperature 9.5 °C (LANUV NRW 2010). The length of the thermal growing season allows single cereal cropping and deciduous broadleaf forest trees only. Poorly drained sandy soils dominate in the AOI. Well-drained levees run parallel to most of the river Dinkel (Fig. 2) and some tributary rivulets, but with a gap west of the river opposite Epe village. A second well-drained enclave is a low hill (fifty-seven meters a.s.l.) underlain by cretaceous deposits (Geologisches Landesamt NRW 1993). Numerous erratic boulders indicate glacial till. Impediment of rainwater infiltration by the till results in wetland (moor; bog) unsuitable for crops, hardwood trees, sheep and cavalry. The parish perimeter in 1800 A.D. is associated with peat-moss bog. The historically meandering Dinkel drains into the Atlantic through the Rhine system. The catchment upstream from Epe is about 250 kilometers square. The floodplain is 150-400 meters wide, the streambed ten to twenty meters wide and up to two meters deep. The flow (average 0.3 cubic meters per second) depends on precipitation in the small catchment and is therefore highly variable (LUA 2001, p. 83-7).

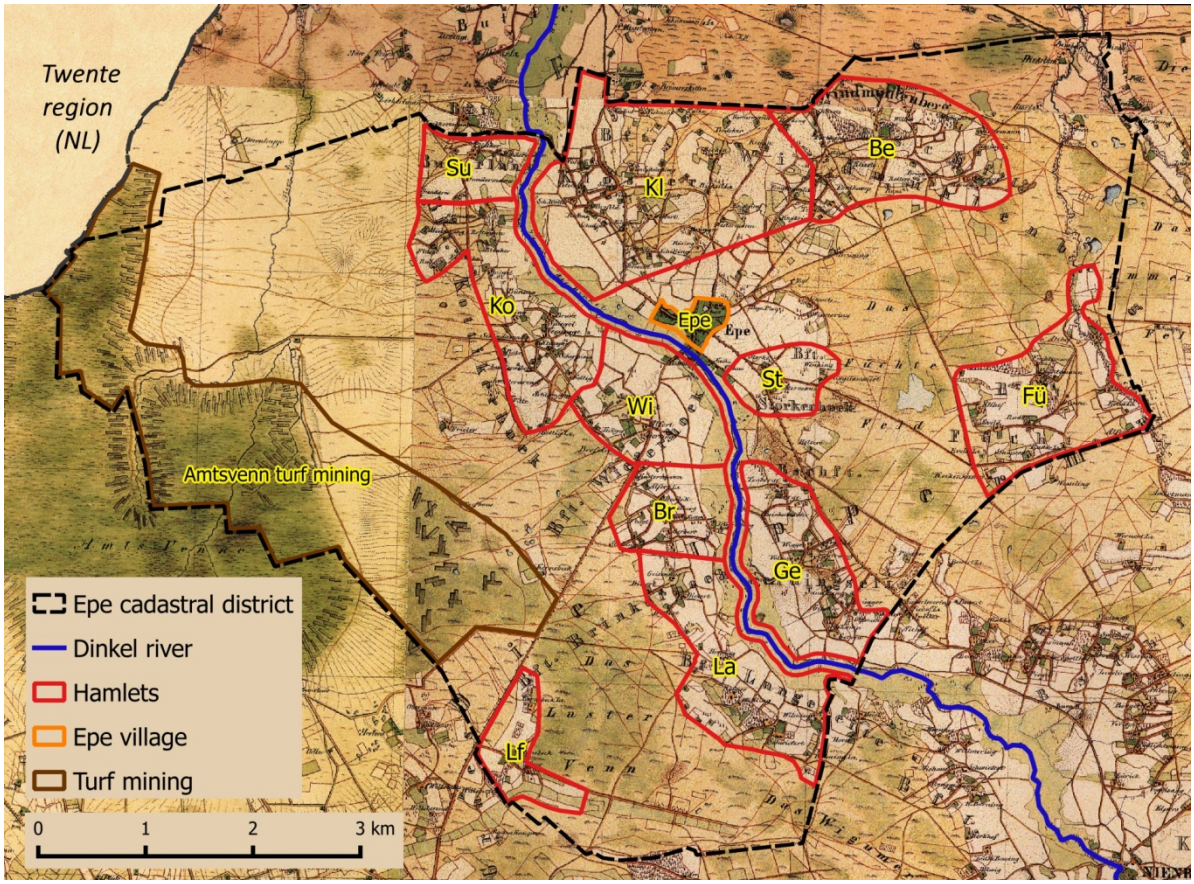

Fig. 2. Location map of Epe village (built-up area), hamlets (ploughed land), river Dinkel and opencast turf mining in the wetland matrix of the AOI; drawn over the topographic map of 1836/50. Basic geodata: © LAND NRW (2018) – Licence dl-de/by-2-0 (www.govdata.de/dl-de/by-2-0).

Hamlet abbreviations: Be = Am Berge; Br = Brinkerhook; F = Füchte; G = Gerdingseite; Kl = Kloster (including Riekenhof); Ko = Kottigerhook; La = Langeseite; Lf = Lasterfeld; St = Storkerhook; Su = Sunderhook; Wi = Wieferthook.

Data sources

The 1827 A.D. cadastral parcel map and linked registry (Dickel and Mietzner 1999) was our key data source. The scale of the map sheets ranged from 1:1250 for strip-fields to 1:10.000 for commons. For each parcel, the registry provided the owner, Land Use/Cover (LUC) and micro-toponym in Low Saxon. These toponyms were also used in referenced literature. Low Saxon is spoken in the north-west of today's Germany and the contiguous eastern Netherlands north of the Rhine. In this context, we provide synonyms for Low Saxon terminology in English, Dutch and German in a glossary (Supplemental online material S1). Parcel owners were natural persons or, occasionally juridical persons. The listed natural person was the male head of the household, widow or unnamed beneficiary.

Further, we used the first Prussian topographic map (1836-50 A.D.) at scale 1:25.000 (NRW-Atlas), the geological map 1:100.000 (Geologisches Landesamt NRW 1993), the soil map 1:50.000 (Geologisches Landesamt NRW, 1974) and the elevation map with one-meter classes and slope steepness in three classes (NRW-Atlas). The German soil types were cross-referenced with the World Reference Base for Soil Resources (Schad 2009; FAO 2014,). For comparison with the wider AOI to the west, the following maps were used: Boerderijkaart [Farmstead map] 1500, HISGIS and the Historical Atlas of Overijssel 1:25.000 (1990). For population estimates over the three centuries before 1827 A.D. we used tax registers of 1499, 1534, 1679, 1693, 1710 and 1750 A.D. (Wilming 1993; Kemper 1998; Naber *et al.* 1998). Since then, modern census data are available.

Data analysis

Our analysis was informed by the alternative hypotheses of strip-field-first or camp-first at three hierarchical scales, parish (AOI), hamlet and farm. The parish boundary was available in the cadastral map and as overlay of the first topographic map (NRW-Atlas). The boundary of the built-up area of the compact Epe village was explicit on both the cadastral ('*Dorf*') and contemporaneous topographic map. The boundaries of the hamlet territories were deducted from the cadastral and topographic maps ('*Bauerschaft*'). Both maps depict the boundaries between farmland and common as well as the farmstead locations. The farmstead names per hamlet were obtained from Kemper (1990). Subsequently, all parcels per farmstead owner (farm hereafter) were identified in the registry. Then, the farms were located on the parcel map and each hamlet territory established as the aggregate of its farms. Two hamlets were spatially subdivided by apparent contrasting farmstead patterns in sub-hamlets. Consequently, we obtained sixteen primary tables (not included), namely, Epe village, twelve hamlets and two sub-hamlets, and a dispersed settlement. Next, Land Use/Cover (LUC) of all parcels per village and hamlet farm was identified in the cadastre and entered into the primary tables. The pertinent LUCs (Dickel and Mietzner 1999, pp. 2-3) were ploughed parcel ('*Acker*'), vegetable garden, homestead garden or orchard ('*Gemüsegarten*' or '*Obstgarten*'), wood/forested/oak camp ('-*holz*'), hay-meadow ('*Wiese*'), pasture/grazed ('*Weide*'), turf ('*Torf*'), heathland ('*Heide*') and leased-for-life farmstead ('*Lieftucht*'; '*Leibzucht*'). A farm containing one or more leaseholdings was referred to as estate ('*Gut*'). Beyond the LUCs, ploughed parcels were identified on the parcel map as long strip (150-300 meters), short strip (50-150 meters) or camp.

Farm features were extracted from the primary village and hamlets tables and entered into the first synoptic table with village and hamlets in the rows and features in the columns (Table 1).

TABLE 1. FARM FEATURES PER VILLAGE AND HAMLET; strips (*long/short/none*); number of strips, number of strips fields; type (*strip/camp*); size (*large/medium/small*); tenure (*freehold/leasehold*); number of meadows, oak camps, crop camps and pasture camps.

SETTLEMENT		**STRIP**		**STRIP FARM**			**CAMP FARM**			**TENURE**		**MEADOW**	**CAMP**			
NAME	LENGTH*	NUMBER		Number owned						Free	Lease		Oak	Crop	Pasture	C+P
		Parcel**	Field***	Large	Medium	Small	Large	Medium	Small	Mean number per farm						
Epe village	Long/Short	6	2/2	10	36	110				156	24	0.2		0.5		
Langeseite	Long	5.3	1	4	4				1	9	8	3	1	4	1	5
Wieferthook	Long	6	1	2	4	1				7	2	0.3	0.3	2	1.3	3.3
Brinkerhook	Long	1	2			3			2	5				2	0.8	2.8
__sub-hamlet	Long	7.7	1	4	1					5	8	2	1	2	1.4	3.4
Gerdingseite	Long	5.5	1	6	1					7	1	3.2	1	4.4	4	8.6
__sub-hamlet							1	3	5	9		1.3	0.7	4.3	2.1	6.1
Kloster	Long//Short	3//5	2	7	2	4		1	13	29	5	1	0.1	1.7	1	2.7
Storkerhook	Long/Short	14	1	1				2		3		2	0.7	6	2	8
Riekenhof	Short	2	1		1		1		1	3	1	0.7	0.3	5	2	7
Kottigerhook	Short/Long	6	1	1			6	6	9	22	8	1.4	0.3	3	1.2	4.2
Sunderhook							2		2	4	7	2	0.7	2.3	1.5	3.8
Am Berge							3	6	11	20	7	0.5	0.7	2.3	1	3.3
Füchte							2	4	5	11	4	0.6	2	3	2.2	5.2
Lasterfeld							1	1		2	2	0.5	3	3	3.3	6.3
Amtsvenn								1	3	4		0.7	0.5	2	0.7	2.7

* / Long and Short per farm; // Long or Short per farm

** Mean per strip farm

*** Village: 2 Long/2 Short

no value

TABLE 2. LANDSCAPE FEATURES PER VILLAGE AND HAMLET: farmstead pattern (*nucleated/linear/cluster/dispersed/village fringe*), settlement type (*strip/camp*), common (*single/multi-hamlet*), strip-field(s) (*long/short strips*), river/rivulet occurrence, soil types of strips and soil types of camps.

SETTLEMENT *BAUERSCHAFT*		**TYPE**	**COMMON** *GEMEINHEIT*		**STRIP FIELD** *ESCH**		**RIVER; RIVULET****	**SOIL** TYPE *BODEN****	
Name	Pattern	Type	Single hamlet	Multi-	Long strip	Short		Strip	Camp
Epe village	nucleated	Strip	Mersch/Bülten		NW; Esteresch; Lange Esch	N/E	Dinkel	Plaggic	
Langeseite	linear	Strip		Laster Venn	Lange Esch/Lange Acker		Dinkel Rottbach	Plaggic	Plaggic/Gleyic Podzol
Wieferthook	linear	Strip		Amtsvenne	Lange/Kottige Esch		Dinkel/Rottbach	Plaggic	Gleyic Meadow
Brinkerhook	cluster	Camp		Laster Venn			Rottbach		Plaggic/Gleyic Podzol
_sub-hamlet	linear	Strip		Laster Venn	Lange Esch/in Esch		Dinkel	Plaggic	Plaggic/Gleyic Podzol
Gerdingseite	linear	Strip	Feld	Füchterveld	Im Esch		Dinkel	Plaggic	Plaggic/Gleyic Cambisol
_sub-hamlet	cluster	Camp	Paask Büül	Füchterveld			Dinkel		Plaggic/Gleyic Podzol
Kloster	fringe/linear	Camp/Strip	Feld/Gemeinheit	Venne	NW	N/E	Esch-/Bosingbach/Dinkel	Plaggic	Plaggic/Gleyic Podzol
Storkerhook	village fringe	Camp/Strip		Füchterveld	Esteresch	E	*none*/Dinkel	Plaggic	Gleyic Podzol/Fluvisol/Gleyic Cambisol
Riekenhof	village fringe	Camp/Strip	Feld	Venne		E	*none*/Dinkel	Plaggic	Plaggic/Gleyic Podzol
Kottigerhook	linear/cluster	Camp	Feld	Amtsvenne			Dinkel/Rott-/Schwarzbach		Plaggic/Gleyic Fluvisol
Sunderhook	cluster	Camp	Feld	Amtsvenne			Schwarzbach		Plaggic/Gleyic Podzol/Gleyic Fluvisol
Am Berge	cluster	Camp	't Feld	Füchterveld					Plaggic/Stagnosol/Cambisol/Gleyic Podzol
Füchte	linear/cluster	Camp	Feld/Mühlenriete	Füchterveld			Goorbach		Plaggic/Gleyic Podzol/Gleyic Cambisol
Lasterfeld	linear	Camp		Laster Venn			Bröckbach		Plaggic/Gleyic Podzol
Amtsvenn	dispersed	Camp		Frielers Venn			Flörbach		Cambisol/Gleyic Podzol/Fluvisol

absence

* NW= long strip: *Wöhninger Esch, in (de) Esch, Dakelsberg, Hoge Kamp, Brookacker, lange Stück, Bree(de), Ameland*

N = short strip: *Rieken, Engbringkamp, Mertenskamp, Brinkerei*

E=short strip: *Busgarten,Blickesch*

Lange Esch=long strip: *Lange Acker, in Esch, Kottige/Kottker Esch*

** / as in third column (Settlement Type)

*** Plaggic= Plaggic Anthrosol (TABLE 6*)*

The following categorical features were entered: strips (long/short/none), number of strips, number of strip-fields, type (strip/camp), size (large/medium/small), tenure (freehold/leasehold), number of meadows, oak camps, crop camps and pasture camps. The farm size classes were defined by the number of parcels: more than fifteen (large), between seven and fifteen (medium) and less than seven (small).

Next, the farmstead pattern of the settlements (nucleated, linear, cluster, dispersed, village fringe) was classified, based on the parcel map. Further, the landscape was subdivided in five categories (river floodplain, river levee, rivulet levee, hill and the remaining hinterland commons), based on the topographic, geologic and elevation/slope maps. Next, the associated commons of village and hamlets were extracted from the registry (single versus multi-hamlet). Subsequently, the village and each hamlet were visually matched with the landscape categories and soil types. The findings were entered in the second synoptic (Table 2) using the same sequence of settlements in the rows as in Table 1.

The demography was analysed to assess whether it could be a driver or result of the spatiotemporal pattern of strip- versus camp-first. The tax registers used for population estimates contained a variety of tax agencies (parish; church; manorial landlord), taxable units (farmstead; natural person per tenure class; natural person; household) and unequal census districts (parish; village; multi-hamlet commons). Customs in naming and spelling of family and farmstead varied between registers and over centuries. Consequently, the tax registers required interpretation for data extraction. We took into account that landholdings were attached to farmsteads and farmsteads were named after surnames, first names and/or position of the owner-occupier as well as vice versa (e.g. Kokhuis 2000, p. 17). A local conversion factor from household to person was provided by the 1750 A.D. census (Kemper 1998) and used for other registers. Contemporaneous population estimates and household to person conversion factors from the wider AOI were used for cross-reference (Slicher van Bath 1975; Könenkamp 1989; Lensing and Robben 2015).

We contextualised our findings within an historical time scale starting with the arrival of sedentary farming in the AOI at about three thousand years B.C., over the Iron Age, the Migration period, the Early Medieval and High Medieval and the early modern periods. For some aspects, we referred to the present situation. An overview of historical periods for the wider AOI is provided in Table 3.

TABLE 3. TIMETABLE OF HISTORICAL FEATURES OF THE WIDER AREA OF INTEREST (AOI).

HISTORICAL PERIOD		**FEATURE** wider AOI	**REFERENCE**
3000 B.C	Neolithic	Graves; long house	Finke 1990
		Forested landscape/island settlements	Groenewoudt *et al*. 2007
800 B.C.	Iron Age	Checkerboard celtic fields	Goossens 2009; Arnold 2017
		Ard & mouldboard plough Dinkel	Verlinde 2004
		Sod technology	Groenman-van Waateringe & Geel 2017
		Horse	Finke 1990
		Deforested well-drained land	Burrichter 1970; Groenewoudt *et al*. 2007
1 A.D.	Roman Imperial	Germania magna	
		Traded Roman artefacts	Boosen 1980; Finke 1990
		Hamlets at sites of medieval strip	Scholte Lubberink 2008, in Goossens 2009
		Hamlets	Verlinde 2004
400 A.D	Migration	Saxons	
.		Anglo-Saxon settlement of England	Boosen 1980; Winkelmann 1980; Hoskins 1985
600 A.D.	Early medieval	Worth	Althaus 1957; Dickel and Mietzner 2002
		Hamlets	Grünewald 2005; Dertwinkel 2015, p. 8
		Duke of Saxony	
		Open strip-fields	Hoskins 1985, p. 45; Strotdees 2017, p. 19
		Marken territories (commons)	Koenig 1938; Stroink 1962, pp. 85-7
		Kamp (camp)	Slicher van Bath 1944; Strotdees 2017, p. 23
1100 A.D.	High medieval	Prince-Bishoprics	
		Münster/Utrecht/Osnabrück	
		Hanseatic League	
		Church building Epe 1188 A.D.	
		Manor house Epe 1325 A.D.	
		Manor house Gronau 1371 A.D.	
		Marken institutions recorded	Olde Meierink 1980, p. 19
		Feudal tenure	
		Headman farmsteads	Olde Meierink 1980, p. 19; Naber *et al*. 1998
		Strip & enclave hamlets	Kemper 1998; Naber *et al*. 1998
		Plague around 1350 and 1427 A.D.	Kokhuis 2000, p. 46 and p. 61
1500 A.D.	Early Modern	Feudal tax registers (6)	Wilming 1993; Kemper 1998; Naber *et al*. 1998
		Hanseatic League	
		Eighty/Thirty Years' Wars	Kröll 2010
		Münster-Dutch Wars	Kröll 2010
		Recurrent plague till 1670 A.D.	Fischer 2012
		Thirty village households 1499 A.D.	This article
1700 A.D.		Village immigrant population boom	This article
		Linen village cottage industry	This article
		Hollandgänger	Lensing and Robben 2015; this article
		Floodplain camp hamlets	This article
		Dispersed bog farms	This article
1800 A.D:	Modern	Napoleon/Prussia	This article
		Abolishment of feudal tenure	
		Parcel cadastre and registry	
		Partition of commons	
1945 A.D.	Post-WW II	Consolidation of strips	This article

Our findings were tested by cases from the wider AOI. Grey literature was accessed at the Landeskundliches Institut Westmünsterland, Vreden (regional history and geography), the municipality of Gronau and the Heimatverein Epe e.V. (village social-history association). Subsequently, the interpretation of the literature findings was discussed with experts at these repositories.

Presentation of the findings

We started with a historical description of the research area followed by a description and discussion of the single village and each of the hamlets categories based on the two synoptic tables. Next, we synthesised our findings and discussion, concluded with a hypothetical narrative consistent with our findings, and provided an answer to our research question, strip-field-first or camps-first.

Results

Historical framework

Within a radius of twenty kilometers from the AOI, palynological (Burrichter 1970) and archaeological evidence of mixed farming dates back to the Neolithic Funnelbeaker culture (ca. 3000 B.C.) indicated by graves and a long house (Finke 1980), celtic fields (Goossens 2009, p. 9; Arnold 2017) and late Iron Age farming with ard and mouldboard plough (Verlinde 2004). The open strip-field is first recorded in the wider AOI in the early medieval period (Strotdees 2017, p. 19). From the same period and area, several hamlets composed of a few farmsteads are known from excavations (Grünewald 2005; Dertwinkel 2015, p. 8). The pioneer farmers opened up the beech and oak woods for cultivation with axe and torch, starting on well-drained land including levees (Hesmer and Schroeder 1963; Burrichter 1970; Pott and Hüppe 1991; Groenewoudt *et al.* 2007). Agriculturally unsuitable land such as wet oak-birch and alder woodlands were gradually converted into heathland, a mosaic of evergreen dwarf-shrub (*Erica tetralix*; *Calluna vulgaris*), grass, wood and wetland by deforestation, followed by soil nutrient depletion due to cropping, grazing, burning and sod extraction (Burrichter 1970; Esselink and Gils 1994; Leuschner and Ellenberg 2017, pp. 40-52). By the eighteenth century, the wider AOI was largely deforested and partly depleted. Consequently, farmers and villagers in the AOI must have depended on oak camps for timber and mast (Hesmer and Schroeder 1963; Cate 1972) and on turf for fuel (Dertwinkel 2014). The main branches of livestock production in the wider AOI were hog husbandry, based on oak acorns and beechnuts (Cate 1972, p. 190, Dertwinkel 2014), and cattle husbandry (Middendorf 1927). Sheep husbandry was minor (Cate 1972; Slicher van Bath 1975; Brakensiek 1991; Wilming 1993); consequently, wool weavers were rare in 1750 A.D. compared with linen weavers (Naber *et al.* 1998). The prominence of hogs in the AOI was reflected in the equivalent number (120 respectively 128) of parcel toponyms for hogs versus cattle pastures (Dickel and Mietzner 2002). In addition, horse pasture toponyms occurred nineteen times. However, no toponym referred to sheep.

During antiquity, the wider AOI was part of Germania magna, but a range of Roman artefacts indicated contact with the Empire (Boosen 1980; Finke 1990). The locations of hamlets in the Roman Period often correspond with those of medieval hamlets associated with open-fields in the wider AOI (Groenewoudt *et al.* 2007, p. 18; Scholte Lubberink 2008 as cited by Goossens 2009, p. 25). During the post-Roman Migration Period, Saxons emigrated from the north of the wider AOI (Behre 2002) to England. In the Migration Period, pollen counts of cereals and other indicator plants of farming declined sharply at several sites in the wider AOI, but did not disappear completely (Burrichter 1976; Winkelmann 1980). In this regard, settlement of the AOI during the early Migration Period is confirmed by archaeological evidence (Finke 1990). Elsewhere in the wider AOI, palynological (Behre 2002; Groenewoudt *et al.* 2007) and archaeological studies (Winkelmann 1980; Kreyenschulte and Spannhoff 2017) suggest uninterrupted, but scattered settlement throughout the Migration Period. The sixth and seventh centuries A.D. saw the immigration of Saxons into the narrow and wider AOI (Winkelmann 1980). Several commons in the wider AOI are already identifiable by their toponyms in the early medieval records of the Werden monastery; the regional term for common (Marke), is documented from the same period (Kokhuis 2000, pp. 29-30). In the late eight century A.D., Charlemagne conquered and annexed the land of the Saxons and brought Christianity, monasteries (Münster; Werden), literacy and education in Latin (Kröll 2010, pp. 39-43, Kokhuis 2000, p. 19). During the early medieval period, the Duke of Saxony was the territorial landlord followed in 1180 A.D. by the Prince-Bishop of Münster, both under the overlordship of the Holy Roman Emperor (Tibus 1867, pp. 973-4). From the twelfth to the seventeenth century, hanseatic market towns around the AOI (Coesfeld, Deventer; Osnabrück and Münster) traded in linen. After alternating occupations by Prussia and Napoleonic France in 1802-15 A.D., Gronau market town, Epe village and the hamlets of Epe parish together become part of Prussia. In 1808 A.D., Napoleonic France abolished feudal tenure in the narrow and wider AOI, without compensation to the landlord for freeing farmers from servitudes, but with compensation for land in kind or cash (Dickel and Mietzner 1999). Subsequently, partition of the commons was decreed in 1821 A.D. and implemented by Prussia. Both land reforms required a cadastre. The Prussian land tax cadastre of 1827 A.D. (Dickel and Mietzner 1999) served the purpose and was the empirical foundation of our study.

Epe village and the surrounding hamlets

Gronau municipality is spatially equivalent to the medieval parish Epe and recorded in the Prussian cadastre. It embraces two riverine settlements, Gronau and Epe, about four kilometers

apart. Gronau was a moated market town around a tower castle in the Dinkel floodplain, founded in 1371 A.D. along the east-west (Kremer 1979, p. 42) and hanseatic route between Münster and Deventer. In contrast, Epe was an unprotected, medieval agrarian village recorded from 1188 A.D. at the eastern levee associated with the parish church, the moated clergy house and the moated manor (first recorded 1325 A.D.) west of the river. Before the twelfth century, the AOI was governed by distant ecclesial (Heek) and manorial jurisdictions (Bentheim; Burgsteinfurt). Epe (*Apa*) is Indo-European for place at the water (Tibus 1867, p. 896; Antrop 2007, p. 149), suggesting an ancient river crossing of the north-south route following the Dinkel levees. Beyond the two nucleated settlements, the parish contained twenty-one hamlets, twelve of which form the AOI. The AOI spatially corresponds with the current cadastral district Epe, Epe municipality (1898-1975) and the Uppermark prior to 1827 (Fig. 1).

The hamlets were grouped in two agrarian territorial governance units, the northern Eilermark and the southern Uppermark (Lagerbuch Epe 1679), both probably dating back to the medieval era (Stroink 1962, pp. 85-7). The magistrate position in the Eilermark was attached to House Gronau and in the Uppermark to House Epe; prior to Napoleonic land reform, both manor houses owned all watermills as well as some farms in the hamlets. Hamlet and agrarian village affairs were managed by a local headman, a primus inter pares. The position was inherited with a major hamlet estate (Kemper 1998; Naber *et al.* 1998). Four hamlet headmen from the AOI were customary law advisors to the regional civil court (Naber *et al.* 1998). Often, hamlet headmen were appointed or elected as executives of the chief magistrate of the common (Dertwinkel 2015). Hamlet farms were held by manorial landlords, church institutions, monasteries and citizens from towns outside the parish. Ten hamlet farms were freeholds of the owner-occupier (Lagerbuch Epe 1679). Manorial tenure was thus a patchwork at hamlet and parish level.

Farmsteads with associated land rights are historically inherited undivided (impartible inheritance) in what are now northwest Germany and the contiguous northeastern Netherlands, unlike southern portions of both countries (Brakensiek 2002). Since 1947, classified farms may not be subdivided in the northwestern states of Germany including the AOI (Kannewurf 2004, Fertig and Fertig 2006). From the high medieval era to the Napoleonic defeudalisation in the wider AOI, ancestral farmsteads were inheritable leaseholds owned by manorial landlords. The leasehold contained servitudes and rights beyond rent in farm produce, labour and/or cash. Farmstead household members needed permission from the landlord for marriage and leaving the territorial jurisdiction of the landlord (‘*Eigenbehörigkeit*’). The permit was issued up to

WW I in the AOI (Diekmann 2002). In return, the landlord provided protection to farm and farmer (Kemper 1998).

At the time of the 1827 cadastre, several lesser classes of tenure were known beyond ancestral estate owners. These included leasehold-for-life, accommodating parents, widows, siblings, colonists, cottager or smallholder, squatter on the common and landless farmhand or crofter ('*Heuerling*') leasing a small plot with dwelling from the farmstead owner-occupier (Strotdees 2017, pp 60-1). Smallholders and landless farmhands together are also referred to as peasant (Vasudevan 1988; Schlumbohm 1992). In 1679 A.D., the owner-occupier of the ancestral hamlet farm also owned a plough and two to three draught horses, a third of the hamlet squatters owned one to two horses and a quarter a plough; the lowest hamlet classes and villagers owned neither horse nor plough (Lagerbuch Epe 1679;Wilming 2004). Earlier on, in 1534 A.D. eleven horses were counted in Epe village versus 362 in the hamlets (Wilming 1993). All ancestral farmsteads and some smallholdings held inheritable land rights including a share in the common. Only large to medium-sized holdings could support a household by farming only. The smallholders in the hamlets depended for livelihood on income from local or migratory agrarian employment to the Netherlands combined with linen trading, and the village smallholders on the linen cottage industry (Middendorff 1927; Herzog 1938, p. 64-7; Riepenhausen and Schüttler 1986, Naber *et al.* 1998; Brakensiek 2002; Lensing and Robben 2015).

Findings and discussion per settlement type

The two synoptic tables (Table 1 and 2) were the base for the description and discussion of the findings for Epe village, strip hamlets, camp hamlets and unploughed land. Detailed descriptions of individual hamlets are provided in an online supplement (Supplemental online material S2).

Epe village

In 1827, the nucleated village of Epe is situated along crossroads at the eastern Dinkel levee on plaggic soil; implying plaggen farming came before the village. The village farmsteads were complemented by a homestead garden or orchard parcel. On average, the villagers held six long strips dispersed over two well-drained strip-fields at the eastern levee and short strips at two poorly drained hinterland strip fields (Table 1). The two long strip-fields directly bordering the built-up village area (Wöhninger Esch within the NW Esch; Esteresch; Fig. 4; Table 1) were more squarish than the hamlet strip-fields and their strip-length at the lower end of the range (<200 m). The alignment of short strips suggests in several places subdivisions of long

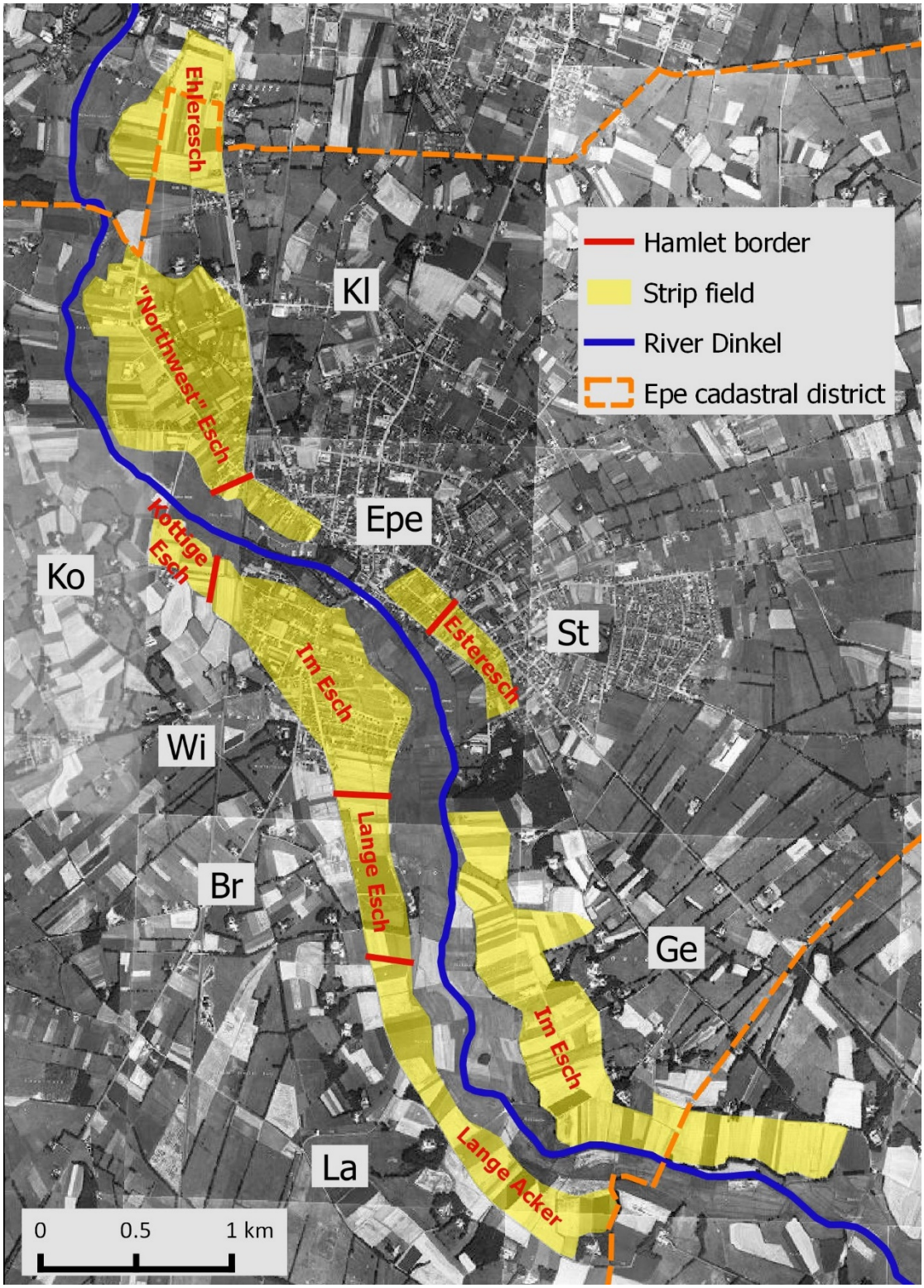

Fig. 4. Location map of the strip-fields in the AOI as around 1800 A.D. drawn over aerial photography of 1969/75 A.D. Basic geodata, aerial photography: © Geodatenatlas Kreis Borken (2018).

Hamlet abbreviations: Br = Brinkerhook; Ge = Gerdingseite; Kl = Kloster (including Riekenhof); Ko = Kottigerhook; La = Langeseite; St = Storkerhook; Wi = Wieferthook.

strips, confirmed by the alternation of strip ownership pattern as in long strip fields. It would appear that the short strips were not laid-out for mouldboard ploughing to grow cereals, but instead cultivated by the spade and/or hoe for flax, potatoes and garden crops (Brebaum 2015, pp. 146-8). Flax cultivation and processing allowed a village household to subsist from a much smaller holding (<one hectare) than any other crop (Slicher van Bath 1976, p. 297). Similar open short-strip fields were identified around Gronau, Enschede (NL) and at the lower Dinkel in Losser (NL), all settlements with a linen cottage industry.

The village farmers' corporation held a riverine dune ('*Bülten*') and a floodplain ('*Mersch*') common. The latter was equivalent to the village green of Anglo-Saxon England (Hoskins 1985, pp. 59-64). The dune formation was probably forced by the pioneer farmers as in the wider AOI along the rivers Dinkel, Regge and Vechte (Willemse and Groenewoudt 2012). Generally, villagers did not hold crop, pasture and oak camps or meadows, unlike the hamlet farmers (Table 1, 2 and 4). Two of the village farmsteads each held a worth camp across the river (Table 5) suggesting a historical residential move from hamlet to village. The cadastre recorded 184 village farmsteads and nineteen non-agrarian buildings. The latter included the parish church, clergy houses, alms-house, medical practice, school and watermill. The village farmsteads were owned by 156 natural persons (Table 1), two by the parish. Generally, persons owned a single farmstead, but fifteen owned two, two owned three and a single person owned four farmsteads. Nearly one in five village farmsteads were without an agrarian land holding and belonged to innkeepers, butchers, blacksmiths, carpenters and shoemakers (Naber *et al.* 1998). Three-quarters of the village farms were smallholdings unable to provide for a household. Substantial non-farm income was derived from artisan linen spinning by women and weaving by men (Naber *et al.* 1998). Only two of the village farmstead of 1827 A.D. (Dickel & Mietzner 1999) were related by family name to those of 1499 A.D. and only seven to hamlet farmsteads in 1499 A.D. (Kemper 1998). Significant immigration into the village is suggested.

TABLE 4. ALTERNATION OF STRIP-FIELD AND CAMP AT THE DINKEL LEVEES FROM SOUTH (TOP) TO NORTH (BOTTOM)

PARCEL SHAPE	HAMLET	TOPONYM	PARCEL OWNER(S)	CADASTRAL CODE
			DINKEL LEVEE EAST	
Camp	Gerdingseite	Nieland	Hamlet farmer (Gerven)	V 251
Strip-field	Gerdingseite	Esch	Hamlet farmers	V 252/273; 25-64
Camp	Gerdingseite	Eskamp	Schulze Tenberge; Burrichter	V 92/97
Strip-field	Kloster	NW Esch	48 village+10 hamlet farmers	XVI dispersed
Camp	Kloster	Hogenkamp Woorte	Absentee (von Oer) Niehoff; Burrichter	X 434 VI 1/2
Strip-field	Eschseite	Ehleresch	Outside AOI	Outside AOI
			DINKEL LEVEE WEST	
Camp	Langeseite	Esch	Hamlet farmer (Willming)	VI 11
Strip-field	Langeseite	Lange Esch	Hamlet farmers	VI 66–95/104–111
Camp	Langeseite	Woortkamp	Hamlet farmer (Herving)	VI 218
Strip-field	Brinkerhook	Lange Esch	Hamlet farmers	VI 182–188/196–204/243–291
Camp	Brinkerhook	Woorte	Hamlet farmer (Gerbert)	VI 292
Camp	Brinkerhook	Kamp	Schulte Dinkelborg	VI 143/144
Strip-field	Wieferthook	Lange Esch	Hamlet farmers	XI dispersed
Camp	Wieferthook	Drostenworte	Brefeld widow; von Droste	XI 262
Strip-field	Wieferthook	Kottker Esch	Hamlet farmers	X dispersed
Camp	Wieferthook	Woorte	Schlamann; widow headman	X 143/163

TABLE 5, WORTH CAMP PARCELS (*WOORTE*), HAMLET, FARM TYPE AND LAND USE/ COVER

WORTH	HAMLET	FARM Type	USE/COVER	CADASTRAL CODE
Woorte	Langeseite	Strip	Crop camp	VI-59
Woorte	Langeseite	Strip	Crop camp	VI-60
Woortkamp	Langeseite	Strip	Crop camp	VI-61
Woortkamp	Langeseite	Strip	Crop camp	VI-218
Woorte	Brinkerhook	Strip	Crop camp	VI-292
Woorte	Brinkerhook	Strip	Crop camp	VI-307
Woorte	Wieferthook	Strip	Crop camps	X-143/163
Woortken	Dorf Epe	Strip	Crop camp	X-137
Drostenworte	Dorf Epe	Strip	Crop camp	XI-262
d' Woorte	Am Berge	Camp	Crop camp	XIII-23
Woorte	Kloster	Strip	Meadow; crop	XVI-1/2
Woorte	Kottigerhook	Camp	Crop camps	XVII-312/313

Strip hamlets

Hamlets or their sub-hamlets with classical open strip-fields were associated with the Dinkel levees, their farmsteads linearly arranged (Fig. 2, Table 2, Supplemental online material S2), and contained five to nine medium-sized to large long-strip farms (Table 1). The number of farms per hamlet was similar to those in upstream levee hamlets (e.g. Lagerbuch Heek 1679)

and strip hamlets in Anatolia (Hütteroth 1974). The four levee farmsteads holding the hamlet headman position (Table 4) are on record since the literate medieval era. Most other large to medium strip farms have been on record since 1499 A.D. The farms in camp sub-hamlets of the strip hamlets (Table 1 and 2) were documented more recently (Naber *et al.* 1988). At the hamlet boundaries, the open strip-fields were interrupted by large camps with specific toponyms and owned by members of the hamlet's upper classes (Table 4). The long-strip fields were situated between the hay-meadow parcels in the floodplain and the line of hamlet farmsteads surrounded by their house camps (Fig. 3). The same sequential landscape pattern was identified downstream (De Zoeke hamlet, Losser (NL); HISGIS) and upstream (e.g. Wext hamlet, Heek; Geodatenatlas) along the river Dinkel in the wider AOI. In Drenthe, the sequence was often floodplain-hamlet-open strip field (e.g. Spek 2004, pp.28-9, p. 168). The number of strips per farmstead was on average five to eight (Table 1), similar to strip numbers in the Twente (Koenig 1938, p. 149). Both are somewhat lower than the eight strips predicted in another historical geographic context (Mc Closkey 1989). The three to eight house camps of each strip farm contained several ploughed and grazed camps as well as oak camps, the latter more often lacking close to the village (Table 1). Six hamlets included worth camps (Table 5), all associated with Plaggic Anthrosol. Additional arable and pasture camps were disjunctive with the house camps and often associated with Gleyic Podzol.

The hamlet strip-fields were one strip-wide and parallel to the floodplain or several strips wide in the meanders (Fig 4). The hamlet strip-fields and house camps were associated with raised (one to two meters), well-drained Plaggic Anthrosol (Table 6); the favourable drainage may result from the natural levees and its subsequent enhancement by sods and soil from excavated ditches. Most strips were ploughed perpendicular to the river Dinkel and drained by a ditch in the floodplain parallel to the border of the strip-field (cf. Matzat 1988). Often, this field border is an anthropogenic, steep edge (Fig. 3); locally, a second elevational level occurs within the strip-field suggesting repeated extensions (Slicher van Bath 1976, p. 64) into the floodplain. Given the position of strip-fields between floodplain meadow, and house camps, sods were probably sourced in the meadow as in the wider AOI (cf. Verlinde 2004) rather than from hinterland heathland. The twofold toponym for sod meadow ('*Plaggenmate*') suggests the same (Dickel and Mietzner 1999). More so, as alluvial sods provide a more fertile soil. The open strip-fields were not consolidated simultaneously with the partition of the commons. Until the mid-twentieth century, strip parcellation can be identified on aerial photography (Fig. 4; cf.

Spek 2004, p. 656). Today, the former strip-fields are still open, i.e. is not enfolded in contrast to bordering camp fields (Fig. 5; Geodatenatlas).

Fig. 3: Toposequence of landscape elements in the Gerdingseite hamlet from west to east: hay meadow in river Dinkel floodplain (foreground), wooded open field edge (behind the bicycle),

open field (middle ground behind trees); in the background the farmstead with its associated oak camp (right) and a house camp indicated by trees surrounding the parcel (center left).Photography (14 February 2018): A. Mölder

Fig. 5: Open field with forage maize stubble, farmstead with associated oak camp (right) and house camp (center left) at the eastern levee of the river Dinkel (Gerdingseite hamlet). Photography (14 February 2018): A. Mölder

TABLE 6. CROSS TABULATION OF SOIL TYPES, HAMLETS AND LAND USE/ COVER

SOIL TYPE (BODEN)				HAMLET	USE/COVER
English FAO 2014	German NRW 1974	Drainage NRW/FAO	Code NRW		
Plaggic Anthrosol	Grauer Plaggenesch	well	E8	all except Amtsvenn	long strip; camp
Gleyic Plaggic Anthrosol	Brauner Plaggenesch	poor	E7	Epe/Kloster/ Riekenhof	short strip
Gleyic Podzol	Podsol-Gley	poor	pG8	most	common; camp
Gleyic/Histic Fluvisol	Gley; Auenboden	poor/flooded	G7	most	hay-meadow
Stagnosol	Pseudogley	poor	S	Am Berge	camp
Cambisol	Braunerde-Podsol	well	bP8	Am Berge	camp
Gleyic Cambisol	Gley-Braunerde-Podsol	poor	gP8	Am Berge/ Amtsvenn	camp
Podzol	Podsol	well	P8	Epe (Bülten)	common pasture

Two strip hamlets contained agrarian camp sub-hamlets (Table 1, 2). The camp farms were mostly leaseholds-for-life, small to medium sized and situated on the common's side of the estates with strips, suggesting relatively recent colonies. A third strip hamlet was beyond its

small strip farm core largely a conglomerate of residential smallholdings at the northern fringe of the nucleated village, mostly associated with well-drained Plaggic Anthrosol like the village (Fig. 2, Table 2).

Camp hamlets

In the hinterland away from the Dinkel levees, we identified camp hamlets only (Fig. 2, Table 2). Neither the cadastral nor the topographic map of the AOI allowed identification of enclosed versus open camp parcels. However, pre-partition topographic maps contiguous with the AOI showed that most house camps, both in enclave and levee hamlets were enclosed at the time. All camp hamlets contained a number of large to medium-sized inheritable farms recorded since 1499 A.D. in the tax registers, as did the strip hamlets. In 1679 and 1710 A.D., a relative large number of squatters and smallholders were recorded for the first time in the three larger hinterland camp hamlets synchronic with the establishment of the camp sub-hamlets of strip hamlets (Table 7). Camp hamlets were either linear or cluster settlements. Beyond the absence of strip holdings, camp farm hamlets showed the same parcel mix as strip hamlets, that is homestead garden, oak, crop and pasture house camps as well as disjunctive hay-meadows. The number of owner-occupied farmsteads in camp hamlets ranged from two to twenty (Table 1). Camp hamlets generally embarked on systematic land improvement with sods and drainage leading to Plaggic Anthrosol.

Two bordering hinterland hamlets were located in the Dinkel floodplain, three hamlets were enclaves in the common and one settlement consisted of four dispersed farms within the bog (Fig. 2, Table 2). The floodplain camp hamlets were situated opposite Epe village west of the river. One hamlet name (Kottigerhook) referred to smallholders (‘*Kotter*’), the other (Sunderhook) to a slice of the common sold to a natural person (‘*Sundern*’; Strotdrees 2017). The camps were associated with raised (one meter) Plaggic Anthrosol (Tables 2 and 6) without steep edges along the floodplain meadows, but further inland some camps showed anthropogenic steep edges. Given the proximity of the two hamlets close to the river Dinkel, the absence of a strip field was striking. It is explained by the local gap in the Dinkel levee instead showing Gleyic Fluvisols related to rivulets and the river Dinkel (Table 2). The floodplain camp hamlets contained neither a farmstead with a medieval record, nor a farmstead with an attached headman position in contrast to the enclave camp hamlets and the strip hamlets. These absences, combined with the hamlet names suggest a post-medieval colonisation.

TABLE 7. DEMOGRAPHIC DATA FROM 1499–1925; SOURCES AND HISTORICAL CONTEXT

YEAR A.D.	CENSUS TRACT	CENSUS OBJECT	PERSONS
400–1500	*Middle Ages*		
1499	Epe village + parish	Persons 150 + 700[1]	900
1534	Epe village + parish	Households 29 + 139[2]	940
1568-1648	*Eighty Years' War/Thirty Years' War*		
1665–72/3	*First and second Münster-Dutch Wars*		
1679	Epe village	Farmsteads 60[3]	240
1679	Parish	Farmsteads 90 + 78[4]	1008
1693	Epe village + parish	Farmsteads taxed by the Church[5] 38 + 83	650
1710	Parish	Farmsteads (74) + lower tenure classes (168)[6]	1008
1750	Epe village+ parish	Farmsteads: 238 + 277; Persons: 1023 + 1768[7]	2791
1769	Epe village+ parish	Farmsteads 318[8]	1908
1815–1845	*Partition of commons; land tax cadastre; population census*		
1820	Epe village[9]	Persons	1130
1854	*Industrialisation: textile factory Van Delden, Epe parish*		
1875	Epe village + parish[10]	Persons	2700
1881	*Textile factory Laurenz Brothers*		
1895	Epe village + parish[11]	Persons: 1267 + 6124	7391
1897	*Textile factory Germania Epe village*		
1899	Epe village + Uppermark[12]	Persons	3820
1899–1914	*Expansion of textile industry*		
1925	Epe village + Uppermark[13]	Persons	6173

Epe Parish: Uppermark + Eilermark
Uppermark: Twelve (12) hamlets; see Fig. 2 and Table 2 in Part 1 for the names and the geographical location
Eilermark: Nine (9) hamlets around Gronau market town

1. Kemper 1998, pp. 113–16
2. Wilming 1993
3. Wilming 1998
4. Kemper 1998, pp. 116–20
5. Naber *et al.* 1998, pp. 130–4
6. Kemper 1998, pp. 121–3
7. Naber *et al.* 1998, p. 149
8. Lagerbuch Epe 1679
9. https://de.wikipedia.org/wiki/Epe_(Westfalen)
10. http://www.tenhumbergreinhard.de/downloads/zeittafeldergemeindeepe.htm
11. https://de.wikipedia.org/wiki/Epe_(Westfalen)
12. http://www.tenhumbergreinhard.de/downloads/zeittafeldergemeindeepe.htm
13. https://de.wikipedia.org/wiki/Epe_(Westfalen)

The three enclave camp hamlets were situated at slightly elevated and well-drained terrain, the hill or rivulet levees and therefore arable enclaves in multi-hamlet wetland commons. The founding farms in each of the hamlets, Bergesbuer/Barlo (Am Berge), Füchtemann (Füchte) and Kernebeck (Lasterfeld) were on record from the literate high medieval period, contemporaneously with the levee hamlets (Kemper 1990). The single hamlet commons of the enclave hamlets to the east of Epe village (Füchte and Am Berge) were owned by Epe village ('*Gemeinde*'). Camps were mostly associated with well-drained Plaggic Anthrosol, the single and multi-hamlet commons with Gleyic Podzol or Stagnosol (Tables 2 and 6).

Four dispersed camp-farms were situated far apart in the southwestern uncultivated corner of the parish (Amtsvenn/Frielers Venne; Table 2). The absence of both large holdings and Plaggic Anthrosol combined with conifer camps suggests a relative recent settlement.

Unploughed land: bog, heathland and meadow

The ploughed lands of village and hamlets were generally surrounded by wetland: floodplain hay-meadows at the river/rivulet side and commons elsewhere. These wetlands could not be ploughed without capital investment in drainage infrastructure beyond the financial means of village or hamlets. Common lands (Table 2) were found all around the periphery of the research area in 1827 A.D. Most of the common land was classified as heathland in the Prussian cadastre. However, the first topographic map shows abundant opencast turf mining in the southwest of the AOI. Aerial photography of 1954-65 A.D. (Geodatenatlas) showed a considerable expansion of open cast mining since 1827 A.D. Within village and hamlets, smaller commons were classified as pasture or fuel wood. Commons were generally listed as corporate property ('*Gemeinheit*'). However, two single-hamlet commons within enclave hamlets (Füchte; Am Berge) were public property of Epe village. Only the owner of the floodplain common ('*Mersch*') is recorded more specifically as village farmers' corporation. The two multi-hamlet commons (Uppermark; Eilermark) were each governed by the shareholders from the bordering hamlets under the leadership of the magistrate. Smaller commons within the village and hamlets were probably governed by the shareholders under their local headman. Portions of common land ('*Zuschläge*') were sold to establish new camp farms (e.g. Brakensiek 2002; Dertwinkel 2015). At partition, a third of the commons ('*tertia marcalis*') were allocated to the feudal landlords and two third, pro rata parte to the shareholders (Hesmer and Schroeder 1963, p. 106 and p. 114). During the Napoleonic period prior to the Prussian partition, a portion of the parish share in the commons had been allocated to landless villagers (Wigger 1998).

Currently, a checkerboard field system prevails in the partitioned and drained former common, prominently including recent coniferous and broadleaf woodland, particularly in the share of the former feudal landlord (cf. Hesmer and Schroeder 1963). The two pastoral village farmers' commons in Epe became municipal property in the partition and function currently as public park and sports facilities. The wettest and peat-mined portions of the bog in the southwestern quarter of the AOI were obviously unsuitable for partition into field and forest parcels. The wetness is testified by the multitude of small open water bodies visible on the topographic maps and aerial photographs (Geodatenatlas). Currently, the excavated and mined moorland is a state

(NRW) nature reserve of about 900 hectares (Amtsvenn-Hündfelder Moor). The meadow parcels along the river Dinkel are still '*open*' today suggesting collective grazing of cattle or horses in the past. Between 1827 A.D. and the present, meadow parcels have often been drained, consolidated in larger parcels and partially converted into cropland. The former strips have been consolidated in large fields only after 1970 A.D. (Geodatenatlas). The openness of the former strip-fields remains scenically striking today in the rural hamlets. Similarly, the oak camps are visually prominent in an otherwise flat, deforested landscape and indicate from far the current and medieval sites of farmsteads with medium to large holdings (Fig. 5).

Demographic development

Population estimates for Epe village and Epe parish are presented in Table 7. The estimates for the year 1750 versus 1769 A.D. suggest that head counts may yield substantially higher population numbers than a tax register; the latter do not capture the landless, lower agrarian classes. The taxable population seems to have been relatively stable around thousand persons over the sixteenth and seventeenth centuries notwithstanding devastating wars and recurrent pest epidemics in this early modern period. Between 1700 until 1827 A.D., the registered population rather suddenly doubled or tripled, as reported for the wider AOI (Schlumbohm 1992; Slicher van Bath 1975; Brakensiek 2002; Lensing and Robben 2015, p. 22). During this period a sizeable peasant class developed that was self-employed as spinners (women) and weavers (men) in the linen cottage industry. In Epe village over hundred households in 1750 A.D. included a weaver and presumably an equivalent number of spinners; among hamlet residents weavers were non-existent (Naber *et al.* 1998). In addition, groups of peasants seasonally migrated during the same period (1650 to 1850 A.D.) to The Netherlands as farmhands and petty linen traders (Kremer 1979, p. 59; Siemsen 2015; Lensing and Robben 2015). A gathering point for such groups was situated at the village periphery along the road to The Netherlands. From 1679 A.D. onward, camp sub-hamlets on the common side of two strip hamlets absorbed less than ten households. Simultaneously, squatters and smallholders settled in the commons' fringes of camp hamlets. In other words, spontaneous encroachment of the commons had started prior to partition (Middendorff 1927; Brakensiek 2002). The family cum farmsteads names of the post-1679 A.D. settlers are unrelated to those of the medieval residents of the AOI. Whether the settlers in the commons and village were immigrants or untaxed and therefore unregistered landless residents could not be established. Similarly, the number of large-medium landholdings and farmstead owners remained stable over centuries in Epe parish and in the wider AOI from 1560 until 1860 A.D. (Herzog 1938, p. 127; Slicher van

Bath 1975; Schlumbohm 1992; Lensing and Robben 2015). Farm households ranged from two to five persons above the age of twelve including celibate domestics (female) and farm hands (male) and contained on average 2.3 nuclear family members in the narrow and wider AOI (Dertwinkel 2014, pp. 77-8/137-42; Könenkamp 1989; Naber *et al.* 1998). In 1660, nuclear families in three hamlets included on average less than one child above the age of twelve. Generally, the smallholder couples lived in households smaller than the average, while household size at large to medium farms was slightly above average (Supplemental online material S3: T1-T6). In the same century, the number of children born per couple was about five, resulting from of a relative high age (26-28) at first marriage of the woman (Schlumbohm 1992). The pre- and post-partition population were similar (Table 7) suggesting that parcelling out the commons among shareholders did not result in immigration. Evidently, the post-partition land market did not attract farmer-occupiers from outside the parish. However, within half a century after land reform an immigration boom was initiated by the capital-intensive upscaling of the textile cottage industry from 1854 A.D. onward as reflected in the census data of 1875/1895 A.D. (Table 7). This industrialization of the AOI was driven by urban moneyed entrepreneurs. Simultaneously, the textile industry took off across the wider AOI (e.g. Lensing and Robben 2015).

Overall discussion

The mixed settlement pattern of nucleated village, hamlets and isolated farmsteads as found in the narrow and wider AOI had its early medieval parallel in the northern and western Anglo-Saxon counties in England.

Epe villagers held strips on classical open fields and at short-strip open fields. The latter were located in the hinterland on poorly drained Plaggic Anthrosol. Short strips were probably cultivated for flax and as kitchen or market garden with the hoe rather than the mouldboard plough. In contrast to hamlet farmers, villagers rarely held oak, crop or pasture camps. Together the village farmers held two pastoral commons. Two thirds of the villagers were smallholders also occupied in the linen cottage industry or as artisan showing that Epe was a proto-industrial, agrarian service village. Hamlets were composed of three to thirty-four farmstead households embodying the lower half of the range in the wider AOI and the Alps. The strip hamlets each cultivated their own section in the western or the eastern classical open strip-field at the levees of the river Dinkel; the farmsteads were situated between open field and wetland common and surrounded by enclosed house camps used for crop, pasture and oak. The strip-field proximity to the farmsteads was characteristic for extensive lowlands. In the mountains, however, the flat

strip-fields are more distant from associated settlements sited in steeper terrain. As the hamlet mostly held a single strip-field, these were not laid out for the medieval two- and three-field system. All hinterland hamlets consisted of camp holdings only.

The tenure pattern at parish level was associated with physical geography. Strip hamlets were located on the long, well drained river levees between floodplain and wetland and camp hamlets in the wetland hinterland on the smaller rivulet levees, the hill and in a levee-less stretch along the river. The number of farms per strip hamlet in the AOI ranged from one to seven, similar to the agrarian settlement size the wider AOI in the late Iron Age (Verlinde 2004), during the Early Middle Ages (Grünewald 2005) and strip hamlets in Anatolia (Hütteroth 1974). Strips and house camps were situated at Plaggic Anthrosol. In contrast, dispersed and hamlet fringe camps were often located at Gleyic Podzol. Hay-meadows and oak camps occurred in strip and camp hamlets signalling mixed crop-livestock farming in both. The village and some hamlets held small commons in close proximity. The large northern and southern multi-hamlet hinterland commons institutions were both ruled by a hereditary feudal magistrate and the owners of the large and medium-sized farms. These hinterland commons consisted of deforested wetland at Gleyic Podzol or peat. A headman farmstead was recorded in each major strip and enclave camp hamlet in the literate twelfth to thirteenth centuries. Further, both hamlet types include ancient worth camps.

All indicators suggest that at parish scale, strip and enclave camp hamlets share a similar history. The other camp hamlets seem settlements that are more recent. Unlike at parish level, strip farms appeared to predate camp farms at hamlet level. Moreover, within these levee hamlets, the strip holding farms are large to medium-sized, the camp farms more often smallholdings. In other words, the answer to the research question, strip or camp first, was found to be scale, time and location dependent.

The following hypothetical narrative is consistent with our findings. It points to farmers familiar with the Neolithic agrarian package enriched with horse, mouldboard plough and sod technology, settling in small hamlets of about five to ten farmsteads, each including a headman’s farmstead at relatively small well-drained sites in a wetland and floodplain matrix. Each farmstead was surrounded by a few crop, oak and pastoral house camps raised and fertilised by sods. At the time of settlement, probably in the early Middle Ages, first the (house) camps were established. Next, strip fields were established on already deforested river levees and from there into the floodplain. These were established collectively by subdivision, digging of ditches draining to the river, and raising the fields with grass sods from the floodplain. In

parallel, enclave camp hamlets expanded their farms beyond the house camps into forested land by increasing the number of camps. In that phase, strip and camp hamlets occurred at parish scale at the same time, but under different geographical conditions. In a next phase, further farming expansion was left with poorly drained sites only and resulted in floodplain camp hamlets, camp sub-hamlets in the hinterland of the strip hamlets and dispersed camp farms. Both at parish and strip hamlet scale, strip came before camp. The strip parcellation of the open field is unlikely to result from farm subdivisions at inheritance. Halving of existing strips width- or lengthwise would seem a possibility given the strip patterns in the AOI. However, we do not observe parcellation within hay-meadows or house camps, neither in strip hamlets nor in camp hamlets. More likely, the house camps will remain with the ancient farm stead and the disjunctive camps allocated to the new farmsteads.

Parish church and manor house situated at the ancient river Dinkel crossing known as Epe appeared in written records in the twelfth and thirteenth centuries respectively. Up to 1499 A.D., about twenty immigrant artisans cum peasants, owning eleven horses in 1534 A.D. settle at the already cultivated NW and SE open fields between river crossing and church. It seems unlikely that there and then any well-drained levee land was left for reclamation by the immigrants. Consequently, the immigrants may have leased or bought long strips from the landlord, the church. The immigrant villagers may also have converted poorly drained hinterland commons to the north and east of the settlement into short strip fields mainly for flax. These commons were probably owned by Epe village at the time, as were the commons of the hamlets to the north and east in 1827 A.D. It appears that between 1600 and 1827 A.D., the growth of Epe village to a settlement of about 150 households, was driven by its linen cottage industry, again largely by immigration from outside the parish. By 1679 A.D., horses had disappeared from the village, indicating the end of long-strip cereal cultivation by the villagers.

The agrarian package, the landscape and the hamlet settlement pattern of sedentary crop-livestock farmers of the open strip-field system were available in the AOI from the late Iron Age onward as testified by archaeological evidence. Written evidence referring to the AOI appeared from the twelfth century A.D. onward, and showed the structure of the AOI as documented in 1827 A.D. in terms of manorial and territorial landlords, strip and camp hamlets, location of ancestral and headmen farmsteads and village buildings. Commons were not identified in the narrow AOI prior to the medieval period, but they are in the wider AOI as toponyms from the early medieval period and subsequently as institution from the high

medieval period until 1827 A.D. In the century before the Napoleonic-Prussian land reforms, the number of registered inhabitants increased simultaneously with the linen cottage industry of Epe village, the encroachment of new camp farms into the contact zone of strip and camp hamlets with the common, and seasonal labour migration. The growth in the registered population was probably partly due to registration of formerly untaxed lower agrarian classes settled in the commons' fringes and by immigration from outside the parish into the village.

Summary conclusions

Our three research questions were answered as follows. Settler farms were grouped in hamlets of five to ten farmsteads surrounded by house camps at relatively small areas of well-drained land in a wetland and floodplain matrix possibly during the late Iron Age, but more probably in early medieval times. At previously deforested levees, strip-fields were added towards the floodplain meadows. On the commons side of the levees, additional camps were reclaimed. Specialised camps-only and strip hamlets were identified. In the latter, ancestral strip and younger camp farms co-existed. The answer to our third research question, strip-field-first versus camps-first was shown to be subject to spatial and temporal scales, in agreement with the Hierarchy Theory. Consequently, the controversy in the literature was identified as a spatio-temporal scaling issue.

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Literature

Agterbosch, F.J.M. *et al.*, 1998. *Markeboek Lonneker 1545-1751*. Hengelo: Nederlandse Genealogische Vereniging.

Albers, W.J., 1966. *Geschiedenis van Gelderland van de vroegste tijden tot het einde der Middeleeuwen*. The Hague: Martinus Nijhoff.

Allan, R.C., 2001. Community and Market in England: Open Fields and Enclosures Revisited. *In*: M. Aoki and Y. Hayami, eds. *Communities and Markets in Economic Development.* Oxford University Press, pp. 42-69.

Althaus, R. 1957. *Siedlungs- und Kulturgeographie des Ems-Werse-Winkels*. Unpublished Dissertation. Münster University.

Antrop, M., 2007. *Perspektieven op het Landschap*. Gent: Academia Press.

Arnold, V., 2017. Tim-Online und "Celtic Fields" in Nordrhein-Westfalen. In: Rupp, N. *et al.*, eds. Winds of Change – Archaeological Contributions in Honour of Peter Breunig*, Frankfurt Archaeological Studies,* 35, 35-46.

Arnoldussen, S. and Scheele, E.E., 2014. De Celtic fields van Wekerom: kleinschalige opgravingen van wallen en velden van een laat-prehistories raatakkersysteem. *Grondsporen*, 18, Rijksuniversiteit Groningen.

Ault, W., 1972. Open-field farming in Medieval Europe. A study of village by-laws. London: Routledge.

Blume, H. and Leinweber, P., 2004. Plaggen Soils: landscape history, properties and classification. *Journal of Plant Nutrition and Soil Science*, 167, 319-327.

Beaumont, P., Blake, G.H. and Wagstaff, J.M., 1976. The Middle East: a geographical study. London: John Wiley & Sons.

Behre, K., 2002. Zur Geschichte der Kulturlandschaft Nordwestdeutschlands seit dem Neolithikum. *Bericht der Römisch-Germanischen Kommission*, 83, 39-68.

Bergmann, R., 2006. Hofwüstungen und Eschsiedlungen im südwestlichen Münsterland. *Siedlungsforschung. Archäologie – Geschichte – Geographie*, 24, 195-217.

Bloch, M., 1966. *French rural history*. Berkeley: University of California Press.

Boer, D.E.H. de, Boone, M.H., and Hessinger, W.A.M., 1992. *Nederlands verleden in vogelvlucht. De Middeleeuwen: 300 tot 1500*. Leiden: Martinus Nijhoff.

Boerderijkaart Twente 1500. www.markegrenzen.nl/docs/BoerderijkaartTwente1500Zuidoost.jpg [Accessed 09 September 2017].

Boosen, J.D., 1980. Römische Kaiserzeit und frühe Völkerwanderungszeit im westlichen und zentralen Münsterland. *Führer zu vor- und frühgeschichtlichen Denkmalen*, 45, 156-174.

Brakensiek, S., 1991. *Agrarreform und ländliche Gesellschaft. Die Privatisierung der Marken in Nordwestdeutschland 1750-1850*. Paderborn: Ferdinand Schöning.

Brakensiek, S., 2002. The management of common land in north-western Germany. *In*: M. de Moor, L. Shaw-Taylor and P. Warde, eds. *The management of common land in northwest Europe, c. 1500-1850*. Turnhout: Brepols, 225-245.

Brakensiek, S., 2004. Die Auflösung der Marken im 18. und 19. Jahrhundert: Probleme und Ergebnisse der Forschung. *Kataloge und Schriften des Museumsdorfs Cloppenburg*, 14, 157-169.

Branford, J., 1987. *A dictionary of South African English*. Cape Town: Oxford University Press.

Brebaum, U., 2015. *Borken – altes Flachs- und Leinenland*. Jahrbuch des Kreises Borken. Borken: Der Landrat, 146-151.

Burrichter, E. 1976. Vegetationsräumliche und siedlungsgeschichtliche Beziehungen in der Westfälischen Bucht. *Abhandlungen aus dem Landesmuseum für Naturkunde zu Münster in Westfalen*, 38, 3-15.

Burrichter, E., 1970. Beziehungen zwischen Vegetations- und Siedlungsgeschichte im Nordwestlichen Münsterland. *Vegetatio*, 20, 199-209.

Campbell, B., 1996. Shaping the rural environment: surveyors in ancient Rome. *The Journal of Roman Studies*, 86, 74-99.

Cate, C.J. ten, 1972. *Wan god mast gift...; Bilder aus der Geschichte der Schweinezucht im Walde*. Wageningen: Pudoc.

Dahlman, C.J., 1980. *The open field system and beyond; a property rights analysis of an economic institution.* Cambridge: Cambridge University Press.

Dertwinkel, S., 2015. *Geschichte der Marken in Hollich, Sellen und Veltrup von den Anfangen bis zur Auflösung.* Greven: Heimatverein Burgsteinfurt/Landwirtschaftlicher Ortsverein Burgsteinfurt.

Dickel, H. and Mietzner, E., 1999. *Die Flurnamen der Stadt Gronau*. *Das Preußische Grundsteuerkataster von 1827.* Vreden/Gronau: Landeskundliches Institut Westmünsterland, Text/ Karten.

Dickel, H. and Mietzner, E., 2002. *Die Flurnamen der Stadt Gronau. Atlas und Namenregister. Westmünsterlandische Flurnamen.* Vreden/Gronau: Landeskundliches Institut Westmünsterland.

Diekmann, N., 2002. Auswanderer aus Gronau und Epe. *In*: H. Dickel, ed. *Bürgerbuch Gronau und Epe*. Gronau, Hanspeter Dickel, 194-198.

Ellenberg, H., 1963/1978. *Vegetation Mitteleuropas mit den Alpen*. Stuttgart: Ulmer.

FAO, 2014. *World Reference Base for soil resources; International soil classification system for naming soils and creating legends for soil maps*. Rome: Food and Agriculture Organization of the United Nations.

Fertig, C. and Fertig, G., 2006. Bäuerliche Erbpraxis als Familienstrategie: Hofweitergabe im Westfalen des 18. und 19. Jahrhunderts. *In*: S. Brakensiek, M. Stolleis and H. Wunder, eds.

Generationengerechtigkeit? Normen und Praxis im Erb- und Ehegüterrecht 1500-1850. Berlin: Duncker und Humblot, pp. 163-187.

Finke, W. 1980. Die Jungsteinzeit im westlichen und zentralen Münsterland. *Führer zu vor- und frühgeschichtlichen Denkmalen*, 45, 67-85.

Finke, W., 1990. Ausgrabungen in Heek. *In:* H. Hellenkemper, H.G. Horn, H. Koschik, eds. *Archäologie in Nordrhein-Westfalen: Geschichte im Herzen Europas*. Mainz: von Zabern, pp. 149-153.

Fischer, D., 2012. Chronik des Münsterlandes. Münster: Aschendorff.

Geodatenatlas. https://maps.kreis-borken.de/atlasfx_bildungskreis [Accessed 22 September 2017].

Geologisches Landesamt NRW, 1993. Geologische Karte von NRW 1:100.000. Sheet C 3906. Krefeld.

Geologisches Landesamt NRW, 1974. Bodenkarte Nordrhein-Westfalen 1:50.000. L3906_Vreden. L3903_Ahaus. Krefeld.

Giani, L., Makowsky, L. and Mueller, K., 2014. Plaggic Anthrosol: Soil of the Year 2013 in Germany: An overview on its formation, distribution, classification, soil function and threats. *Journal of Plant Nutrition and Soil Science*, 177: 320 -329.

Gils, H.A.M.J. van, Batsukh, O., Rossiter, D.G., Munthali, W. & Liberatoscioli, E. (2008) Forecasting the pattern and pace of *Fagus* forest expansion in Majella national park, Italy. *Applied Vegetation Science*, 11, 539-546.

Gils, H.A.M.J. van, Siegl, G. & Bennett, R.M., 2014. Living commons in West-Tyrol, Austria; lessons for land policy and administration. *Land Use Policy*, 38, 16-25.

Gils, H.A.M.J. van, Bennett, R. & Hipondoka, M, 2015. Of pastures and tourism. A comparison of Tyrolean and Namibian commons institutions. *In*: N. Grüne, J. Hübner and G. Siegl. *Rural Commons*. Studien Verlag, Innsbruck: pp. 258-273.

Goossens, E., 2009. *Archeologische beleidsadvieskaart met AMZ-adviezen. Gemeente Haaksbergen*. RAAP, Archeologisch Adviesbureau BV, Weesp.

Grimm, J., 1854. *Deutsche Rechtsalterthümer*. Zweite Ausgabe. Göttingen: Dieterichsche Buchhandlung.

Groenewoudt, B.J. *et al.*, 2007. Towards a reverse image. Botanical research into the landscape history of the eastern Netherlands (BC 1100 – AD 1500), *Landscape History*, 29, 17-33.

Groenman-van Waateringe, W. and Geel, B. van, 2017. Raised bed agriculture in northwest Europe triggered by climatic change around 850 BC: a hypothesis. *Environmental Archaeology; the Journal of Human Palaeoecology*, 22, 166-170.

Grünewald, C., 2005. Archäologie des frühen Mittelalters vom 5. bis zum 9. Jahrhundert in Westfalen; ein Überblick. *Archäologie in Ostwestfalen*, 9, 71-81.

Guzowski, P., 2015. The commons in late medieval and early modern Poland. *In*: N. Grüne, J. Hübner and G. Siegl, eds. *Rural Commons*: Innsbruck: Studien Verlag, 68-78.

Hall, D., 2014. *The Open Fields of England*. Oxford University Press.

Hambloch, H., 1960. Einödgruppe und Drubbel. Ein Beitrag zu der Frage nach den Urhöfen und Altfluren einer bäuerlichen Siedlung. *Siedlung und Landschaft in Westfalen*, 4: 39-56.

Head-König, A., 2015. Common land and collective property in pre-Alpine and Alpine Switzerland. *In*: N. Grüne, J. Hübner and G. Siegl, eds. *Rural Commons*. Innsbruck: Studien Verlag, pp. 232-244.

Heller, W. and Hanewinkel, J., 1990. Flurformen in den Beckenlandschaften der Provinz Sakarya/NW-Anatolien. Eine Fallstudie. *Geographische Zeitschrift*, 78, 243 -253.

Hempel, L., 1957. Heuerlingswesen und crofter system; ein agrar- und sozialgeographischer Vergleich von Siedlerschichten in Deutschland und Schottland. *Zeitschrift für Agrargeschichte und Agrarsoziologie*, 5, 169-180.

Hersping, P.G., 1963. *Bevölkerung und Siedlung in der Niedergrafschaft Steinfurt. Eine Siedlungs- und sozialgeographische Untersuchung.* Thesis (PhD). University of Münster.

Hesmer, H. and Schroeder, F.-G., 1963. Waldzusammensetzung und Waldbehandlung im Niedersächsischen Tiefland westlich der Weser und in der Münsterischen Bucht bis zum Ende des 18. Jahrhunderts. Forstgeschichtlicher Beitrag zur Klärung der natürlichen Holzartenzusammensetzung und ihrer künstlichen Veränderungen bis in die frühe Waldbauzeit. *Decheniana, Beiheft*, 11, 1-304.

High Court of Namibia, 2016. The Njagna Conservancy Committee v. The Minister of Lands and Resettlement (A 276-2013) [2016] NAHCMD 250 (18 August 2016).

HISGIS. www.hisgis.nl/hisgis/gewesten/overijssel [Accessed 30 January 2016].

Historische Atlas Overijssel, 1990. *Chromotopographische kaart des Rijks 1:25.000*. Den Ilp (NL), Robas: Sheets 399, 400 and 418.

Hooke, D., 1981. Open-field agriculture. The evidence from the pre-conquest charters of the West Midlands. *In:* T. Rowley, ed. T*he Origins of Open Field Agriculture.* London: Chroom Helm.

Hooke, D., 2010. 'The past in the present'—remnant open field patterns in England. *Landscape History*, 31, 73-75.

Hoskins, W.G. 1985. *The making of the English Landscape*. Chapter 2: The English Settlement. London: Penguin books, pp. 45-75.

Hütteroth, W., 1974. The influence on social structure of land division and settlement in Inner-Anatolia. *In*: P. Benedict, E. Tümertekin & F. Mansur, eds. *Turkey Geographic and Social Perspectives*. Leiden: E.J. Brill, pp. 19-48.

Inalcik, H and Quataert, D., 1994. *An economic and social history of the Ottoman Empire*. Cambridge University Press.

Kannewurf, T., 2004. Die Höfeordnung vom 24. April 1947: Entstehungsgeschichte und Einordnung in die Entwicklung des Anerbenrechts. *Rechtshistorische Reihe*, 296, 1-224.

Kaune, D., 2016. Der Blick auf die kleine Welt – Frühe, handgezeichnete regionale Landkarten zwischen Mimesis und Metrik. *Archivnachrichten aus Hessen*, 16, 58-60.

Keddie, N.R., 1980. *Iran. Religion, politics and society*. New York: Frank Cass.

Kemper, H. 1990. *Die Eper Bauerschaften und ihre Höfe*. Gronau-Epe: Holzwig M.A.

Kemper, H. 1998. *Steuer und Abgabenlisten aus der Vergangenheit*. Epe in der Vergangenheit IV. Heimatverein Epe e.V., Gronau-Epe: 113-121.

Koenig, H.J., 1938. Eschsiedlungen in den östlichen Niederlanden. *Westfälische Forschungen; Mitteilungen des Provinzialinstituts für Westfälische Landes–und Volkskunde*, *1*, *pp. 143–57.*

Klöntrup, J.A., 1799. *Alphabetisches Handbuch der besonderen Rechte und Gewohnheiten des Hochstifts Osnabrück mit Rücksicht auf die benachbarten westfälischen Provinzen. II. Band*. Osnabrück: Karl und Compagnie.

Könenkamp, W., 1989. *Bauernfamilie und Gesinde; Soziale Ordnung und Arbeitsteilung auf westfälischen Bauernhöfen um 1800*. Westfalen im Bild, Reihe: Westfälische Agrargeschichte, Heft 2, Münster.

Kokhuis, G.J.I., 2000. *De geschiedenis van Twente. Het graafschap Twente (803-1248)*. Odenzaal: TGU.

Kremer, L., 1979. *Grenzmundarten und Mundartgrenzen; Untersuchungen zur wortgeographischen Funktion der Staatsgrenze im ostniederländisch-westfälischen Grenzgebiet. Teil 1*. Münster: Aschendorff.

Krenzlin, A. and Reusch, L., 1961. Die Entstehung der Gewannflur nach Untersuchungen im nördlichen Unterfranken. Textband und Kartenband. *Frankfurter Geographische Hefte*, 35, 1-132.

Krnáčová, Z., Hreško, J. and Vlachovičová, M., 2016. An evaluation of soil retention potential as an important factor of water balance in the landscape. *Moravian Geographical Reports*, 24, 44 -54.

Kreyenschulte, S and Spannhoff, C., 2017, Neue Ergebnisse der Siedlungsgeschichtsforschung – an nordmünsterländischen Beispielen. *Beiträge zur westfälischen Familienforschung,* 75, 129-151.

Kröll, U., 2010. *Das Geschichtsbuch des Münsterlandes*. Münster: Agenda Verlag.

Lagerbuch Epe 1679. Available from: http://wiki-de.genealogy.net/Epe [Accessed 05 September 2017]

Lagerbuch Heek 1679. Available from: http://wiki-de.genealogy.net/Heek [Accessed 31 October 2017]

Lensing, H. and Robben, B., 2015. "Wenn der Bauer pfeift, dann müssen die Heuerleute kommen!" Betrachtungen und Forschungen zum Heuerlingswesen in Nordwestdeutschland. Studiengesellschaft für Emsländische Regionalgeschichte, Haselünne. Lingen: van Acken.

Leuschner, C. and Ellenberg, H., 2017. *Ecology of Central European Forests (Vegetation Ecology of Central Europe, Volume 1)*. Berlin and Heidelberg: Springer.

Löw, K.F.L. von, 1829. *Über die Markgenossenschaften*. Heidelberg: Mohr.

LUA, 2001. *Referenzgewässer der Fließgewässertypen Nordrhein-Westfalens; Teil 2: Mittelgroße bis große Fließgewässer*. Merkblätter 29. Landesumweltamt NRW, Essen.

Manzi, A., 2008. *Legumi della montagna abruzzese*. Atessa, Italy: Talea Edizione.

Manzi, A., 2013. *Storia dell'ambiente nell'Appennino Centrale*. Pescarabruzzo: Meta Edizione & Fondazione.

Manzi, A., 2016. L'agricoltura nel Parco della Majella [Agriculture in the Majella National Park]. *In*: L. di Martino *et al.*, eds. *Aspetti peculari ed originali.* Caramanico Terme, Italy: Majambiente Edizioni, pp. 58-68.

Matzat, W., 1988. Long strip field layouts and their later subdivisions: a comparison of English and German cases. *Geografiska Annaler*. *Series B, Human Geography*, 70, 133 -147.

Mc Closkey, D. N. 1989. The Open Fields of England: Rent, Risk, and the Rate of Interest, 1300-1815. *In*: D.W. Galenson, ed. *Markets in History: Economic Studies of the Past.* Cambridge University Press, pp. 5-51.

Middendorff, R., 1927. Der Verfall und die Aufteilung der gemeinen Marken im Fürstentum Osnabrück bis zur napoleonischen Zeit. *Mitteilungen des Vereins für Geschichte und Landeskunde von Osnabrück*, 49, 1-157.

Mölder, A., 2009. Eine hochmittelalterliche Bischofsvita als wertvolle Quelle zur Wald- und Vegetationsgeschichte – Die "Vita Bennonis" des Norbert von Iburg. *Forstarchiv*, 80, 203-207.

Mölder, A., 2016. Small forest parcels, management diversity and valuable coppice habitats: an 18th century political compromise in the Osnabrück region (NW Germany) and its long-lasting legacy. *iForest*, 9, 518-528.

Müller-Wille, W., 1952. *Westfalen – Landschaftliche Ordnung und Bindung eines Landes*. Münster: Aschendorff.

Naber, J. *et al.*, 1998. *‚Status animarum', ein Seelenverzeichnis von 1749/50*. Epe in der Vergangenheit IV. Heimatverein Epe e.V., Gronau-Epe: 139-201.

Nacke, A. 1996. *Markenrecht und Markengerichtsbarkeit im Münsterland*. Münster: LIT Verlag.

Niemeier, G., 1944. Gewannfluren, ihre Gliederung und die Eschkerntheorie. *Petermanns Geographische Mitteilungen*, 90, 67-74.

Nielsen, N.H. and Dalsgaard, K., 2017. Dynamics of Celtic fields. A geoarchaeological investigation of Oster Lem Hede, Western Jutland, Denmark. *Geoarcheology,* 32, 414-434.

Nightingale, M., 1953. Ploughing and field shape. *Antiquity*, 27, 20-26.

NRW-Atlas. https://maps.kreis-borken.de/atlasfx_bildungskreis; www.tim-online.nrw.de/tim-online; [Accessed 10 September 2017].

Olde Meierink, L.H.M. 1980. *Monumenten van Losser*; deel 1. Losser: Stichting Historische Kring. Oosthuizen, S., 2006. *Landscapes decoded: the origins and development of Cambridgeshire's medieval fields.* Hatfield: University of Hertfordshire Press.

Oosthuizen, S., 2011. Archaeology, common rights and the origins of Anglo-Saxon identity. *Early Medieval Europe*, 19, 153-181.

Overton, M., 1996. *Agricultural revolution in England: the transformation of the agrarian economy, 1500-1850.* Cambridge: Cambridge University Press.

Planhol, X. de, 1968. Geography of settlement. The Land of Iran. *In*: W.B. Fisher, ed. *The Cambridge history of Iran.* Cambridge: Cambridge University Press, pp. 409-468.

Pöll, C., 2015. Transformationsprozesse in der alpinen Milchwirtschaft des späten 19 Jahrhunderts. Die Einführung der Hartkäseerzeugung auf den Gemeinschaftsalmen des Nordtiroler Unterlandes. *In*: N. Grüne, J. Hübner and G. Siegl, eds. *Rural Commons*. Innsbruck: Studien Verlag, pp. 218-238.

Postan, M.M., 1972. The Medieval Economy and Society: An Economic History of Britain, 1100-1500. Berkeley and Los Angeles: University of California Press.

Pott, R. and Hüppe, J., 1991. Die Hudelandschaften Nordwestdeutschlands. *Abhandlungen aus dem Westfälischen Museum für Naturkunde*, 53, 1-313.

Premrl, T. , Udovč, A., Bogata, N. and Krč, J., 2015. From restitution to revival: A case of commons re-establishment and restitution in Slovenia. *Forest Policy and Economics,* 59, 19-26.

Rackham, O., 1980. *Ancient woodland; its history, vegetation and uses in England*. London: Edward Arnold.

Renes, H., 2010. Grainlands. The landscape of open fields in a European perspective. *Landscape history*, 31, 37-70.

Renes, H., 2016. Landscape history and archaeology of open fields in Europe. Agrarian technology in the medieval landscape. *Ruralia*, 10, 255-265.

Riepenhausen, H. and Schüttler, A., 1986. „Die bäuerliche Siedlung des Ravensberger Landes bis 1770" von Hans Riepenhausen 1938 mit einem Nachtrag „Das Ravensberger Land 1770-1986" von Adolf Schüttler. *Siedlung und Landschaft in Westfalen*, 19, 1-172.

Schad, P., 2009. German soil classification. In: P.V. Krasilinikov, ed. *A handbook of soil terminology, correlation and classification*. London: Earthscan, pp. 122 -130.

Schlumbohm, J., 1992. From peasant society to class society: some aspects of family and class in a northwest German protoindustrial parish, 17th-19th centuries. *Journal of Family History*, 17, 183 -199.

Schuknecht, F., 1952. Ort und Flur in der Herrlichkeit Lembeck. *Westfälische Geographische Studien*, 6, 1 -91.

Siemsen, M., 2015. „Unser Stift hat seine Bevölkerung blos der Arbeit in Holland zu danken" – Hollandgang und Hollandgänger aus der Perspektive Justus Mösers. *Heimatjahrbuch Osnabrücker Land*, 2015, 15-24.

Sieverding, W., 1986. Langstreifenflur und Drubbel im Licht der heutigen Forschung. *Jahrbuch für das Oldenburger Münsterland*, 35, 33-43.

Slicher van Bath, B.H. 1944, 1972. *Mensch en land in de middeleeuwen. Bijdrage tot de geschiedenis der nederzettingen in Oostelijk Nederland*. Thesis (PhD). University of Amsterdam.

Slicher van Bath, B.H., 1960/1963/1976. *De agrarische geschiedenis van West-Europa 500-1850*. Utrecht/Antwerpen: Het Spektrum / *The agrarian history of Western Europe, A.D. 500-1850*. London: Arnold (page numbers in the text refer to 1976 edition)

Slicher van Bath, B.H., 1975. De demografische ontwikkeling tijdens de republiek. In: *Vaderlands verleden in veelvoud; 31 opstellen over de Nederlandse geschiedenis na 1500*. The Hague: Martinus Nijhof, pp. 312-337.

Spek, T., 2004. *Het Drentse Eschdorpenlandschap. Een historisch, geografische studie*. Utrecht: Uitgeverij Matrijs.

Spek, T., 2006. Entstehung und Entwicklung historischer Ackerkomplexe und Plaggenböden in den Eschlandschaften der nordöstlichen Niederlande (Provinz Drenthe). *In:* W. Schenk and H. Bergmann, eds. *Ein Überblick über die Ergebnisse interdisziplinärer Forschung aus neuester Zeit*. Siedlungsforschung. Archäologie – Geschichte – Geographie, 24. Bonn: Arkum, 219-250.

Uhlig, H., 1961. Old hamlets with infield and outfield systems in Western and Central Europe. *Geografiska Annaler*, 43, 285-312.

Stroink, L.A., 1962. *Stad en land van Twente*. Hengelo: Drukkerij Smith.

Strotdees, G., 2017. *Im Anfang war die Woort – Flurnamen in Westfalen*. Bielefeld: Verlag für Regionalgeschichte.

Thirsk, J., 1964. The common fields. *Past & Present*, 29, 3-25.

Thomas, G. *et al*., 2016. Technology, ritual and Anglo-Saxon agrarian production: the biography of a seventh-century century plough coulter from Lyminge, Kent. *Antiquity*, 90, 742-758.

Tibus, A., 1867. *Gründungsgeschichte der Stifter, Pfarrkirchen, Klöster und Kapellen im Bereiche des alten Bisthums Münster mit Ausschluß des ehemaligen friesischen Theils*. Münster: Friedrich Regensberg.

Vasudevan, H.S., 1988. Peasant land and peasant society in Late Imperial Russia. *The Historical Journal*, 31, 207-222.

Verlinde, A.D., 2004. De Germaanse nederzetting te Denekamp binnen een regionaal archeologisch kader van de Romeinse tijd. *Overijsselse Historische Bijdragen*, 119, 57-92.

Vries, J. de, 1976. *The economy in an age of crises; 1600-1750*. Cambridge: Cambridge University Press.

Wiens, J.A., 1989. Essay review; spatial scaling in ecology. *Functional Ecology*, 3, 385-397

Wigger, D., 1998. Die Teilung der Eilermark. *Bürgerbuch Gronau und Epe*, 9, 238-241.

Willemse, N.W. and Groenewoudt, B.J., 2012. Resilience of Meta-Stable Landscapes? The Non-Linear Response of Late Glacial Aeolian Landforms to Prehistoric Reclamation along Dutch River Valleys. *eTopoi. Journal of Ancient Studies*, 3, pp. 245 -55.

Wilming, W., 1993. Eine Viehzählung im Kirchspiel Epe Anno 1534. *Bürgerbuch Gronau und Epe*, 3, 154-157.

Winkelmann, W., 1980. Zur Frühgeschichte des Münsterlandes. *Führer zu vor- und frühgeschichtlichen Denkmalen*, 45, 175-210.

Winterhalder, B., 1990. Open field, common pot: Harvest variability and risk avoidance in agricultural and foraging societies. *In:* E. Cashdan, ed. *Risk and Uncertainty in Tribal and Peasant Economies*. Boulder, Colorado: Westview Press, pp. 67-87.

Supplemental online material S1

GLOSSARY

Englisch terminology as in this article with Low Saxon, German and/or Dutch equivalents

Low Saxon is the language of the toponyms used in the 1827 A.D. cadastre and in the pertinent literature on the strip-field system in the wider AOI. For additional toponyms see Strotdrees (2017) and for common land, common's institutions and commoners see Gils *et al*. (2014).

ENGLISCH	LOW SAXON	GERMAN	DUTCH
abolition of serfdom	n.a.	Bauernbefreiung	afschaffing horigheid
ancestral farmstead	Vollbauer/Vollerbe/(ge)heele Erbe	Vollerbenhof	volgewaarde
ard plough		Hakenplug	eergetouw
bog (*Sphagnum*)	Venne	Venn	veen
cadastral district	n.a.	Gemarkung	kadastrale gemeente
camp	Kamp	Kamp	kamp/kemp/kavel
camps	Kämpe	Kampen	kampen
Celtic field	n.a.	Kammerflur	raatakkersysteem
checkerboard field system	n.a	Blockflur	
closed corporation holding land rights	Marke (*multi-hamlet*) Bauerschaft/buurschap (*single*)	Mark Bauerschaft	Marke buur(t)schap
cluster hamlet	n.a.	Haufen	gehucht
common land	Mark/Gemeinheit/Heide/Feld	Allmende (e.g. Alps)	mark(e)
common institution	Gemeinheit/Marke	Mark	(boer)marke
consolidation (of parcels)	n.a.	Verkoppelung Flurbereinigung	ruilverkaveling
cover sand	n.a.	Flugsand	dekzand
enfolded	n.a.	eingefriedet	omheind
estate (> one farm(stead)	Gut	Gut	landgoed
farmstead	Hof(f)/Hofstede	Hofstelle	hoeve/boerderij
freehold	(schatz)freies Hof/Gut		vrije boer
hamlet (no church)	Bauerschaft/buurschap	Weiler	buurtschap
hay-meadow	Mate/Mote	Mähwiese	hooiland/made(landen)
headman	Burrichter/Schulze/Schulte		boerrichter/scholtenboer

Headman's farmstead	Schulzehof/Schultenhof	Haupthof	scholtenboer
heathland	Heide	Heide	heide
house camp	Hofkamp/Hauskamp	hofnahe Blockflur .	huiskamp
impartial inheritance	n.a.	Anerbenrecht	Saksisch erfrecht
landless farmhand/crofter	Heuerling/Backhäusler	Heuerling	boerenknecht
linear hamlet	n.a.	Reihensiedlung	flank-es-nederzetting
leasehold-for-life	Lieftucht/lijftucht	Leibzucht	pachtboerderij
levee (*natura*l)	n.a.	Uferwall	oeverwal
magistrate (*Marke*)	Markenrichter	Markenherr	holtrichter
manorial landlord	Grundherr	Grundherr/Gutsherr	grondheer
market town	Wigbold/Weichbild	Marktstadt	marktstad
(hay-)meadow	Mate/Mote	(Mäh-)Wiese	hooiland
mouldboard plough		Kehrpflug	keerploeg
oak camp	Telgenkamp/Eichelkamp/Höff	Eichenkamp	n.a.
open field/open strip-field	Esch/Esk	Esch/Langstreifenflur	es/enk (*meermans*)
parcel		Parzelle/Grundstück	perceel/kavel
parish	Kirchspiel/kerspel	Kirchspiel	kerkgemeente
Partition of commons	n.a.	Markenteilung Gemeinheitsteilung	markendeling
peasant	Kötter	Kleinbauer	keuter boer
Plaggic soil/Anthrosol	n.a.	Plaggenesch	enkeerdgrond
prince-bishop	Fürstbischof	Fürstbischof	wereldlijke/bischoppelijke landsheer
regional civil court	Gogericht	Volksgericht	volksgerecht
regulations of common	Verkörung/Willkeur	Markenordnung/ Markenverfassung	markenrechten
share of (land) use right	Ware/waar	Anteil	aandeel
shareholder	Erbe/gewaarde/eigengeerfde	Erbe	erfgenaam
shareholder meeting	Hölting/holting/marckenspraecke	n.a.	n.a.
short-strip field	Leinenland/lienlanden		vlasakkers
synchronous cropping		Flurzwang	n.a.
sod	Plagge	Plagge	plag/scharre

squatter	Brinksitzer/brinksitter/bi-sitter	n.a.	n.a.
smallholder/cottager	Kötter/Erbkötter/Pferdekötter		koter/keuter boer
steep edge	n.a.	Eschkante	steilkant
territorial landlord	n.a.	Landesherr	landsheer
strip-field; see open field			
tower castle	Turmburg/Turmburcht	Turmburg	donjon/kasteeltoren
veld (SA English)	Feld (Marke)		broader in modern NL
village (with church)	Dorf	Dorf	dorp/kerkdorp
worth	Woorte	n.a.	woerd

Supplemental online material S2

Individual strip hamlets

The medieval name of the **Langeseite hamlet**, *´Lange Zeihl´* means long line (Naber *et al*. 1998). The hamlet is situated on the western levee of the river Dinkel (Fig. 2). The linear farmstead settlement was located between the classical long-strip field and the common. The hamlet was composed of eight large to medium strip estates with on average five strips. The hamlet stood out by it high number of leaseholds-for-life and meadows (Table 1). Unusually, the parcel shape of meadows ranged from strip to camp, suggesting pre-cadastral LUC conversion. The farmstead parcel was surrounded by an oak camp and two to five house camps. All farmsteads held either disjunctive meadows and/or camp parcels. Most of the strips were oriented perpendicularly to the river Dinkel, but two blocks of strips were laid out at an angle with the dominant cardinal direction. All strips and house camps were associated with Plaggic Anthrosol raised one to two meters above the bordering hay-meadows. Additional camps and the farmsteads were located on Gleyic Podzol. The raised strip-field showed anthropogenic steep edges down to the Dinkel meadows over considerable distance, as did a few camps along the Rottbach rivulet.

The name Brinkerhook is relatively recent; in 1750 A.D., it was part of Langeseite (Naber *et al*. 1998). In 1827, **Brinkerhook hamlet** consisted of a linear strip sub-hamlet and a camp sub-hamlet of smallholdings without garden, meadow or tree camp (Fig. 2; Table 2). These smallholdings upgraded their tenure from squatter in 1679 A.D. to leasehold-for-life in 1710 A.D. and smallholding in 1750 A.D. (Naber *et al*. 1998). The headman estate (Schulze Dinkelborg) was among the eldest on record (1198 A.D.) in the AOI. This ancestral farmstead was situated at the riverine side of the strip-field unlike all others that were located near the common. The linear sub-hamlet stood out by its high number of leaseholds-for-life (Table 1). Both leaseholds and smallholder camps are situated on the common's side of the estates suggesting relatively recent colonies. Evidently, these squatters (*Brinkers*)/smallholders provided the contemporaneous name to the hamlet. Both camps and strips were associated with Plaggic Anthrosol without any steep edges. Some camps were situated on Gleyic Podzol.

The **Wieferthook hamlet** was named after its then largest estate Wieffert, aka Wyffort, a family name in the wider AOI. The hamlet was known in the medieval period as Slade after the Schlamann estate that held the headman position (Kemper 1998; Naber et al. 1998). Seven estate owners of ten farmsteads are recorded in the hamlet (Table 2). One was a smallholder (named Kotte) with a single strip and three camps. The six medium to large holdings were strip farms with an average number of strips in its section (Kottker/Kottige Esch) of the long open field (Lange Esch), house camps and camps further away from the farmstead. Two holdings included a meadow, the two others oak camps. Both camps and strips were associated with Plaggic soils raised one to two meters above the bordering hay-meadows with steep edges at the riverside.

The pre-cadastral name of the **Gerdingseite hamlet** was *´Gerding Zeihl´*; the first term referred to a farmstead (Gerd's place; Gerd-ing), the second to the linear farmstead settlement (Naber et al. 1998). Seven large to medium strip estates were lined up on the inland side of the strip-field (Fig. 2). Further inland, two clusters of small to large camp farms bordered the common (Tables 1 and 2). The headman's estate (Schulze Tenberge) was an anomaly within the AOI. It held no strips, but instead two exceptionally large camps at the levee contiguous with the strip-field (Tables 2 and 6). The strip farms held an above average number of meadows and camps; similarly, the farms in camp sub-hamlet contained relative high number of camp parcels (Table 2). The parcel shape of meadows ranged from strip to camp as in the Langeseite, suggesting pre-cadastral land use change. Five of the camp farms in the Gerdingseite were small to medium leaseholds-for-life of the larger hamlet estates in 1710 A.D., similar to the situation in Brinkerhook camp sub-hamlet. Two family/farm names (Brinkschnieder; Kötter) refer to a lesser tenure class; their farms were bordering the common. The hamlet contained a classical long strip-field bounded by riverine hay-meadows and inland house camps. Both strips and camps were associated with raised (one to two meter) Plaggic soils. In several places, the strip-field was laid out at two levels and has anthropogenic steep edges with associated drainage ditch on the meadow and partly along the hinterland side.

The large **Kloster hamlet** (twenty-nine estates) bordered Epe village to the north. In the absence of a monastery (*´Kloster´*), the hamlet name may have referred to enclosure (*´Cloester´*). Ten smallholdings of the hamlet held only one or two parcels and were in effect rural village residences. Two of those residences were located on a strip, a feature unknown elsewhere in the AOI at the time, but common later during village expansion. On average, the strip farms contained fewer strips than elsewhere in the AOI. However, the estate of the former manorial landlord (von Oer), the headman (Schücking) and the largest estate (Wolbert) held a similar number of strips as farmsteads in other hamlets (Table 2). Another farmstead (Niehoff), notwithstanding its name meaning new farm, contained two worth parcels, suggesting a history as long as the hamlets to the south. Finally, Kloster included only a single medium-sized camp farm, the majority of camp farms were smallholdings (Table 1). The largest estate with four leaseholds-for-life was owned by an absentee former landlord (*'Freiherr'*). Most of the hamlet is associated with well-drained Plaggic Anthrosol (Table 1 and 2).

The small **Riekenhof hamlet** was situated at the northern fringe of the Kloster hamlet and consisted of three farms: the large Rieke camp holding, a medium-sized strip farm with holdings on the NW-field and a smallholding. Most camps were situated on well-drained raised Plaggic Anthrosol, the more recent according to their toponyms (*´Niengrund; nie Kämpken´*) on poorly drained Podzol (Table 2). The small Storkerhook hamlet at the eastern village fringe bordering the common was named after its largest estate (Gut Stork), that included camps, a substantial holding in the SE strip-

field and meadows along the river Dinkel. Two other farmsteads each held ten camps (Table 1). In addition, the hamlet contained three homesteads holding land. Only the large estate was associated with well-drained Plaggic Anthrosol, the camp farms with Gleyic Podzol (Table 2).

Individual camp hamlets

Floodplain camp hamlets

The large **Kottigerhook camp hamlet** is situated opposite Epe village west of the river (Fig. 2). '*Kottiger*' may refer to Köttig, the owner of the largest estate. Family and hamlet name refer to smallholder (´*Kotter*´). The hamlet is a conglomerate of two parallel linear settlements in the north and a cluster in the south. The linear alignments follow a rivulet and the ploughing frontier at the common respectively. The southern cluster is associated with a second Dinkel tributary (Table 2). Only the largest estate, originally part of the Slade/Wieferthook hamlet (Kemper 1998) held strips. The number of hay-meadows per owner was comparably high (Table 1). The camps are associated with raised (one meter) Plaggic Anthrosol without steep edges along the floodplain meadows, but further inland some camps showed anthropogenic steep edges. The Plaggic Anthrosol occurs in a matrix of Gleyic Fluvisol associated with two Dinkel tributaries (Table 2).

The small **Sunderhook hamlet** around the large Sundermann estate was not depicted on the first topographic map. The toponym ´ *Sundern*´ referred to a slice of the common sold to a natural person (Strotdrees 2017). The second major estate was held by the count of Bentheim in addition to his extensive estates in and around market town Gronau. Beyond the two large holdings, the hamlet contained two smallholdings. Given the position of the two hamlets close to the river Dinkel (Fig. 2), the absence of a strip field seemed striking at first. It is explained by the local gap in the Dinkel levee with a matrix of Gleyic Fluvisols related to rivulets and river floodplains. Camps were associated with Plaggic Anthrosol (Tables 2 and 6). The two camp hamlets in the floodplain did contain neither a farmstead with a medieval record, nor a farmstead with an attached headman position in contrast to the enclave camp and strip hamlets. These absences combined with the hamlet names suggest a relatively recent colonisation.

Enclave camp hamlets in the common

The hamlets were situated at slightly elevated and therefore well-drained terrain, the hill or rivulet levees and therefore arable enclaves in the common. The founding farms in each of the hamlets, Bergesbuer/Barlo (Am Berge), Füchtemann (Füchte) and Kernebeck (Lasterfeld) were on record from the literate high medieval period, contemporaneously with the levee hamlets, but unlike three other camp hamlets west of the Dinkel river (Kemper 1990).

The **Am Berge or Mühlenberg hamlet** is located at the only hill in the AOI (Fig. 2). Twenty camp estates constituted the hamlet. Eleven were smallholdings. The three large estates included leasehold-for-life farmsteads. The hamlet common was held by Epe village (´*Gemeinde*´), the surrounding fenland by a multi-hamlet common. Camps were mostly associated with well-drained Plaggic Anthrosol, but some with unimproved poorly drained Podzol as was the central common (Tables 1, 2 and 6).

'*Füchte*' (moist) appeared in the name of the **Füchte hamlet**, the surrounding multi-hamlet common (Füchter Feld) and the largest farm (Füchtermann). The hamlet consisted of two enclaves in

the common to the east of Epe village (Fig. 2). The larger enclave was an open cluster settlement with seven owners of eleven camp-farms and the smaller one a linear settlement of four camp farms along a rivulet (Table 1). The two enclaves were separated by a hamlet common (Mühlenriete) owned by Epe village. None of the landowners was linked by property or relatives to Epe village. Three landowners each held a share in a common (Ammerter Mark) just outside the parish (Kemper 1998). The hamlet contained six medium to large holdings and five smallholdings, one of the latter parish-owned. The camps were associated with well-drained Plaggic Anthrosol, the central and surrounding commons with Gleyic Podzol and Stagnosol (Tables 2 and 6).

The **Lasterfeld hamlet** consisted of two rivulet-associated estates with four farmsteads at the southern edge of the Laster Venn multi-hamlet common (Fig. 2 and Table 2). The hamlet was known in medieval times as *`Lasterhusen´* meaning last houses (Kemper 1998). The large estates embrace the property of the owner-occupier and two leaseholds-for-life and together contain relatively large crop, pasture and wood holdings; the second was a medium-sized camp farm (Table 1). Both estates were associated with Plaggic Anthrosol on levees, their camps raised (one to two meters) and partly with steep edges (Table 2).

Four dispersed camp-farms were situated in the **Amtsvenn/Frielers Venne** far apart in the southwestern uncultivated corner of the parish (Fig. 2), three smallholdings and one medium-sized holding. The absence of Plaggic Anthrosol combined with conifer camps suggests a relative recent settlement (Tables 1, 2 and 6).

Supplemental online material S3

Supplement T1. Household (HH) composition at large-medium farms (*Voll*- und *Halberbe*) in 1660 A.D. at Hollich hamlet, Burgsteinfurt; compiled from Dertwinkel (2015, pg. 137-9)

Serial No	Source No	HH	Man	Woman	Child *	Labour **	Pauper
1	4	3	1	1	1		
2	5	4	1	1	2		
3	6	4	1	1		2	
4	10	4	1	1	1	1	
5	12	4	1	1	1	1	
6	13	4	1	1		2	
7	14	5	1	1	1	1	1
8	22	4	1	1	1	1	
9	35	4	1	1	1	1	
10	36	4	1	1	1	1	
11	37	4	1	1		2	
12	40	4	1	1	1	1	
13	41	4	1	1		2	
14	43	2	1	1			
Mean		**4**	**1**	**1**	**0.7**	**1**	

**Older than 12-14 years; younger children were not recorded*

***Celibate Knecht* (male) or *Magd* (female)

Supplement T2. Household (HH) composition of smallholders (*Kötter* and *Brinksitzer*) in 1660 A.D. at Hollich hamlet, Burgsteinfurt; compiled from Dertwinkel (2015, pg. 137-9)

Serial No	Source No	HH	Man	Woman	Child *	Labour **	Pauper
1	1	2		1		1	
2	2	2	1	1			
3	3	3	1	1		1	
4	7	1	1				
5	8	3	1	1		1	
6	9	2	1	1			
7	11	4	1	1		2	
8	15	3	1	1	1		
9	16	3	1	1	1		
10	17	3	1		1		1
11	18	3	1	1	1		
12	19	2	1	1			
13	20	3	1	1			1
14	21	3	1	1		1	
15	23	3	1	1	1		
16	24	5		1	1	2	
17	25	2	1	1			
18	26	4	1	1	1	1	
19	27	3	1	1		1	
20	28	4	1	1		2	
21	29	2	1		1		
22	30	2	1	1			
23	32	4	1	1		2	
24	33	3	1	1	1		
25	38	3	1	1		1	
26	39	2	1		1		
27	42	2	1	1			
28	44	3	1	1	1		
Mean		**2.9**	**1**	**1**	**0.4**	**0.5**	

Supplement T3. Household (HH) composition at large-medium farms (*Voll*- und *Halberbe*) in 1660 A.D. at Sellen hamlet, Burgsteinfurt; compiled from Dertwinkel (2015, pg. 139-41)

Serial No	Source No	HH	Man	Woman	Child *	Labour **	Pauper
1	5	4	1	1	2		
2	6	3	1	1		1	
3	7	2	1	1			
4	17	3	1	1	1		
5	22	4	1	1		2	
6	28	2	1	1			
7	29	3	1	1			1
8	34	2	1	1			
9	35	3	1	1	1		
Mean		**2.9**	**1**	**1**	**0.4**	**0.3**	

Supplement T4. Household (HH) composition of smallholders (*Kötter* and *Brinksitzer*) in 1660 A.D. at Sellen hamlet, Burgsteinfurt; compiled from Dertwinkel (2015, pg. 139-41)

Serial No	Source No	HH	Man	Woman	Child *	Labour **	Pauper
1	1	4	1	1		2	
2	2	3	1	1		1	
3	3	3	1	1		1	
4	4	2	1	1			
5	8	2	1	1			
6	9	3	1	1		1	
7	10	3	1	1	1		
9	12	3	1	1	1		
10	13	3	1	1	1		
11	14	2	1	1			
12	15	3	1	1			
13	16	3					
14	18	3					
15	19	1	1				
16	20	1	1				
17	21	1					1
18	23	6	1	2	2	1	
19	24	3	1	1	1		
20	25	3	1	1	1		
21	26	3	1	1			1
22	27	3	1	1	1		
23	30	2	1	1			
24	31	2	1				1
25	32	3	1	1		1	
26	33	3	1	1	1		
Mean		**2.6**	**0.8**	**0.8**	**0.4**	**0.3**	

Supplement T5 Household (HH) composition at large-medium farms (*Voll*- und *Halberbe*) in 1660 A.D. at Veltrup hamlet, Burgsteinfurt; compiled from Dertwinkel (2015, pg. 141-2)

Serial No	Source No	HH	Man	Woman	Child *	Labour **	Pauper
1	1	5	1	1	2		
2	2	4	1	1		2	
3	5	5	1	1	2	1	
4	7	5	1	2		3	
5	8	4	1	1	2		
6	9	5	1	1	2		
7	12	4	1	1	2		
Mean		**4.6**	**1**	**1**	**1.7**	**0.9**	

Supplement T6. Household (HH) composition of smallholders (*Kötter* and *Brinksitzer*) in 1660 A.D. at Veltrup hamlet, Burgsteinfurt; compiled from Dertwinkel (2015, pg. 1412)

Serial No	Source No	HH	Man	Woman	Child *	Labour **	Pauper
1	3	3	1	1		1	
2	4	4	1	1		2	
3	6	4	1	1	2		
4	10	4	1	1		2	
5	11	4	1	1		2	
Mean		**3.8**	**1**	**1**	**0.4**	**1.4**	