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RE-EVALUATING MAPS OF DOMESDAY POPULATION DENSITIES:

A case study from the Cambridgeshire fenland

By SUSAN OOSTHUIZEN[1]

Abstract

Professor Sir Clifford Darby's county, regional and national maps of a range of data drawn from the Domesday Book revolutionized scholarship on the social and economic history of late Anglo-Saxon England (e.g. 1935, 1936a, 1936b, 1971, 1977). While this paper does not seek to challenge Darby's general conclusions, a case study re-examination of the inter-relationship between population density and physical geography in the Cambridgeshire fenland in 1086 suggests the regional usefulness of methodological adjustments to his mapping. It indicates that the population density of the peat and silt fens in the late eleventh century may have been significantly higher than that shown in Darby's original maps, with implications for the contemporary social and economic history of eastern England.

Introduction

The magnificence of many fenland churches allows even a complete stranger to infer the large numbers of inhabitants in and general prosperity of the region during the Middle Ages (Figs 1, 2).

Its affluence is confirmed in the lay subsidies of 1327, 1332 and 1334. Settlements on the silt fens (for which there is the most information) were so prosperous that they generated among the highest returns per square mile and per vill in England, as well as some of the highest rates per taxpayer (Campbell and Bartley 2006: Maps 18.3, 18.13). Although only 20% of English settlements paid more than £225 in 1334, that select group includes not only Ely (paying £358), Leverington (paying £360), and Wisbech (paying £410) but almost every other silt fen vill (Glasscock 1973: 181–3; 1975: 28, 107, 168–9). Wealth was relatively widely distributed: more than 60 lay inhabitants paid the subsidy in each fenland vill (Campbell and Bartley 2006: Map 18.8); and across the three subsidies the average value of the twentieth (in 1327) or tenth (in 1332 and 1334) of each individual's moveable goods ranged between £2.10s. and £3 (Campbell and Bartley 2006: 18.13). By 1334 the fen basin was among the wealthiest and most populated regions of England (Campbell and Bartley 2006: Maps 18.8, 18.9d).

At Domesday, by contrast, an underpopulated, underexploited landscape was revealed in H. C. Darby's maps of densities of population and ploughteam per square mile across the fen basin (1935: 40; 1971: 289, 296; Figure 3a, c). In fact, population densities in fenland were so low that a mappable result could only be achieved by combining the four hundreds of the Isle of Ely into two pairs (e.g. Figure 3b and c), rather than following his conventional practice of using individual hundreds as a base (which, by averaging population across a number of vills, smoothed inconsistencies and made it easier to compare regions). His calculations showed that there were just 0.9 tenants for every square mile in Wisbech and North Witchford Hundreds, and around 3.3 per square mile in Ely and South Witchford Hundreds. These figures are exceptionally low when compared with upland Cambridgeshire south of the River Ouse where the average was around 9 tenants per square mile, leading Darby to conclude that 'the sparse distribution of Domesday villages ... suggests that the Fenland was an area of comparative poverty in the eleventh century' (1940: 122).

Such judgements were consonant with early documentary sources which described a frighteningly wild and isolating landscape, penetrated only by a few explorers who liked it too little to stay. In 731 Bede described Ely 'surrounded on all sides by sea and fens' (Sherley-Price 1990: 237); just a few years earlier St Guthlac is said to have founded his hermitage at Crowland in 'a fen of immense size', an uninhabitable and 'uncultivated place of broad wilderness' infested by 'accursed spirits' (Swanton 1993: 93). A view, it might be said, which persisted into the mid-twentieth century when the Victoria County History described the fens north and east of Littleport as 'one of the loneliest pieces of country within a hundred miles of London' (VCH 4: 96). Archaeological excavations and stray finds appeared to confirm those accounts, intensive fieldwork indicating that 'early and middle Saxon sites in the Cambridgeshire fenland are few' (Hall and Coles 1996: 128).

The contrast across the fen basin between late eleventh-century poverty and early fourteenth-century wealth was thus established. The dominant interpretative model for explaining these differences was first developed in Darby's iconic *Medieval Fenland* (1940: 141–2). He argued that monastic houses, newly founded or re-established in the late tenth century, were catalysts for transforming management for subsistence before 1066 to management for substantial profit by about 1250. The results of Miller's research on the medieval economy of the abbey and bishopric of Ely supported these views, concluding that the objective of 'the Old English abbots' before 1066 had been 'consumption rather than profit' (Miller 1951: 42). By the mid-twelfth century a 'major revolution' had taken place: ecclesiastical institutions in

[1] University of Cambridge.

Figure 1 St Clement's church, Terrington St Clement. The 'Cathedral of the Fens' is cruciform in plan, and 168 feet long with a detached tower to the north.

fenland, whether monastic or episcopal, by then being intensely focused on commercial opportunity (Miller 1951: 43). The *Liber Eliensis* reported proudly before 1177 on 'the loveliness of its [the Isle of Ely's] fields and pastures' (Fairweather 2005: 213, my addition); Matthew Paris described in the mid-thirteenth century how 'a wonder has happened in our time; for in the years past, beyond living memory, these places were accessible neither for man nor for beast … This is now changed into delightful meadows and also arable ground' (cited in Darby 1940: 52). Large groups of lay tenants collaborated in the metamorphosis of the higher reaches of the fen; while many were enfeoffed with just a few acres each, collectively they were able to transform substantial areas. Widespread conversion of rough fen into meadows and pasture supporting immense herds of cattle grazing 'horn under horn' was – said Darby – 'a great revolution in economic geography' (1940: 141–2). The net income, for example, from the estates with which the bishopric was endowed in 1109 increased from £484 in 1086 to £2550 in 1298–9 (Miller 1951: 94). The consensus established by Darby and Miller persists today: 'The Fenland and Fen-edge economy that supported these extraordinary taxpayer numbers was largely a product of widespread colonization and reclamation during the previous 250 years [before 1334]' (Campbell and Bartley 2006: 331).

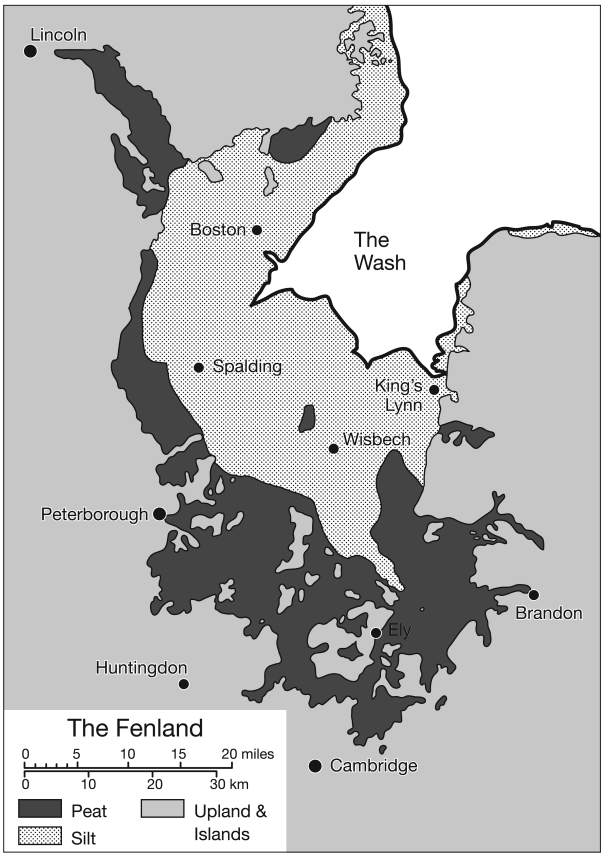

Figure 2 Geography of the medieval fenland (after Darby 1940).

Darby's maps

Darby's pioneering maps of eleventh-century England were based on the calculation per square mile, conventionally within each hundred, of densities of the settlements, ploughteam, tenants, manorial values and agricultural resources listed in the Domesday Book (1971, 1977; hereafter DB). His maps made it possible to compare the utilization of landscape and the vibrancy of regional economies across the country as a whole. The central issue for this paper is that Darby's method took no account of variations in physical geography. While he acknowledged that the maps often showed the impact of underlying geological conditions on arable cultivation –

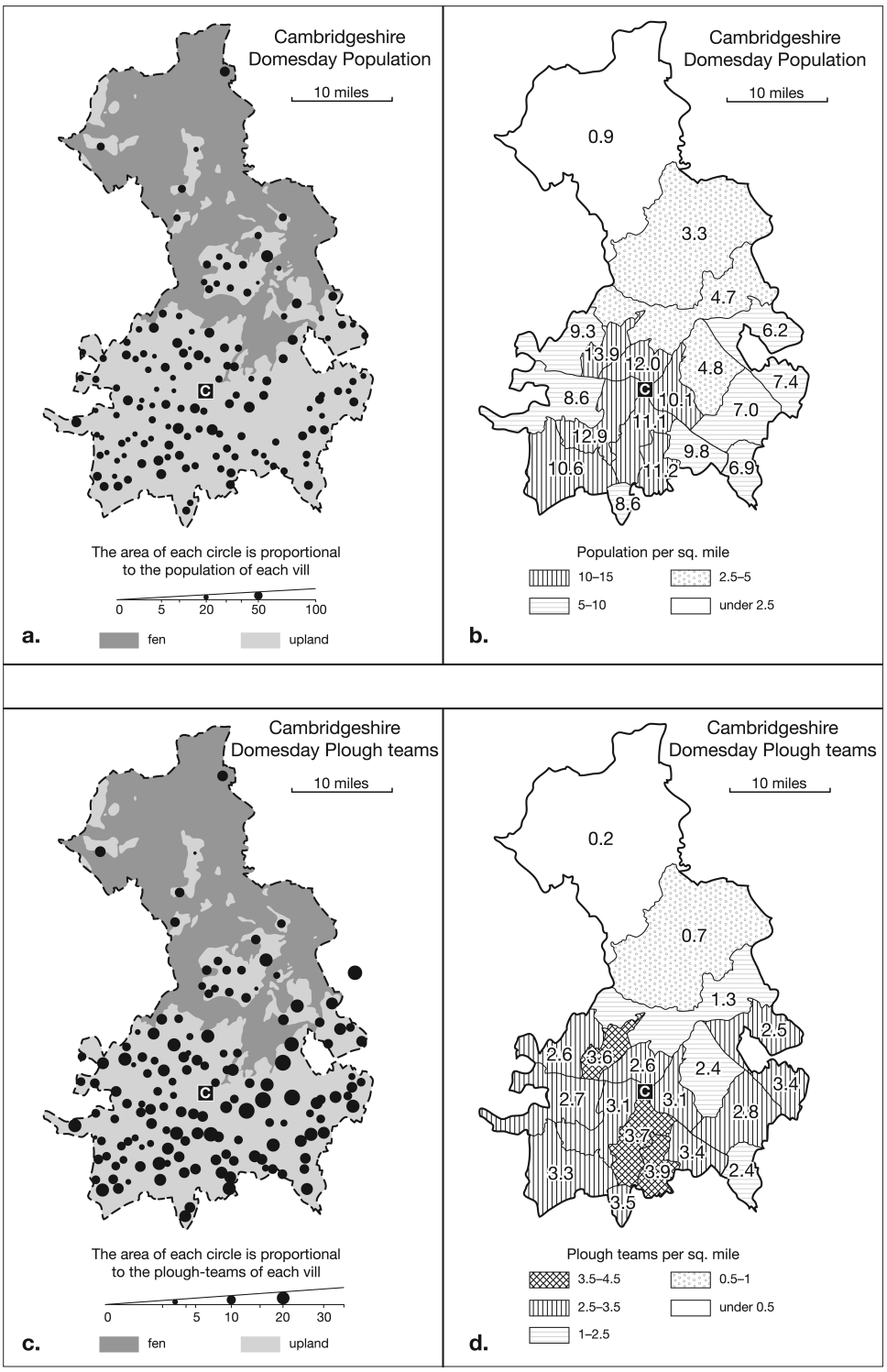

Figure 3 Darby's calculations of population and ploughlands in Cambridgeshire in 1086 (after Darby 1971).

for example, the way in which the infertile soils of the Mendips and the Chilterns inhibited ploughing – he also noted that there was not necessarily a direct correlation between difficult soils and arable cultivation, citing the extensive arable fields found on the easily-flooded Somerset Levels (1977: 128–9).

Since Darby's aim was a comparison of the distributions and densities of Domesday data across England as a whole, his approach could not substantially be criticized. If he had been required to temper his mapping with an acknowledgement of underlying physical conditions, all sorts of difficulties were likely to have followed. How 'severe' would geographic marginality have had to have been for the mapping process to take it into account? How was the boundary to be recognised between physical conditions which 'should' be identified in the mapping process, and those which 'need not'? If marginal land of one kind or another were to be recognised in his analysis, how should its physical limits be defined? That is, could criteria be identified that would assure consistency of analysis between one area and the next?

Darby sensibly took the most straightforward approach – simply to ignore the underlying geography and to take administrative units (generally hundreds) instead. He may have considered that on a country-wide scale differences between regions might perhaps in the end be less important than similarities. That decision appears to have been accepted by reviewers, most of whom focused not on his methodology but on the link between his maps and wider scholarship (cf. Postan 1954; Perry 1969; Harvey 1980; Palmer 1986; Hamshere 1987; Williams 1989; see also Darby 1960, 1962, 1977: 375–384). There has been little, if any, critique of the way in which the maps were constructed. Darby himself appears to have been bullish on this point: Harley noted Darby's 'belief in the descriptive objectivity and explanatory power of maps' to the extent that 'the map *bestowed objectivity*' (1987: 81, 84, my emphasis).

The problem

There is, nonetheless, a real problem in mapping the densities of population (and other indices of prosperity) in the eleventh-century Cambridgeshire fens. That difficulty lies in the extreme physical geography of the fen basin, where – unlike the uplands which surround it – there is no middle ground between land that is or is not available for settlement.

A brief digression into the character of the fens before drainage in the seventeenth century explains why this is the case. The fenland basin is, in effect, a vast delta for rivers that drain much of eastern and midland England and extends over 4,000 square kilometres (Figure 2). Water coming into the medieval fen, whether fresh or marine, was slow to drain across the barely-sloping basin floor and often caused flooding. The flood line – the level above Ordnance Datum above which settlement was securely beyond the reach of seasonal inundation – had stabilised at around 3.5m or 11½ ft above OD by the eighth century where it has remained, more or less, ever since (Hall 1987: 11). Land below that height flooded regularly in the long months between autumn and spring, and irregularly after unusually heavy and persistent periods of rain; raised peat bogs in many of these low-lying areas reached depths of 4m or more by about 1000 AD (Friday and Rowell 1997: 14); meres and lakes had formed in those pockets below sea level that were too low to drain (Figure 2). No-one in their right minds would settle here, and the homes and fields of anyone mad enough to try would have been submerged as soon as the waters began to rise, as they did from time to time each year. A number of 'islands' of higher ground stand proud of the flood-line in the peat fen – some larger, like Whittlesey, Chatteris, Doddington and Ely; others smaller, like Thorney, Norney, Littleport or Quaney. Along the shoreline of the Wash a broad band of inhabitable silt had been built up by the middle Anglo-Saxon period. Both islands and silts rose sufficiently high above sea level to offer locations for permanent settlement that lay safely above the highest floods.

The flaw in Darby's calculations, of course, was that they treated fenland as if its entire area was as habitable as the south Cambridgeshire uplands. This was clearly not the case, and the resulting comparison between vills and hundreds in upland Cambridgeshire and those in the fen basin showed densities across two quite different kinds of landscape, each with quite different carrying capabilities (Figure 3). The number of plough-teams per square mile in fenland is low because there are fewer acres that can be ploughed; the number of settlements is low because the flood line placed an absolute restriction on their location. The fenland distributions are all sparse because they are affected by the exceptional limitations of the physical geography and, to that extent, they are not comparable with upland parishes where almost all land is at least capable of being ploughed, and where physical geography places almost no restraint on the location of settlement. This means that, while Darby's comparison of densities of Domesday populations and ploughteam between fen and upland works well as an index of the influence of extreme geographic conditions on such variables, it is unjust in the terms in which he framed it: an index of social and economic vibrancy.

For Darby, what stood out from these maps was the poverty of the eleventh-century fenland basin (1935: 439). Although he recognised that 'the figures take no cognizance of variations within each county. The fens in Cambridgeshire, for example, brought down the average density for that county considerably' (1936a: 210), he was nonetheless sure that 'here is no vague generalization about the comparative values of fen and upland, but *definite statistical evidence*' for the impoverished condition of fenland in 1086 (1940: 122, my emphasis). Because the same methodological flaw underpins the calculations of densities of ploughteam and other measures of wealth in 1086, the distribution shown on each map confirms those on the others in a circular argument. Whether or not the maps of densities of population and plough-teams in fenland do indeed reflect poverty and under-exploitation is yet to be demonstrated. All they can really be said to show is the restriction placed by the flood line on the area available for settlement and arable cultivation. The point has been made convincingly in relation to the silt fens, where around 40% of the Norfolk parishes was marsh and fen and where, if these were taken into account, they were no poorer or wealthier than their upland neighbours (Silvester 1985: 111).

It is possible that, despite his apparent confidence, Darby may have been conscious of these anomalies. As early as 1940 *Medieval Fenland* explained that by the early eleventh century 'although the Fenland was but scantily peopled, and although much of it was marsh and water, yet even its waters were not without value; already its characteristic activities were not lacking in organisation and control' (Darby 1940: 14). Just over thirty years later, his unease with the characterization of fenland as underpopulated was implied by the publication of Figures 77–80, reproduced here in Figure 3a, b, c, d, of the *Domesday Geography of Eastern England* (1971: 284–5, 289–90). Figure 77 (Figure 3c) showed the number of ploughteam *per vill* while Figure 78 (Figure 3d), on the opposing page, mapped their densities *per square mile*. Figure 79 (Figure 3a) showed the numbers of tenants *per vill*, and Figure 80 (Figure 3b) – again on the opposing page – showed the density of tenants *per square mile*.

It is clear from Figures 77 (Figure 3c) and 79 (Figure 3a) that the respective numbers of ploughteam and

tenants per vill in the fenland were indistinguishable from those in the upland. This result stands in obvious contrast with the densities mapped on the opposing pages. Here was a conundrum – densities appeared to show under-development and poverty; the actual numbers told a different story of settlements and agricultural economies no different from those elsewhere in the county. That contradiction could easily be explained, of course, in terms of the available habitable area of settlements in fen and upland, but it presented a problem for characterising the fenland economy as impoverished and under-developed in 1086.

Although the arrangement in Darby's 1971 volume of these figures on opposing pages invited direct comparison between the raw numbers and densities for 1086, he did not comment on the contradiction between them beyond saying, 'the differences between fenland and upland are greater for ploughlands and ploughteam than for population' (1971: 295; see also 1977: 229–31). That is, he suggested that the explanation lay in the value brought to the fen economy by non-arable occupations. Yet his comments on the region's fourteenth-century prosperity explicitly acknowledged precisely those geographic problems in mapping fenland densities by square mile: 'although [in 1332], acre for acre, the fen country was not as wealthy as that of the upland, yet the fenland villages themselves seem to have been communities quite as prosperous as their upland neighbours' (1940: 130, my addition). The same comment could as easily have been applied to the material from DB but it was not. The problem in meeting head-on the discrepancy between his analyses of the data for 1086 and those for 1332 would have been directly to challenge the conclusion (and prevailing consensus) that there had been a 'remarkable change' in the circumstances of the fenland between those dates: 'In 1086, the prosperity of the upland was many times that of the Fenland. By 1332, the situation was reversed, and the greater part of the Fenland seems to have been many times as prosperous as that of the upland' (1940: 141).

This paper attempts to resolve that contradiction by asking what might be revealed about the prosperity of the fenland in 1086 if the population density of that region were calculated only in relation to inhabitable land lying above the flood line. Would the consensus continue to hold of fenland poverty in 1086, and an economic revolution in the region by 1300?

Sources and methods

Population density is a calculation of population at a known date over a specified area at the same date or its nearest approximation. The principal source for the late eleventh-century population of most English vills is DB, which lists the tenants and other land-holders in each vill. The problems with DB are well-known in this regard. Not all the population is enumerated – only those who are tenants, who are assumed to be heads of households, and it is that number which Darby properly used for his own calculations since it is, whatever its flaws, known. It is possible, perhaps even likely, that other landholders were not enumerated. Lewis was able to demonstrate that many landholders were omitted, especially Anglo-Saxon sub-tenants of those who are listed in DB (1995). Only those who were sufficiently prominent to be listed as jurors for one or another Cambridgeshire hundred were brought into recorded history. Any calculations of DB populations and population densities are quite possibly underestimates; the best that can be said about them is that the calculation errs on the side of caution.

Any reckoning of the area of a medieval fenland vill that was available for settlement is as fraught, since it depends on knowing both the extent of its parish and the area of fen within the parish: the subtraction of the latter from the former could supply the acreage of land available for settlement and cultivation. From this the population density for the area of dry land above the flood line can be estimated. There are any number of problems in attempting such a calculation, of which the most obvious are, first, in establishing the area of each medieval parish, and second, in establishing the eleventh-century area within it that was subject to seasonal flooding.

It is almost impossible to know the medieval acreages of fenland parishes from which we wish to subtract the area of fen in order to arrive at some idea of the land in each parish that was habitable. Changes to parish boundaries were often unrecorded before the later eighteenth century; in many cases, the first firm statement of parish acreages came with Parliamentary enclosure. The position in fenland was additionally complicated by large areas of medieval extra-parochial intercommons including Grunty Fen in the Isle of Ely, the vast tracts which lay between the Nene at March and the Catswater on the edge of the Northamptonshire uplands, and the huge area that separated the archipelago of Chatteris, Doddington, Wimblington and March in the west from the higher ground of Littleport and the Isle of Ely in the east (e.g. CUL EDR G3/27). By 1953, most of that extra-parochial land had either been allotted to neighbouring parishes in the process of parliamentary enclosure or utilized in the establishment of new parishes (VCH 4: 3). Large parts of previously intercommonable pastures were, for instance, absorbed by the parishes of Littleport, March and Outwell in the nineteenth century. An entirely new parish – Welches Dam – was created in 1883 from an extensive area of fen intercommonable by all the parishes to west and east; Manea, previously a hamlet of Coveney, also received parochial status in 1883 when an additional 4,000 acres of the same intercommon was allotted to it (VCH 4: 136, 138, 164–5).

Such illustrations reveal how the combination of a lack of documentation and substantial changes in administrative boundaries make it all but impossible to establish a precise or even relatively reliable correlation between the modern acreage of fen parishes and their eleventh-century antecessors. Late twentieth-century acreages noted by David Hall have been used here. This is in part because reliability of these figures is supported by the high regard in which the quality of Hall's fieldwork is held, and in part because they were calculated within a decade of each other in a period in which accurate surveying is the norm, but the uncertainty of correlating them with their medieval antecessors remains a problem (Hall 1987, 1992, 1996).

A second difficulty in calculating the proportion of habitable ground in each fen parish at any date lies

not only in the variability of the area that lay below the flood line, both from year to year and from century to century, but also in the range of that variation. Such changes could be driven by natural events or by human intervention. Localised flooding was part of daily life in the medieval fen basin (as it is in the Bedford Levels today) and so were minor variations in water level from one year to the next. Even relatively small changes could have a noticeable impact: the Ely Coucher Book noted in 1251 that there were 4 acres in West Meadow in Willingham 'which can also be gained for certain in very dry years and 3 acres there can be joined to them' (CUL EDR G3/27: f.58r(2)). Similarly the Bishop's demesne at Leverington included 'another fen called *Northale* containing 40 acres, but sea flooding sometimes reduces it and sometimes increases it' (CUL EDR G3/27: f.39d(1)).

The range of that seasonal variation could be exacerbated by climate change: areas liable to freshwater or marine flooding tended to become more extensive during downturns and to shrink in the upturns (Hall 1987: 10–11). Sudden and severe climatic change in the first half of the fourteenth century saw a shift from occasional flooding to 'a time of pronounced environmental instability' (Campbell and Bartley 2006: 41). The result was persistent, acute freshwater flooding across the basin as the burden of rain and melting snow caused rivers to break their banks. On the fen-edge, for instance, continued waterlogging had transformed Holme Fen in Cottenham from a dry into a wet fen by about 1315, while in 1358 '30 acres of fen meadow are then permanently under water' in Willingham (Ravensdale 1974: 7, 8). There were innumerable catastrophic episodes of marine flooding along the entire coast of the Wash in the same period (Darby 1940: 55–60). Under these conditions the area that could be counted as lying above the flood line in, say, 1350 was likely to have shrunk by comparison with that that had been available for settlement a century earlier.

The construction of canals (locally called 'lodes'), sluices and weirs were a further influence on the extent of fen in each parish. Under normal conditions these works provided the physical framework for careful management of water levels, including seasonal flooding, in the higher reaches of the fen, and underpinned many medieval assarts for pasture or meadow. In 1251, for example, forty-seven of the Bishop's 'newly-enfeoffed' tenants at Waldersey in Elm had improved nearly 750 acres of fen there for pasture and meadow, while just under 60 tenants held about 550 acres of similar intakes at Apesholt in Littleport (CUL EDR G3/27 f.7d(2), f.8r(1), f.13r(2), f.13d(1)). Sometimes the approximate period or even the date of the intake is known, but just as often it is not. The date at which 5,000 acres in Waldersey were drained in 1605–6, being 'compassed about with certain Banks commonly called and named the Ring of Waldersee and Coldham', is known because it was undertaken by Act of Parliament (Wells 1828–30, II: 39). The period in which Coveney Dams, an area of nearly 900 acres, was taken in from the fen is unknown; it had certainly been completed by 1636 (Wells 1828–30, II: 192–4; Hall 1996: 51–3). The respective influences of seasonal variation, climatic change and human intervention make it problematic, to say the least, to infer that (for example) in 1086 Grunty Fen covered 1280 acres just because that was also its extent in 1636 (Wells 1828–30, II; 194).

These difficulties come to the fore in the earliest known survey of the extent of the peat fen undertaken in 1636 by the great cartographer William Hayward (Wells 1828–30, Vol. II: 141–233). The strength of Hayward's work is in the accuracy of his surveying. Property boundaries shown on his map of Sir John Peyton's estate at Doddington in 1601–3, for example, can be overlain exactly by the modern Ordnance Survey map (CA archives, Map of Doddington). This means that we can be sure that, when Hayward noted that the fens at Throckenholt covered 224 acres, he was probably correct (Wells 1828–30, II: 207). But because he did not explain the criteria he used in deciding the perimeters of the fen, we cannot be sure about exactly which parts of Throckenholt were included in that acreage. Moreover, because he excluded some areas of improved fen, like that in Waldersey noted above, but included others like Coveney Dams we cannot be sure that all areas of the peat fen were included in his survey. Another problem is that Hayward recorded the peat fens parish by parish, a method which ran into difficulties as soon as areas of extra-parochial intercommon were surveyed. For example, he placed in Somersham 10,700 acres of 'a great continent of ffenground undivided', in which the soke of Somersham (including Bluntisham, Earith, Colne, Pidley and Fenton) intercommoned with Ramsey and Warboys (Wells 1828–30, Vol. II: 231). Yet that stretch of peat fen did not lie within Somersham parish. The problems in using Hayward's survey are vividly exemplified at Littleport to which he allocated such large acreages of fen that their total area (*c*.24,680 acres) is substantially greater than that of the modern parish (18,301 acres) (Wells 1828–30, II: 161–4; Hall 1996: 19).[2] Such illustrations mean that Hayward's figures, however accurate in themselves, can only be regarded as indicative of the extent of the peat fen even in 1636. The representation of densities in pairs of hundreds provides a useful means of avoiding some of the problems caused by Hayward's apparent misallocation of some areas of fen to one or another parish, as well as problems arising from measuring parish acreages and their relationship with existing or former intercommons or assarts. It has the additional benefit of providing direct comparability with Darby's own maps which also paired the fenland hundreds.

The reliability of Hayward's figures in relation to estimations for the late eleventh century is further complicated by uncertainties about the impact of climate change on the area of land available for settlement between 1100 and 1636. Average summer and winter temperatures were respectively between 1.4 and 1.7 degrees Celsius lower in 1636 than they had been five centuries earlier, and the later period was characterized by stormier, wetter weather in which the area of fen is likely to have expanded (Lamb 1985: 153, 154, 155).

[2] This problem was resolved for the purposes of the calculation shown in Table 1 by using the acreages reported by the Fenland Survey: 'a large parish of 7,406 hectares (18,301 acres) which consists of an island of 400 hectares … the remainder being fen ground' (Hall 1996: 19).

These temperatures imply that the area below the flood line in 1636 was probably larger than in 1086. On the other hand, it might be argued that general consistency in the level above OD of the flood line between the eighth century and the modern period implies that the range in variation in the respective proportions of fen and dry land in each parish between 1100 and 1636 may not have been sufficiently substantial to invalidate altogether the use of Hayward's figures in rough estimations of the extent of the fen in 1086. Nonetheless, the uncertainties are sufficient to mean that any calculations of the eleventh-century proportions of fen and fen-island on the basis of his survey can be regarded only as illustrative at best.
It is clear, then, that all three elements of the calculation 'population density = DB population / (area of vill – area of fen)' are problematic. The DB tenants may have been under-enumerated, and in any case represent only heads of household; the area of each medieval vill can only be roughly calculated; and the area of fen wetland in 1086 is likely to have been rather less than it was in 1636. On the other hand, this is all the data available. The choices are to abandon the venture for lack of solid ground, or to go forward warily, recognizing the fuzziness of the result. That second option is chosen here.

Results

The methodology reported in this paper can straightforwardly be outlined. The total acreage of peat fen in each hundred was calculated from Hayward's survey. (The calculation assumes that the area which Hayward recognised as fen was coincident with that that lay below the flood line in 1636, but whether or not this was actually the case is unknown.) That number was subtracted from the sum of the earliest documented (but considerably later) parish acreages for the hundred. The result provided an outline estimate of the area in the hundred that lay above the flood line and was thus available for settlement. For the reasons outlined above, it should be regarded as a rough indication of the ratio of peat fen to habitable land rather than an accurate measurement. The population density of Domesday tenants within each hundred was then calculated per square mile for the habitable areas (Figure 4, Table 1).

Figure 4 and Table 1 show that, where population densities are calculated solely in relation to habitable land, there may have been around 10.4 tenants per square mile in Ely and South Witchford Hundreds in 1086, around three times greater than Darby's figure of 3.3 across the entire area of those hundreds. The difference between those in Table 1 and Darby's calculations for Wisbech and North Witchford Hundreds is more than six-fold: Table 1 suggests that there may have been around 6.1 tenants per square mile on habitable land there in 1086 compared with Darby's figure of 0.9 per square mile. The densities in parts of the fen basin calculated in terms of habitable land are directly comparable with the more affluent uplands of Cambridgeshire south of the fens. The stark contrast between fenland and upland shown on Darby's maps has disappeared.

While Hayward's survey generally makes it possible to estimate population densities per square mile by parish, even though the resulting figures should be treated with extreme caution distributions are revealed

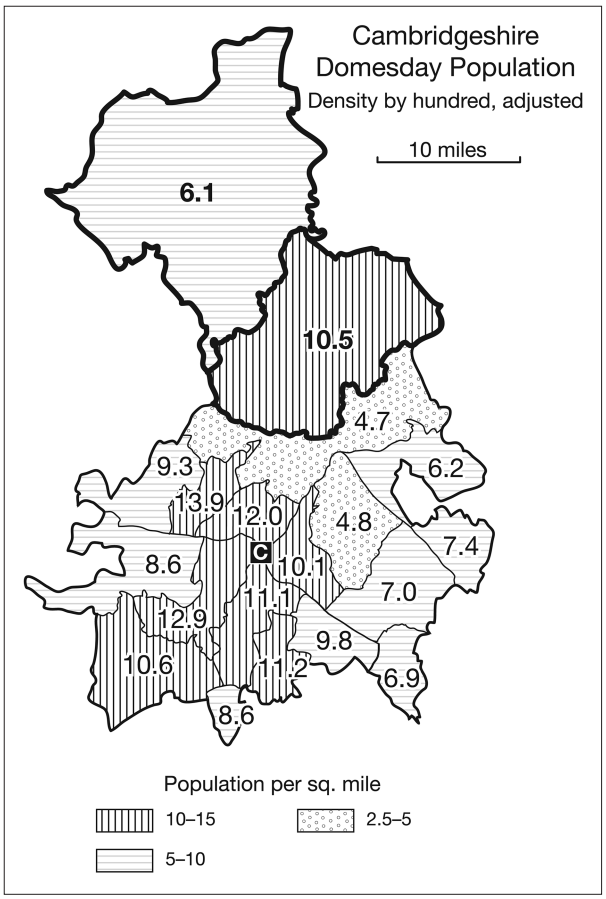

Figure 4 Population densities per square mile, adjusted for habitable land only, by pairs of hundreds in the Cambridgeshire fenland.

across the Isle of Ely in particular that would repay further research (Figure 5, Table 1).

As may be expected, a high proportion of the area of many of the parishes on the Isle of Ely itself was available for permanent settlement and arable cultivation. Places like Haddenham, Wilburton and Little Thetford came in at the high end of the range with between 40% and 60% of habitable ground, while 96% of the parish area at tiny, landlocked Wentworth was dry land.[3] There were smaller proportions of high ground in the central and western parts of the fen basin where the peat was more extensive: only 16% and 21% respectively of Chatteris and the Doddington archipelago lay above the flood line.

Very high figures are revealed in some localities, in some cases substantially exceeding even that of Cambridge (Figure 5; Table 1). That Ely should be so densely populated is not surprising. Less foreseen is an equivalent density in places like Witchford, Wilburton and Haddenham. Littleport, where there was widespread colonization of the higher parts of the fen in 1251, seems to have had a density of 20.1 tenants per square mile in 1086 perhaps indicating that the process of improving

[3] Such figures do not, of course, take into account the rights of intercommon held by many vills in the Isle in pastures and which made a substantial contribution to their economies.

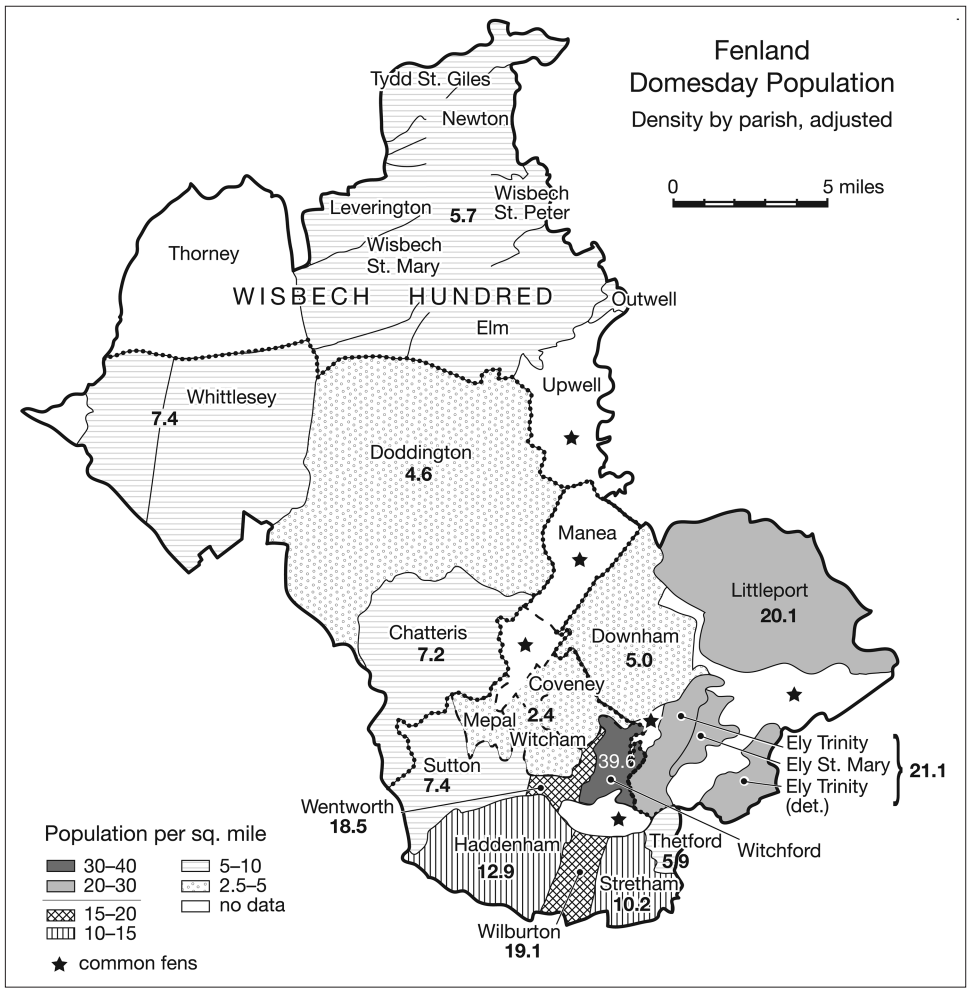

Figure 5 Population densities per square mile, adjusted for habitable land only, by parish in the Cambridgeshire fenland.

rough fen for grazing may already have begun; the same may have been true of Ely with a density of 21.2 per square mile. Wilburton and Wentworth also appear to have had unusually high population densities. The population densities in a number of other parishes, while high, were more in keeping with those in the uplands to the south of the River Ouse: Stretham and Haddenham, for instance, came in with 10.2 and 12.9 tenants respectively per square mile. The population densities of the remaining fen parishes appears low by comparison with these high figures. Darby's median range for population density was in the range of 5 to 10 tenants per square mile. While the median density for upland Cambridgeshire lay at around 9 tenants per square mile, no fenland parish returned fewer than 5 tenants per square mile with the exception of Doddington (4.5 tenants per square mile).

The same is true for estimates of arable land based on density of ploughs per square mile in 1086 (Figure 3, Table 1): when Darby's density of 0.2 ploughs per square mile for the whole of Wisbech and North Witchford Hundreds is recalculated solely in relation to cultivatable ground, the new result suggests a density of 1.16 ploughs per square mile. This six-fold increase is the same level of readjustment as that for population density in those northern Hundreds. Similarly, Darby's calculation of 0.7 ploughs per square mile across the entirety of Ely and South Witchford Hundreds is readjusted to 2.29 ploughs per square mile of land in those hundreds available for arable cultivation. Both lie within Darby's median range across Cambridgeshire as a whole: 1 to 2.5 ploughs per square mile. A comparison of Figures 3b and 3d shows that Darby's calculation of the ratio of tenants to ploughs in Cambridgeshire south of the fens reveals a slightly lower figure (around 3 tenants per plough) than for fenland, where the figure is just over 4 tenants per plough. That excess of population suggests that, even taking the considerable uncertainties behind the calculations behind Table 1 into account, it may have been as true in 1086 as it was in the fourteenth and seventeenth centuries that the undrained fenland supported considerable populations. Landless peasants with access to the fen and its wide range of products could at any time, after all, live as well or better than those who held between thirty or forty acres of arable in the uplands (Spufford 1974; VCH 9: 250).

The tentative results outlined in this paper have three implications for which further research is needed: the first is that the late Saxon fenland is unlikely to have been either underpopulated or underdeveloped; the second is the revelation of unexplained variations between silt and peat fen populations both in 1086 and in 1300; and the third is that the explanatory model for the origins, character and development of the region's fourteenth-century prosperity may need to be reconsidered.

Table 1 Calculating densities of tenants and ploughs in 1086 in the Cambridgeshire fenlands

	1. Parish acreage, modern	2. Fen acres, 1636	3. Upland acres (Col 1-Col 2)	Upland sq. miles	Tenants 1086	Ploughs 1086	Tenants/ sq. mile	Ploughs/ sq. mile
WISBECH HUNDRED	**14,409**	**8,056**	**6,353**	**9.93**	**68**	**10**	**6.85**	**1.01**
Whittlesey	26,201	22,902.4	3298.6	5.15	38	10.5	7.373	2.04
Chatteris	15,125	12,715.8	2409.2	3.76	27	7	7.173	1.86
Doddington soke	37,801	29,965.2	7835.8	12.24	56	8.5	4.574	0.69
NORTH WITCHFORD HUNDRED	**79,127**	**65,583.4**	**13,543.6**	**21.16**	**121**	**26**	**5.718**	**1.23**
WISBECH & N. WITCHFORD HUNDREDS (Darby's unit)	**93,536**	**73,639**	**19,896.6**	**31.09**	**185**	**36**	**6.079**	**1.16**
Littleport	18,301	17,312.5	988.5	1.54	31	6	20.07	3.88
Little Downham	10,952	7,000	3,952	6.18	31	8	5.02	1.3
Ely & Stuntney	14,659	11,577.5	3081.5	4.81	102	23	21.184	4.78
ELY HUNDRED	**43,912**	**35,890**	**8022**	**12.53**	**164**	**37**	**13.084**	**2.95**
Witcham, Manea, Coveney & Mepal	14,160	8,472.75	6696.5	10.46	25	7	2.389	0.67
Haddenham	8,926	4,970.15	3955.85	6.18	80	14	12.943	2.26
Sutton	7,146	3,842.1	3303.9	5.16	38	10	7.361	1.94
Stretham	4,019	1,820.25	2198.75	3.44	35	9	10.188	2.62
Wilburton	2,233	1,228	1005	1.57	30	7	19.104	4.46
Wentworth	1,369	54	1315	2.05	38	7	18.494	3.41
Little Thetford	1,078	533	545	0.85	5	1	5.872	1.17
Witchford	2,319	1,721.25	597.75	0.93	37	7	39.615	7.49
SOUTH WITCHFORD HUNDRED	**41,250**	**22,641.5**	**19617.75**	**30.65**	**288**	**62**	**9.396**	**2.02**
ELY & S. WITCHFORD HUNDREDS (Darby's unit)	**85,162**	**58.531.5**	**27,639.75**	**43.19**	**99**	**452**	**10.466**	**2.29**

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Map of Doddington, Wimblington and March, c.1601–2. Photostat copy made in 1939 from an original, now mislaid, then in the ownership of March District Council

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