ARABLE ACREAGE IN ENGLAND, 1270-1871

Stephen Broadberry, London School of Economics, S.N.Broadberry@lse.ac.uk
Bruce M. S. Campbell, The Queen's University of Belfast, b.m.campbell@qub.ac.uk
Bas van Leeuwen, University of Warwick, bas.vanleeuwen1@googlemail.com

11 October 2011
File: Acreage5.doc

Abstract: As part of a project to reconstruct agricultural output between 1270 and 1871, this paper provides estimates of the total arable acreage in England before the start of official data. Contrary to the recent claims of Clark (2011), it is shown that the arable acreage in the medieval period must have been lower than the peak nineteenth century acreage of 13.9 million acres. By quantifying the main changes in land use between 1290 and 1871 on a regional basis and by taking account of the distribution of the population by county in 1290, a new estimate of 12.75 million acres is obtained for the arable acreage in 1290. Estimates are also provided for other benchmark years, and the arable acreage is apportioned between fallow and the major crops.

Acknowledgements: This note forms part of the project "Reconstructing the National Income of Britain and Holland, c.1270/1500 to 1850", funded by the Leverhulme Trust, Reference Number F/00215AR.

I. INTRODUCTION

The purpose of this paper is to explain the evolution of the arable acreage in England between 1270 and 1871. Self-evidently, the area under arable rotations was a key determinant, along with crop choice and crop yields, of domestic food output and thus the size of the population that could be fed without recourse to significant food imports. Clark's (2011) recent suggestion that the peak arable acreage in the medieval period could have been as high as 20 million acres would mean that medieval England could comfortably have supported a population of more than 6 million, as writers such as Postan (1966) and Smith (2009) have maintained. Here, it is shown that Clark's (2011) figures are implausible, and that the maximum medieval acreage could not have been more than 12.75 million acres.

Reliable information for this vital agricultural input is not available until the mid-nineteenth century, when the 1836 tithe files provide an incomplete guide to the share of land in each county devoted to arable production (Kain, 1986) and then, in 1871, the Parliamentary Papers, based on the first official agricultural statistics state the total amount of arable land, along with other agricultural land-uses, in each county. Estimates of the arable area for earlier centuries must, perforce, be derived from this nineteenth-century information, using (i) quantitative data on changes in the relative area under crop provided by probate inventories, manorial accounts, and similar types of farm-specific information, (ii) geographical information on the relative amounts of arable, meadow, woodland and pasture provided by the *inquisitions post mortem* for the years 1300-49 (Campbell and Bartley, 2006), and (iii) historical accounts of land-use and landscape change for a wide array of manors, villages and regions.

Arable land is here defined as land sown with grain (wheat, rye, bere, barley, oats, and mixtures of the same), field legumes (beans, peas, vetches, and mixtures of the same), grain/legume mixtures, root crops (potatoes, turnips, swedes, and mangold), green crops (cabbage, kohl-rabi, rape, lucerne etc), industrial crops (flax, hemp, madder, saffron, hops, tobacco etc), small fruit, ley crops (clover, sainfoin, and temporary grass in rotation), and bare fallow. Excluded are land used horticulturally for gardens and orchards, all types of permanent grassland, and woodland.

The paper proceeds as follows. After a discussion of the potential agricultural are of England in section II, section III reviews the arable acreage by county in 1836 and 1871, when reliable information first became available from official sources. Section IV then examines changes in land use between 1290 and 1871, while section V presents county level estimates of the arable acreage in 1290. Section VI provides a further cross-check by examining changes in land use between 1086 and 1290, while section VII provides estimates of land use for a number of benchmark years between 1290 and 1871. Section VIII concludes.

II. THE POTENTIAL AGRICULTURAL AREA OF ENGLAND

Only a proportion of England's 32.3 million acres of land is potentially suited to and available for agricultural use. In 1871, following the first systematic national survey of farm-land and farm output, the total area under crops of all kinds, bare fallow, and temporary and permanent grass was 23.5 million acres: 73 per cent of the total (Table 1). Of the remaining 27 per cent, woodland, on the evidence of the 1836 tithe files, probably accounted for at least 5 per cent (Table 2) and un-farmable moorlands and mountains (the latter accounting for over half of the county of Westmorland) plus communications and settlements for the rest.

Discounting woodland as an agricultural land-use, it is doubtful, therefore, whether it has ever been possible to farm more than three-quarters of England's surface area, and even to achieve that has involved heavy investments in land drainage, soil drainage, stone clearance, and liming etc. Whereas in earlier centuries communications and settlements occupied less space, woodland (for utility and amenity) undoubtedly took up more, especially before the land-saving substitutions of coal for wood and charcoal and iron for timber. Additionally, during the Middle Ages large areas had been reserved to provide hunting for kings and nobles (Young, 1979). By 1871 pursuing foxes over farmland had largely replaced hunting deer and wild boars through forests and chases.

The agricultural area always comprised a combination of arable and grassland, with some overlap between them. In 1871 arable of all sorts occupied 59 per cent and permanent grassland (both hay meadows and pastures) 41 per cent of the agricultural area. By this date sown grasses had become a feature of many arable rotations, as crop and livestock production were increasingly integrated on the same land. Together, permanent and temporary grassland accounted for just over half — 53 per cent — of the agricultural area (Table 1). Similarly, in 1836, on the evidence of the partial geographical coverage of the tithe files, arable and pastoral land uses (grassland and common pastures) existed in almost equal proportions (Table 2). Grassland was the default agricultural land-use wherever slopes were too steep, soils too heavy, thin, dry, rocky, acidic or infertile, and water tables too high, rainfall too heavy, altitudes too great and growing seasons too short for arable cultivation. It was also the default agricultural land-use wherever the institutional barriers of common rights and forest law obstructed advance of the plough. By 1871 private and parliamentary enclosure agreements and the disafforestation of most areas once subject to forest law had shrunk but

not quite eliminated these institutional obstacles, which had reached their maximum extent under England's Norman and Plantagenet kings.

Maintaining a proportion of all land as grass was also indispensable to the organic mixed-farming which had long been the prevailing husbandry type throughout England. Without the deployment of several million draft animals for ploughing and carting and additional animals to breed replacement stock and supply the manure so vital to on-the-farm recycling of nutrients, tillage could not have been maintained on such a scale and with such high and sustained levels of productivity. No arable farmer could yet manage without some permanent grassland. Animals and their products also made a vital contribution to diets and supplied a range of raw materials to the manufacturing sector (Broadberry *et al*., 2011). Of course, the precise balance struck between arable and permanent grass varied a good deal. In 1871 in the heartland of intensive arable production in the eastern counties, permanent grass accounted for less than a quarter of all farmland, but in the hillier and rainier western and north-western counties with a greater comparative advantage in pastoral production this proportion rose to half and sometimes substantially more. By this date temporary grass leys were widely incorporated into arable rotations, so that nationally over half of all farmland was devoted to grass of one sort or another. Inclusion of sown grasses into arable rotations had been a key innovation of the agricultural revolution, enabling the arable area to expand at the expense of permanent pasture so that at this climax of Victorian high farming, following repeal of the Corn Laws but prior to the American grain invasion, in most of the predominantly arable parts of England more land was tilled and under arable rotations than ever before.

As a rule of thumb, therefore, it can be assumed that England had a potential agricultural area of 24 million acres, roughly divided between arable and grass, with more arable than pasture in the south and east and *vice versa* in the north and west. Even after partial substitution of temporary grass for permanent pastures, around 40 per cent of the agricultural area remained under permanent grass (Table 1), so that the country's potential arable area was at most 15 million acres, equivalent to 46 per cent of the national land area. To propose, as does Clark (2011: 11), that there could once have been '20 million acres of arable in England' and that 'arable at that level would *still* [emphasis added] only be 62 percent of English land area' (i.e. 80 per cent or more of the country's potential *agricultural* area) is to ignore the very real topographical, environmental, technological and institutional constraints under which all pre-modern English husbandmen, farming organically and relying upon animals rather than machines for farm work, had to operate. In fact in 1871, on the evidence of the first comprehensive and reliable agricultural statistics, only half-a-dozen counties had as large a share of their areas under arable rotations, all of them ranking among the country's premier arable counties: Huntingdonshire, Cambridgeshire, Norfolk, Suffolk, and Hertfordshire plus the East Riding of Yorkshire (Table 3). At the opposite extreme, arable comprised less than 30 per cent of the respective areas of Somerset, Middlesex, and a large block of northern counties comprising Northumberland, Cumberland, Westmorland, Lancashire, Cheshire, Derbyshire, and the West Riding of Yorkshire (Table 3). Nationally, the agricultural statistics reported 13.9 million acres under all kinds of grain crops, green crops and root crops, bare fallow, clover, sainfoin, and grasses under rotation, amounting to 43 per cent of the total national land area. In fact, this was close to the maximum that was logistically possible given England's soils, terrain, climate, mixed-farming needs, and property rights and the competition for land from woodland, settlements, communications, extractive industries, recreational activities and much else.

III. LAND USE IN 1836 AND 1871

1871 marks the culmination of the era of 'high farming' *par excellence* (so named because of the high inputs used to obtain high outputs) when the intensity of organic methods of agricultural production attained its fullest development and the area under agricultural land-uses of one sort or another was pushed close to its natural limits. With 21.3 million people to feed, much former wet-land had recently been drained and brought into arable production for the first time using techniques not previously available. Nevertheless, for reasons of comparative advantage, considerable tracts of land which had been worked as arable during the High Middle Ages but subsequently converted to pastoral production (creating the phenomenon of deserted villages), remained under permanent grass. To quantify the net effect of these and other changes in land-use, it is necessary to track the changing distribution of arable acreage by county, starting with the distribution of the arable acreage in England at the time of its peak usage during the nineteenth century (Table 3).

The second column of Table 3 sets out the total acreage of land in each county, while the third and fourth columns show the arable acreage reported in the 1836 tithe files and the 1871 Agricultural Returns, expressed as percentages of the county area. The fifth column takes the mean of these two ratios, which is taken as an indicator of the maximum extent of the proportion of arable land-use in each county and in the country as a whole. At this time, arable accounted for more than 60 per cent of all land-use in just seven counties, all in eastern England (Essex, Suffolk, Norfolk, Cambridgeshire, Bedfordshire, Hertfordshire and the East Riding of Yorkshire). Only in the recently drained and reclaimed Cambridgeshire did the proportion exceed 70 per cent. At the other extreme, arable comprised less than a quarter of all land-use in Lancashire, Derbyshire and metropolitan Middlesex, and less than one eighth

in hilly and mountainous Westmorland. Thus, in all earlier periods the proportion of each county's land area in arable production can reasonably be taken as between one-eighth and two-thirds.

Nationally, 42.9 per cent of England's surface area was devoted to arable use in the mid-nineteenth century, comprising 13.9 million acres. At that time, England's population was three-and-a-half times its level in 1290, the country was still heavily dependent on domestic grain production, and arable and pastoral production were more closely integrated than ever before via the incorporation of fodder crops and sown grasses into rotations and the near universal adoption of fodder-fed horses for farm work (Table 1 and Figure 1). It is therefore improbable that the amount of arable land in 1290 could have been greater than this. But could it have been smaller? Although in 1290, when the population was at or close to its medieval peak, there were strong incentives to devote as much land as possible to arable production, common rights, royal forest law, high water tables and a range of other physical and institutional obstacles prevented much land from being ploughed up which would later, following reclamation, enclosure and disafforestation, be brought into arable production. A greater reliance upon grass-fed oxen for draught power (Figure 1) combined with a heavy commercial dependence upon wool production from extensively managed sheep imply the existence of relatively generous supplies of grassland. Lower population densities in much of the north, north-west, and south-west also meant that in these regions there was not yet the need to bring all potential arable land into production (Broadberry *et al*., 2011). To be realistic, any estimate of the arable acreage in 1290 needs to take the net effect of these changes in land-use between 1290 and 1836/71 into consideration.

IV. CHANGING LAND-USE, 1290-1836/71

After 1290 major additions to the nation's stock of arable land were made by the drainage and reclamation of many wetland areas, especially the East Anglian Fens. Fortunately, these developments have been quantified (Marshall *et al*., 1978: 255; Grigg, 1988: 29). Harder to estimate are the gains that came from the enclosure and ploughing up of former permanent pasture, from the breaking up of areas previously under forest law, and from the clearance of woodland as coal was substituted for wood as a fuel.[1]

Meanwhile, farmland was being lost to quarries, mines, roads, canals, railways, village and urban expansion, and the conversion of demesnes and occasionally entire manors into landscape parks. Growing urban demand for meat and dairy produce, especially from middle class consumers in the metropolis, also underpinned the growing importance of pastoral farming, leading to the lasting conversion of much heavy land from tillage to permanent grass, particularly on the stiff claylands of the east midlands and south-west midlands. In these regions, strategically well placed between rearing regions to the north and west and the London market to the south and east, physical difficulties and high cultivation costs meant that grassland tended to give better and more reliable financial returns than arable. The widespread phenomenon of village desertion is one legacy of these developments, a seasonal shift in the timing of early-modern marriages another (Beresford, 1989: 35, 39; Kussmaul, 1990: 79-86, 181-196). For climatic reasons, too, the *potential* arable area was greater in 1300 than 1836/71. Thus, around England's upland margins, the transition after 1300 to the cooler climatic conditions of the Little Ice Age lowered the altitudinal limit of cultivation and meant that land which might once have been used to grow crops was now fit only for permanent pasture (Grove, 2004: 622-30).

[1] Wrigley, 2006: 470, reckons that "coal, by providing an acceptable substitute for wood and charcoal, endowed the country with the equivalent of many millions of acres of woodland".

1. The effects of land drainage and reclamation:

Work by Marshall *et al*. (1978) has quantified the amount of land brought into use by more effective methods of drainage and Grigg (1989: 28-32) provides a useful summary of these developments. Table 4, adapted here from Grigg (1989: 29), suggests that nearly 1.39 million acres were thereby brought into use, with the draining of the East Anglian Fens accounting for more than half of the total. Most of this drained land was being used for arable farming by the mid-nineteenth century, although some of it only since the 1820s (Grigg, 1989: 32).

2. Conversion from tillage to permanent grass:

Quantification of the loss of arable to permanent grass is less direct than for the reclamation of land through drainage. One guide to the scale and geographical extent of this shift is provided by a simple count of the numbers of deserted medieval villages (DMVs) in each county, taken from the study by Beresford (1989), and reproduced here in the second column of Table 5. Combined with the surface area of each county, this yields the density of DMVs per 100,000 acres in the third column of Table 5. The density of DMVs per 100,000 acres of arable 1836/71 (column four) is yet more revealing, since this highlights where the post Black Death contraction of arable had proceeded furthest (Figure 2). In many parts of England, of course, the existence of DMVs probably reflects little more than the effects of the declining population and associated settlement change, and there may have been little or no enduring loss of land to arable production. Nevertheless, in eighteen counties the density of DMVs is in excess of the national average, most of them lying along the boundary between the predominantly arable-farming counties of the south-east (where the density of DMVs is mostly below average) and the grassier and more pastoral counties of the north-west and west (where the densities of DMVs are generally lowest of all). In five of these counties (the East Riding of Yorkshire, Rutland, Northamptonshire, Wiltshire, and Hampshire) the density of

DMVs is at least 50 per cent above average, and in a further five (Northumberland, the North Riding of Yorkshire, Leicestershire, Warwickshire, and Oxfordshire) it is more than double the national average. Here, in a band of counties stretching north-east to south-west through the heart of the midlands, potentially at least ½ million acres of land which had been in arable production before the Black Death may have been converted to permanent grassland thereafter and much of it, even at the height of the ploughing-up campaign of the Napoleonic Wars, was never converted back. Presumably, the costs of arable cultivation remained too high and the profits of supplying pastoral products to the ever-expanding London market too rewarding.

This switch from arable to pastoral farming was always a geographically and temporally specific phenomenon. Figures 3 and 4 set out developments in real wages and the ratio of pastoral relative to arable prices. These show that cost and price incentives to convert land to permanent grassland were strongest between about 1350 and 1450 and again after 1650, as real wages increased and reduced profitability in the more labour-intensive arable sector.[2] The heavier the land, the greater the unit labour costs involved in cultivating it and therefore the greater savings obtained by switching to some form of pastoral production. In an era of declining population and tenant scarcity, the excessive drudgery involved in cultivating such holdings also repelled tenants. Hence the pejorative talk of villages "killed by sheep 'who eat up men'", although in many cases partial abandonment had preceded and then precipitated forcible desertion (Dyer, 1982: 19). Post-medieval expansion of the London market then metamorphosed what had begun as a rationalisation of agricultural land-use at a time of high labour costs and slack demand for arable products, into a specific supply-side

[2] This increase in the price of labour occurs in both the main series currently in use, but is somewhat greater in Clark's (2005) series than in Allen's (2001) series (Figure 3).

specialisation according to comparative advantage thereby ensuring that the associated changes in land-use and farm enterprise remained permanent.

What makes this enduring land-use shift so conspicuous is that it was very much the exception. From the mid-fifteenth century until the mid-seventeenth century farm labourers' real wages stagnated while a substantial decline in the price of pastoral relative to arable products favoured the renewed expansion of arable production (Figures 3 and 4). Most areas with a greater comparative advantage in arable production thus witnessed a significant re-expansion in the arable area at this time. In the early eighteenth century government corn bounties helped bolster a high level of agricultural output and then, from 1750, strongly rising domestic demand for grain again encouraged those who could to bring more land into arable production. Strong population growth in the industrialising but naturally more pastoral south-west and north-west will also have stimulated these regions to expand their output of staple food grains. Finally, during the Napoleonic Wars from 1799-1815, and especially during Napoleon's attempted economic blockade of England from 1807, a national ploughing-up campaign reconverted much permanent pasture back to arable. This was when, for example, farmers in High Suffolk switched back from horn to corn production.

During the early modern period the powerful pull of metropolitan market demand encouraged more and more farmers to specialise according to comparative advantage. Kussmaul (1990) sought to identify shifts between arable and pastoral production, and *vice versa*, at the parish level by examining changes in the seasonal pattern of marriage, for which parish registers provide a wealth of evidence (Table 6). Predominantly arable parishes (denoted by A) are identified by a predominance of autumn marriages, following the harvest, while pastoral parishes (denoted by P) are identified by a predominance of spring marriages,

following hay-making, calving and lambing. Parishes which displayed neither pattern are identified as proto-industrial (denoted by X). Kussmaul's evidence, summarised in Table 6, suggests shifts in both directions during the early modern period between 1561-1640 and 1741-1820 — from pastoral to arable as well as from arable to pastoral — as farming everywhere became more specialised. Again, it would be difficult to argue for a large permanent loss of arable land on the basis of this evidence. With the exception of one parish in Staffordshire, all the parishes which became more arable in their marriage patterns were located south and east of a line from the Wash to the Severn estuary. Of those that switched in the opposite direction, ten were in the west midlands and south-west (Worcestershire, Herefordshire, Somerset, Dorset, Devon, Cornwall), and a further ten were scattered from Durham and the North Riding of Yorkshire, through Lincolnshire and Nottinghamshire, to Leicestershire and Wiltshire. This latter group thus complements the pattern of regional specialisation in pastoral production implied by the density distribution of DMVs (Table 5 and Figure 2). It is also worth noting that at a county level, the proportions of parishes which switched to a pastoral marriage pattern was typically greater than the proportions which adopted an arable regime (Table 6).

3. Other changes of land use

Although firm quantitative evidence is lacking for the other changes of land use, it should be noted that they do not uniformly push in one direction. Factors making for the increase of arable land, including a reduction in the amount of forest and woodland and enclosure of former permanent pasture (both of which benefited permanent grassland as well as arable), were offset by other factors making for a decrease, including the expansion of towns and the transport infrastructure and the conversion of agricultural demesnes into landscape parks. As

will be seen from the following reconstruction of the distribution of arable land by county in 1290, the assumption that these effects cancelled out is indeed borne out.

V. LAND USE IN 1290

The starting point for the reconstruction of land use in 1290 is the arable acreage in 1871, which, as noted earlier, amounted to 13.9 million acres. Nearly 1.4 million acres of this land came from drainage by methods which were not available in 1290 (Table 4). Conversely, there is credible quantitative evidence to suggest that some land used for arable purposes in 1290 had been converted to pasture following the Black Death and in 1836/71 had still not been converted back (Tables 5 and 6 and Figure 2). Given the concentration of these developments in a narrow band of midland counties, and the subsequent reversal of incentives to switch from arable and pastoral production (Figures 3 and 4), it is, however, difficult to see how this could have accounted for a permanent net conversion of more than about ½ million acres of arable land to pasture. The maximum arable acreage in 1290 is therefore unlikely to have been more than 12.5 to 13.0 million acres. Whether it was actually as much as this can be tested by deriving a set of county estimates, taking account of the population density in 1290 and the maximum and minimum proportions of arable land use in 1836/71, and then aggregating the results.

The population density in 1290 matters because of the limited possibilities for trading grain between regions at the time: regions with a high population density must therefore have had a high proportion of the county acreage in arable use and *vice versa*. At this date population densities were highest in a group of eastern counties comprising Norfolk (the most populous county of all), Suffolk, Cambridgeshire, Huntingdonshire, and Lincolnshire) (Broadberry *et al*., 2011). In later centuries, as borne out by a wealth of local historical

evidence, most of these counties would add to their arable areas through processes of clearance, reclamation, drainage, and the enclosure of common pastures, thereby reinforcing the strong arable bias of their land-use. Yet in 1290 as much as 59 per cent of their collective surface area and two-thirds of all their farmland may already have been under the plough (Table 8). In the counties of the south-east, the north-east midlands and the south-west midlands, population densities were on average at least 25 per cent lower; hence it is reasonable to suppose that arable constituted a smaller proportion of land-use, as it would in many of these counties in 1836/71. In fact, in many of the midland counties there may have been a net shrinkage in the arable area between 1290 and 1836/71 for the reasons discussed above (Tables 8 and 9).

Tom Williamson (2010), on the basis of systematic parish-by-parish reconstruction of the maximum extent of ploughland from a combination of archaeological and historical evidence, has estimated that prior to the Black Death arable may have amounted to as much as 63 per cent of total land-use in Northamptonshire. If correct, this implies that almost half of all land in the counties of the north-east midlands (Northamptonshire, Rutland, Leicestershire, Nottinghamshire, and Derbyshire) may have been in arable land-use. That proportion would shrink to 39 per cent in 1871, following the permanent withdrawal of approximately ¼ million acres from arable cultivation (Table 9). In the counties of the south-west midlands (Gloucestershire, Somerset, Wiltshire, and Dorset) the amount of arable land in 1290 may also have been greater (by approximately 200,000 acres) than the amount in 1871 (Table 9), since here too there is evidence of village desertion and there were similar incentives to capitalise upon comparative advantage and expand the area devoted to permanent grassland. Conceivably, as much as 45 per cent of land in these counties may have been in arable use before the Black Death. Arable probably accounted for a similar

proportion of land-use in the south and east, although with much variation from locality to locality on account of the diverse topographical conditions and commercial opportunities prevailing in this large region. Here, however, that proportion rose to 54 per cent in 1836/71, since metropolitan growth ensured that these counties became London's bread-basket.

Outside these core regions population densities in 1290 were lower, and in the west midlands, the north-east, south-west, and, especially, the north-west, they were well below the national average and proportionately far lower than they would be in 1836/71, by which time the economies of these regions had become far more dynamic. With their low population densities, above average rainfalls, moors, mosses and hill-land the north-west and south-west can safely be assumed to have had the smallest proportions of arable land in the country, as they would in 1836/71. In the south-west this proportion has been set at 25 per cent and in the more mountainous north-west at 17.5 per cent (Tables 8 and 9). Probably in 1290, as in 1836/71, Westmorland was the least arable county of all, with only one-eighth of its land devoted to arable production (Tables 3 and 7).

Table 7 sets out the estimated proportions and amounts of arable land by county, taking account of variations in population density, the location of the drainage schemes identified in Table 4, the density of DMVs in Table 5, and the effects of urbanisation, which particularly affected Middlesex and Surrey. The net effect of these calculations is an overall arable share in 1290 of 39.5 per cent, amounting to approximately 12.75 million acres (an area equivalent to over half of all farmland). These 12.75 million arable acres differed far more in distribution than quantity from the 13.9 million arable acres in 1836/71. Proportionately, the arable shrank most in metropolitan Middlesex, where pasture and grazing were in high demand from the capital and the massive horse-drawn traffic that it

generated, whereas it grew most in Co. Durham, since cheap grain was needed to feed the growing army of miners who hewed the coal likewise demanded in ever greater quantities by London.

This revised estimate of the arable area in 1290 is very much an upper-bound estimate (Table 8). Given prevailing technologies of cultivation, stock management, and drainage, the heavy reliance upon wood for fuel and timber for construction, the under-developed economies and sparse populations of large parts of the north and west, and the as yet modest population of London, it is difficult to conceive that more land could have been under arable cultivation at this date. Indeed, a lower figure is not improbable. It implies that 1.4 million more acres of land were actually in arable production in 1290 than 1801. Campbell and Overton (1996, 1999) and Campbell (2000) had argued against this possibility and proposed that the arable area in 1290 could have been no greater than that in 1801. Moreover, they accepted a more moderate estimate of 10.5 million acres at the later date on the evidence of the 1801 Crop Returns. In contrast, Clark (2007: 124-5), on an idiosyncratic reading of the early fourteenth-century *inquisitions post mortem* and in order to justify a population estimate of almost 6 million in 1315, proposed that as much as 15.7 million acres may have been in arable production c.1300: 1.87 million acres more than in 1871. More recently he has inflated that estimate to 20 million acres (Clark, 2011). For the reasons given above, both figures seem far fetched and out of touch with geographical and historical reality.

VI. LAND USE IN 1086 AND 1290

How does the revised figure of 12.75 million arable acres in 1290 compare with the evidence of Domesday Book some two centuries earlier? Campbell (2000: 386-9) has discussed the difficulties of deriving credible estimates from this most ambiguous of statistical sources.

Reginald Lennard and F. W. Maitland have proposed estimates of 8-10 million arable acres on the basis of the numbers of recorded ploughlands and ploughteams, but these areas are implausibly high for they are far in excess of the needs and probably also the resources of a population of 1.7 million people, and L. M. Cantor's 11.3 million acres even more so (cited by Clark, 2011: 5). Employing a method of estimation proposed by Frederik Seebohm based upon recorded numbers of land holdings yields a lower and more realistic figure of 5.75-6.0 million arable acres in 1086. If correct, or at least nearer the truth, this implies that the arable area may have slightly more than doubled between 1086 and 1290, when the population grew by a factor of about 2.75. Arable land per capita thus declined by approximately 20-25 per cent between the two dates, which is consistent with the historical view that by 1290, with an average of less than 2.7 arable acres per capita (1 acre of which was probably fallow) (Table 8), population was putting considerable pressure upon available agricultural resources (Hatcher and Bailey, 2001: 21-65).

VII. ARABLE LAND USE, 1270-1871

With benchmark estimates established of the amounts of arable land in 1290 and 1836/71, the final step is the derivation of the overall patterns of land use between 1270 and 1871. Here the sources and methods are described briefly, with detailed sources listed in the notes to Table 10. For the early modern and modern periods, the starting points are the firm estimates of land use in the Agricultural Returns of 1871 and the Tithe Files of 1836, which have been analysed in Table 3. For 1801, reliance has to be placed on the Crop Returns, which most writers agree substantially understated the amount of arable land in use, and which have therefore been adjusted upwards (Turner, 1981; Prince, 1989; Holderness, 1989; Grigg, 1989). Estimates for 1700 and 1750 have been derived from Chartres (1985) and Holderness (1989), who provided benchmarks linked to 1801. The 1600 figure is obtained by

interpolating between 1500 and 1700 using information on population. For the medieval period, the starting point is the 1290 benchmark of 12.75 million acres, derived from Table 7. The benchmarks for 1270 and 1300, 1380, 1420, 1450, and 1500, are obtained by projection backwards and forwards from the 1290 benchmark, using sown acreage data for the manorial sector and tithe data for the non-manorial sector.

Having obtained estimates of the overall arable acreage in use, the next step is to allocate it between fallow and the major crops sown. This information is taken from the Medieval Accounts Database for the period before 1500, the Early Modern Probate Inventories Database for the period 1500-1750 and from Holderness (1989) and Overton (1996) for the period 1750-1850. For the medieval period, it should be noted that the distribution of crops in the demesne sector is assumed to be representative of the country as a whole. This is broadly consistent with the much smaller amount of evidence on the non-demesne sector (Sapoznik, 2008; Dodds, 2007). For the period between 1492 and 1553, there is a gap in information as the manorial records come to an end before the probate inventories become available.

The amount of fallow declined from between a third and a half of the arable area in the medieval period to less than a quarter in the early modern period and eventually just 3.5 per cent by 1871 (Table 10). Amongst the principal winter-sown crops, wheat remained important throughout the period, but rye and maslin (a mixture of wheat and rye) declined sharply during the modern period. Amongst the spring-sown crops, barley and dredge (a mixture of barley and oats) remained important throughout the period, but oats declined in relative importance. The biggest increase in the use of arable land was in potatoes and other crops, particularly clover and root crops after 1700 (Overton, 1996: 99-101, 110).

VIII. CONCLUSIONS

This paper has provided a quantitative account of the evolution of the arable acreage in England from 1270 to 1871, when official statistics first become available. Clark (2011) has recently claimed that the peak medieval arable acreage may have been as high as 20 million acres, which could have supported a very large population at extraordinarily high levels of kilocalorie consumption per head. However, the evidence considered here suggests that such having such a high proportion of the country's total land area of 32.3 million acres under the plough would not have been remotely possible. The upper bound estimate of 12.75 million acres presented here is derived by taking account of (1) the major changes in land use between 1290 and 1871 quantified on a regional basis and (2) the distribution of the population by county in 1290.

The first part of the exercise makes use of the estimates by Grigg (1989) of the amount of land drained and reclaimed, and quantification of the conversion from tillage to permanent grass via Beresford's (1989) analysis of the incidence of deserted medieval villages and Kussmaul's (1990) identification of changes in the seasonal pattern of marriage as parishes switched between a primarily arable pattern (autumn marriages) and a primarily pastoral pattern (spring marriages). The second part of the exercise makes use of the maximum amd minimum shares od land devoted to arable production in any county in 1836/71, together with the distribution of population density in 1290, to arrive at an estimate of arable land use by county in 1290. The population density in 1290 matters because of the ,limited possibilities for trading grain between regions at a time of high transport costs.

TABLE 1: Agricultural and grassland areas as percentages of total area by major region in 1871

Region	Total acreage 1871	*Agricultural area as % total acreage*	*Permanent grass as % agricultural area*	*All grass as % agricultural area*
NE midlands	2,433,209	*83.5*	*53.1*	*61.0*
W midlands	2,404,899	*82.1*	*48.9*	*58.8*
E counties	4,848,111	*81.5*	*22.7*	*34.6*
SW midlands	3,360,492	*78.4*	*50.2*	*61.2*
SE counties	6,866,189	*73.6*	*30.4*	*41.6*
NE counties	5,721,160	*64.7*	*47.3*	*58.4*
NW counties	4,155,139	*62.3*	*60.8*	*73.7*
SW counties	2,539,132	*61.2*	*33.6*	*52.3*
ENGLAND	32,328,331	*72.7*	*41.1*	*52.6*

Source: Parliamentary Papers (1871).

TABLE 2: Agricultural land-use in 1836

Land-use	No. of counties represented	Minimum % of total area	Mean % of total area	Maximum % of total area
Arable[1]	35	21.5	44.1	72.4
Grass[1]	35	15.5	41.3	70.4
Commons[2]	30	0.9	4.6	23.3
Grass + commons[2]	30	16.6	45.9	71.9
Woodland[3]	32	1.4	5.5	15.1
Arable as % (arable + grass + commons) [2]	30	23.0	49.5	79.4

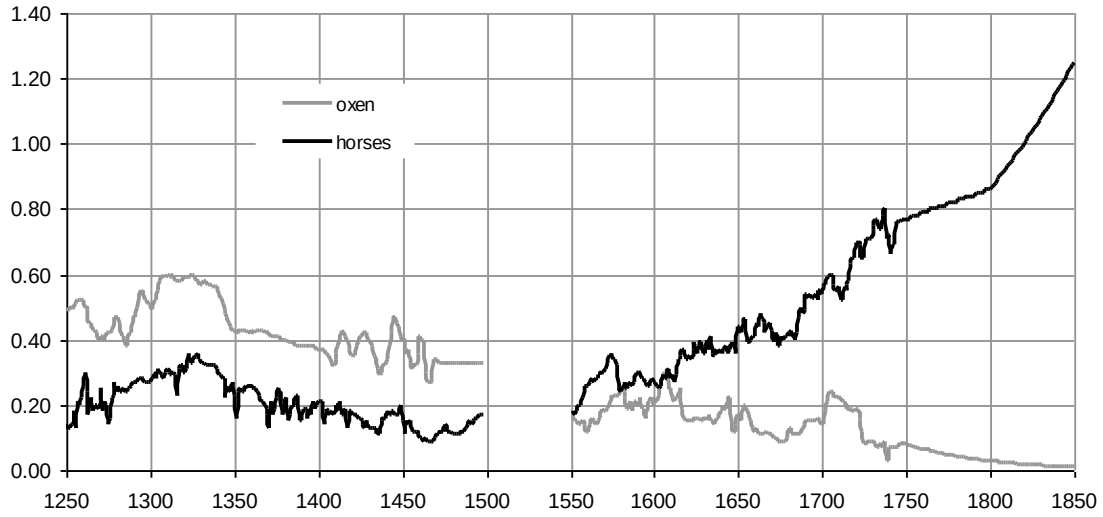
Sources and notes: Kain (1986).
[1] The unrepresented counties are: Cumberland, Leicestershire, Northamptonshire, Nottinghamshire, Westmorland.
[2] The unrepresented counties are the same as (1) plus: Bedfordshire, Derbyshire, Huntingdonshire, Lancashire, Northumberland.
[3] The unrepresented counties are the same as (1) plus: Cheshire, Gloucestershire, Lancashire.

TABLE 3: County acreage and percentage arable, 1836/1871

	County acreage	% arable, 1836	% arable, 1871	Mean % arable 1836/71
Bedfordshire	303,360	60.1	61.5	60.8
Berkshire	481,920	58.5	57.3	57.9
Buckinghamshire	475,520	55.8	45.8	50.8
Cambridgeshire	558,080	70.1	75.6	72.8
Cheshire	613,120	25.5	27.6	26.6
Cornwall	889,600	23.8	43.0	33.4
Cumberland	979,200		27.5	27.5
Derbyshire	646,400	25.3	23.8	24.5
Devon	1,672,320	22.5	39.6	31.0
Dorset	661,760	21.5	37.8	29.6
Durham	635,520	54.9	35.2	45.0
Essex	983,680	72.4	60.4	66.4
Gloucestershire	800,640	32.0	43.8	37.9
Hampshire	1,030,400	64.3	50.2	57.2
Herefordshire	539,520	39.7	38.5	39.1
Hertfordshire	399,360	66.6	63.5	65.1
Huntingdonshire	236,800	49.8	65.8	57.8
Kent	1,000,320	48.5	52.3	50.4
Lancashire	1,234,560	27.1	20.6	23.8
Leicestershire	532,480		35.3	35.3
Lincolnshire	1,707,520	48.7	59.2	54.0
Middlesex	189,440		22.5	22.5
Norfolk	1,317,760	63.8	62.1	62.9
Northamptonshire	638,720		44.7	44.7
Northumberland	1,297,920	46.5	26.1	36.3
Nottinghamshire	532,480		54.8	54.8
Oxfordshire	473,600	55.8	58.1	57.0
Rutland	96,640	38.2	46.3	42.3
Shropshire	860,160	47.0	41.4	44.2
Somerset	1,044,480	24.4	28.3	26.4
Staffordshire	740,480	44.8	32.3	38.6
Suffolk	957,440	70.3	65.0	67.7
Surrey	485,120	48.8	39.9	44.3
Sussex	935,040	43.8	41.3	42.5
Warwickshire	620,800	47.5	43.7	45.6
Westmorland	506,240		12.2	12.2
Wiltshire	849,920	35.1	49.0	42.0
Worcestershire	451,200	42.7	45.1	43.9
Yorkshire, ER	755,200	65.6	64.7	65.2
Yorkshire, NR	1,378,560	32.2	31.3	31.8
Yorkshire, WR	1,815,040	30.0	28.3	29.2
ENGLAND	32,328,320			42.9

Sources: Parliamentary Papers (1871); Kain (1986).

FIGURE 1: From grass-fed to fodder-fed working animals: millions of oxen and horses in England 1250—1850 (10-year moving averages, log scale)



Sources: Derived from the Medieval Accounts Database; the Early Modern Probate Inventories Database; Allen (1994); John (1989); Turner (1998).

TABLE 4: Areas containing extensive drainage systems

Region	'000 acres
Fen District	772
Vale of Pickering	*7*
Beverley and Holderness	*10*
Thorne and Hatfield Moors	*86*
Ancholme Valley	*16*
Lincolnshire Marshes	*61*
Yorkshire & Lincolnshire wetlands	180
Somerset Levels	127
North Kent Marshes	*50*
Romney Marsh	*57*
Pevensey Levels	*12*
South-eastern coastal marshes	119
Lancashire Mosses	89
Norfolk River Valleys	*46*
Essex Coast	*18*
Suffolk Coast	*10*
East Anglian valleys and coast	74
Monmouth Moors	20
Other	5
Total	1,386

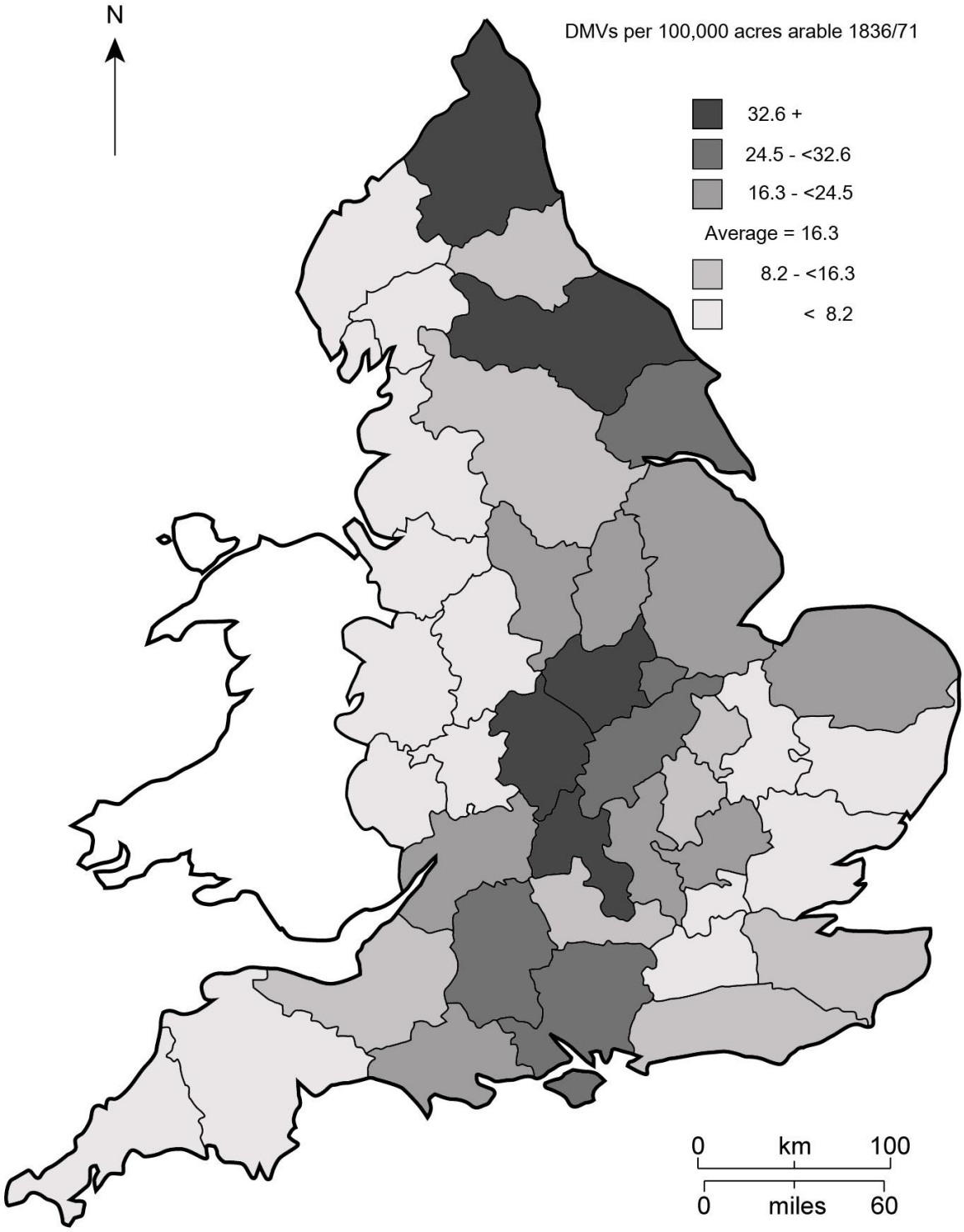
Source: Grigg (1989: 29).

TABLE 5: Density of deserted medieval villages (DMVs)

County	Number of DMVs	DMVs per 100,000 acres	DMVs per 100,000 arable acres in 1836/71
Warwickshire	128	20.6	45.2
Yorkshire, NR	171	12.4	39.1
Oxfordshire	103	21.7	38.2
Leicestershire	67	12.6	35.6
Northumberland	165	12.7	35.0
Rutland	13	13.5	31.8
Wiltshire	104	12.2	29.1
Northamptonshire	82	12.8	28.7
Hampshire	156	15.1	26.5
Yorkshire, ER	129	17.1	26.2
Lincolnshire	220	12.9	23.9
Buckinghamshire	56	11.8	23.2
Nottinghamshire	67	12.6	22.9
Gloucestershire	67	8.4	22.1
Dorset	42	6.3	21.4
Derbyshire	33	5.1	20.8
Norfolk	148	11.2	17.8
Hertfordshire	44	11.0	16.9
Berkshire	43	8.9	15.4
Yorkshire, WR	75	4.1	14.2
Kent	69	6.9	13.7
Huntingdonshire	18	7.6	13.1
Sussex	41	4.4	10.3
Durham	29	4.6	10.1
Somerset	27	2.6	9.8
Bedfordshire	18	5.9	9.8
Staffordshire	22	3.0	7.7
Herefordshire	11	2.0	5.2
Cambridgeshire	17	3.0	4.2
Suffolk	23	2.4	3.6
Worcestershire	7	1.6	3.5
Westmorland	2	0.4	3.2
Cumberland	8	0.8	3.0
Devon	15	0.9	2.9
Cornwall	8	0.9	2.7
Essex	17	1.7	2.6
Cheshire	4	0.7	2.5
Shropshire	9	1.0	2.4
Surrey	5	1.0	2.3
Middlesex	0	0.0	0.0
Lancashire	0	0.0	0.0
England	2,263	7.0	16.3

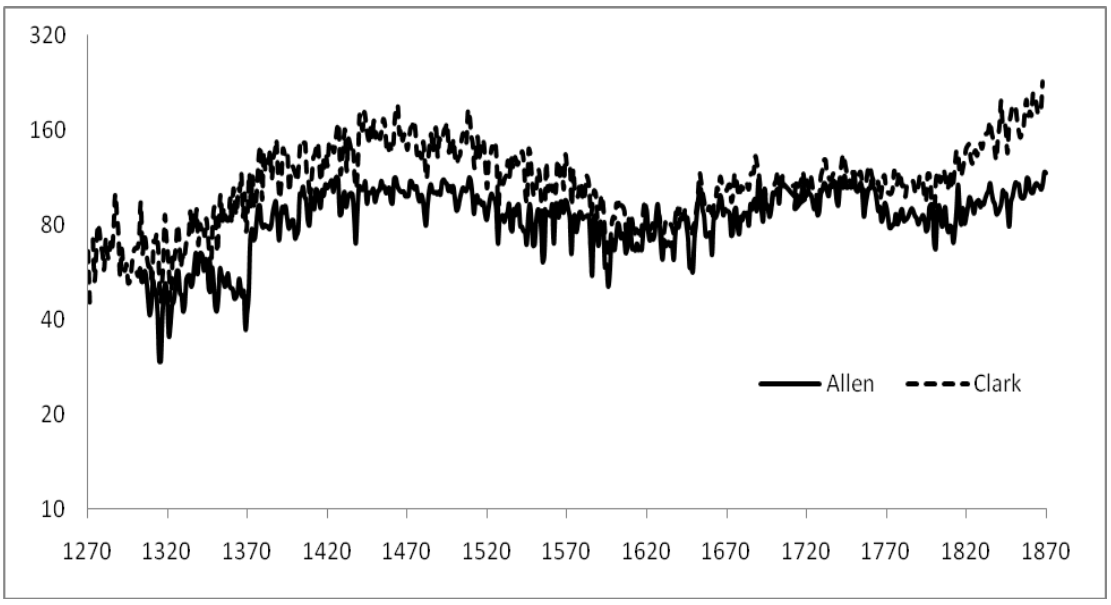
Source: Beresford (1989: 35, 39).

FIGURE 2: Density of deserted medieval villages (DMVs) per 100,000 acres arable in 1836/71



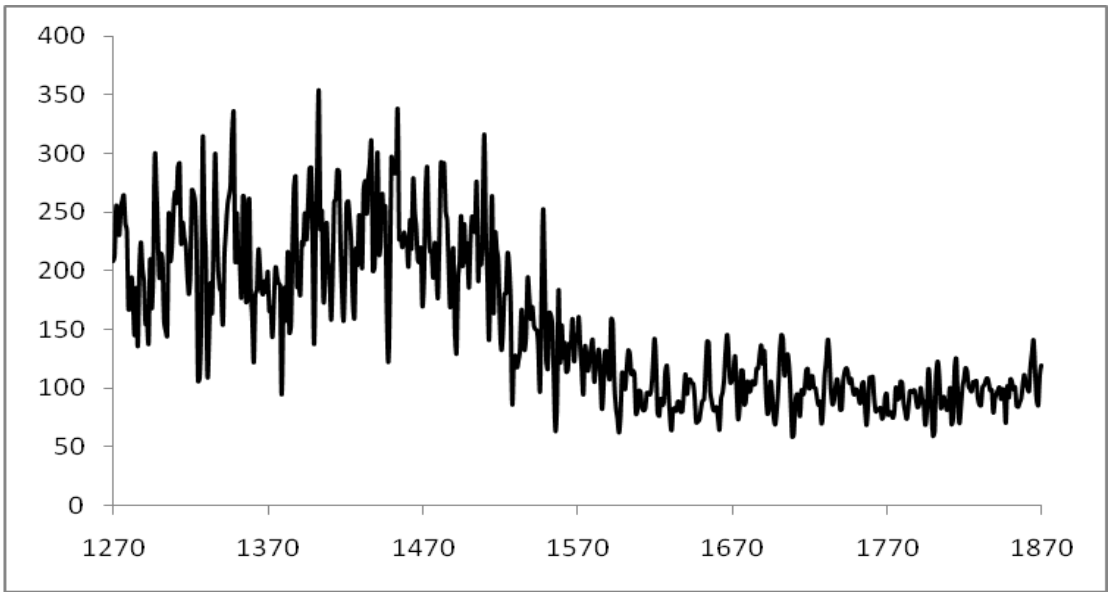
Source: Table 5.

FIGURE 3: Indexed daily real wage of an unskilled building worker (1700=100, log scale)



Sources: Allen (2001); Clark (2005).

FIGURE 4: Ratio of pastoral to arable prices (1700=100)



Source: Broadberry *et al.* (2011).

TABLE 6: Parishes shifting between arable (A) and pastoral (P) marriage patterns, between 1561-1640 and 1741-1820

County	Number of parishes	A to P	P to A	Net % of parishes which switched
From arable to pastoral:				
Durham	3	2	0	67
Lincolnshire	13	4	0	31
Somerset	10	3	0	30
Lancashire	10	2	0	20
Cornwall	5	1	0	20
Herefordshire	6	1	0	17
Devon	15	2	0	13
Dorset	8	1	0	13
Yorkshire, NR	8	1	0	13
Nottinghamshire	9	1	0	11
Worcestershire	12	2	1	8
Wiltshire	14	1	0	7
Leicestershire	25	1	0	4
No net change:				
Huntingdonshire	1	0	0	0
Rutland	1	0	0	0
Middlesex	2	0	0	0
Berkshire	3	0	0	0
Derbyshire	3	0	0	0
Cumberland	5	0	0	0
Northumberland	5	0	0	0
Cheshire	7	0	0	0
Yorkshire, ER	8	0	0	0
Cambridgeshire	10	0	0	0
Buckinghamshire	17	0	0	0
Shropshire	17	0	0	0
Warwickshire	24	1	1	0
Yorkshire, WR	26	0	0	0
Hertfordshire	26	1	1	0
Kent	29	0	0	0
Bedfordshire	31	0	0	0
Northamptonshire	31	0	0	0
From pastoral to arable:				
Suffolk	29	0	1	3
Gloucestershire	21	0	1	5
Staffordshire	19	0	1	5
Essex	17	1	2	6
Sussex	15	1	2	7
Hampshire	10	0	1	10
Surrey	13	0	2	15
Norfolk	29	0	5	17
Oxfordshire	5	0	1	20
England	542	26	19	8

Source: Derived from Kussmaul (1990: 182-194).

TABLE 7: Population density and arable acreage by county in 1290

Region	County	Population per mile^2	% arable	Arable acreage
Eastern England:	Norfolk	200	60.0	790,656
	Huntingdonshire	155	62.5	148,000
	Suffolk	147	60.0	574,464
	Cambridgeshire	136	57.5	320,896
	Lincolnshire	134	57.5	981,824
NE midlands:	Rutland	146	62.5	60,400
	Northamptonshire	145	62.5	399,200
	Leicestershire	112	47.5	252,928
	Nottinghamshire	102	52.5	279,552
	Derbyshire	83	32.5	210,080
South-east:	Middlesex	331	60.0	113,664
	Bedfordshire	141	57.5	174,432
	Oxfordshire	125	62.5	296,000
	Hertfordshire	123	52.5	209,664
	Kent	118	47.5	475,152
	Buckinghamshire	117	47.5	225,872
	Essex	111	50.0	491,840
	Surrey	95	42.5	206,176
	Berkshire	93	50.0	240,960
	Sussex	85	37.5	350,640
	Hampshire	71	47.5	489,440
SW midlands:	Gloucestershire	123	47.5	380,304
	Wiltshire	119	47.5	403,712
	Somerset	105	42.5	443,904
	Dorset	104	42.5	281,248
West midlands:	Warwickshire	98	45.0	279,360
	Worcestershire	82	42.5	191,760
	Herefordshire	77	37.5	202,320
	Shropshire	77	37.5	322,560
North-east:	Yorkshire, ER	111	57.5	434,240
	Yorkshire, NR	70	25.0	344,640
	Co. Durham	62	25.0	158,880
	Yorkshire, WR	52	20.0	363,008
	Northumberland	51	25.0	324,480
South-west:	Devon	60	25.0	418,080
	Cornwall	55	25.0	222,400
North-west:	Staffordshire	58	30.0	222,144
	Cheshire	45	15.0	91,968
	Lancashire	37	15.0	185,184
	Westmorland	37	12.5	63,280
	Cumberland	34	15.0	146,880
ENGLAND		94	39.5	12,772,192

Source: see text.

TABLE 8: Estimated population density and arable acreage by major region in 1290

Region	Total acreage	Estimated total population 1290	Population density per mile^2 1290	Estimated arable acreage 1290	Arable as % total area 1290	Arable acres per capita 1290
Eastern counties	4,777,600	1,164,457	156	2,810,950	58.8	2.4
NE midlands	2,446,720	428,785	112	1,200,070	49.0	2.8
South-east	6,757,760	1,155,425	109	3,268,150	48.4	2.8
South-west midlands	3,356,800	592,096	113	1,506,550	44.9	2.5
West midlands	2,471,680	321,601	83	994,270	40.2	3.1
North-east	5,882,240	592,388	64	1,622,420	27.6	2.7
South-west	2,561,920	232,159	58	639,370	25.0	2.8
North-west	4,073,600	263,247	41	708,220	17.4	2.7
England	32,328,320	4,750,157	94	12,750,000	39.4	2.7

Source: Tables 1 and 7.

TABLE 9: Estimated changes in arable area 1290—1871 by major region

Region	Estimated arable acreage 1290	*Arable as % total area 1290*	Recorded arable acreage 1871	*Arable as % total area 1871*	Estimated net change in arable area 1290-1871	*Estimated net change in % arable 1290-1871*
Eastern counties	2,810,950	*58.8*	3,056,568	*63.0*	245,618	*4.2*
NE midlands	1,200,070	*49.0*	952,758	*39.2*	-247,312	*-9.8*
North-east	1,622,420	*27.6*	1,950,640	*34.1*	328,220	*6.5*
North-west	708,220	*17.4*	1,016,285	*24.5*	308,065	*7.1*
South-east	3,268,150	*48.4*	3,516,531	*51.2*	248,381	*2.8*
South-west	639,370	*25.0*	1,031,253	*40.6*	391,883	*15.6*
South-west midlands	1,506,550	*44.9*	1,311,922	*39.0*	-194,628	*-5.9*
West midlands	994,270	*40.2*	1,007,413	*41.9*	13,143	*1.7*
England	12,750,000	*39.4*	13,843,370	*42.8*	1,093,370	*3.4*

Sources: Parliamentary Papers (1871); Table 8.

TABLE 10: English arable land-use (millions of acres)

	Wheat	Rye/ Maslin	Barley/ Dredge	Oats	Pulses	Potatoes	Other crops	Total sown	Fallow arable	Total arable
1270	2.21	0.72	1.23	2.94	0.29	0.00	0.00	7.40	5.13	12.52
1290	2.69	0.61	1.27	3.17	0.45	0.00	0.00	8.19	4.56	12.75
1300	2.68	0.60	1.27	3.16	0.45	0.00	0.00	8.16	4.56	12.72
1380	1.84	0.36	1.22	1.87	0.47	0.00	0.00	5.75	3.89	9.64
1420	1.61	0.32	1.17	1.66	0.45	0.00	0.00	5.21	3.53	8.75
1450	1.54	0.31	1.15	1.60	0.44	0.00	0.00	5.03	3.41	8.44
1500	1.58	0.37	1.19	1.56	0.47	0.00	0.10	5.26	3.24	8.50
1600	1.85	0.77	1.44	1.32	0.61	0.00	0.72	6.72	2.16	8.87
1650	2.04	0.40	1.89	1.15	1.03	0.00	1.37	7.74	1.88	9.63
1700	1.99	0.42	1.82	1.15	0.98	0.00	1.30	7.64	1.91	9.56
1750	1.95	0.06	1.50	1.82	0.98	0.08	2.53	8.92	1.59	10.51
1801	2.59	0.06	1.47	2.05	0.83	0.17	2.91	10.08	1.27	11.35
1836	3.32	0.06	1.95	1.56	0.59	0.28	4.80	12.57	1.30	13.87
1871	3.32	0.06	1.96	1.45	0.90	0.39	5.27	13.35	0.48	13.83

Sources: 1290: see text. 1270, 1300, 1380, 1420, 1450, 1500: projected from 1290 using sown acreage data for the manorial sector and tithe data for the non-manorial sector. 1600: interpolated between 1500 and 1700 using data on population. 1700: derived from Chartres (1985: 444); Holderness (1989: 145). 1750: derived from Holderness (1989: 145); Chartres (1985: 444). 1801: derived from Turner (1981); Prince (1989: 31); Holderness (1989: 145); Grigg (1989: 39). 1836: derived from Kain (1986). 1871: derived from Afton and Turner (2000).

REFERENCES

Allen, R.C. (2001), "The Great Divergence in European Wages and Prices from the Middle Ages to the First World War", *Explorations in Economic History*, 38, 411-447.

Beresford, M. (1989), "A Review of Historical Research (to 1968)", in Beresford, M. and Hurst, J.G. (eds.), *Deserted Medieval Villages*, Gloucester: Alan Sutton.

Broadberry, S.N., Campbell, B.M.S., Klein, A., Overton, M. and van Leeuwen, B. (2011), "British Economic Growth, 1270-1870: An Output-Based Approach", London School of Economics,

http://www2.lse.ac.uk/economicHistory/whosWho/profiles/sbroadberry.aspx.

Broadberry, S. N., Campbell, B. M. S., and Leuuwen, Bas van (2011), "English Medieval Population: Reconciling Time Series and Cross Sectional Evidence", London School of Economics,

http://www2.lse.ac.uk/economicHistory/whosWho/profiles/sbroadberry.aspx.

Campbell, Bruce M. S., and Bartley, Ken (2006), *England on the Eve of the Black Death: an Atlas of Lay Lordship, Land, and Wealth, 1300-49*, Manchester: Manchester University Press.

Chartres, J.A. (1985), "The Marketing of Agricultural Produce", in Thirsk, J. (ed.), *The Agrarian History of England and Wales, Volume V, 1640-1750, Part II: Agrarian Change*, Cambridge: Cambridge University Press, 406-502.

Clark, G. (2011), "Major Growth of Malthusian Stagnation? Farming in England 1209-1869", unpublished working paper, University of California at Davis,.

Clark, G. (2007), "The Long March of History: Farm Wages, Population, and Economic Growth, England 1209–1869", *Economic History Review*, 60, 97–135.

Clark, G. (2005), "The Condition of the Working-Class in England, 1209-2004", *Journal of Political Economy*, 113, 1307-1340.

Dodds, B. (2004), "Estimating Arable Output Using Durham Priory Tithe Receipts, 1341-1450", *Economic History Review*, 58, 245-285.

Dyer, C. (1982), "Deserted Medieval Villages in the West Midlands", *Economic History Review*, 35, 19-34.

Grigg, D. (1989), *English Agriculture: An Historical Perspective*, Oxford: Blackwell.

Grove, J. (2004), *Little Ice Ages, Ancient and Modern, II*, London, Routledge, revised 2nd edition.

Hatcher, J., and Bailey, M. (2001), *Modelling the Middle Ages: The History and Theory of England's Economic Development*, Oxford: Oxford University Press.

Holderness, B.A. (1989), "Prices, Productivity, and Output", in Mingay, G.E. (ed.), *The Agrarian History of England and Wales, Volume VI: 1750-1850*, Cambridge: Cambridge University Press, 84-189.

Kain, R.J.P. (1986), *An Atlas and Index of the Tithe Files of Mid-nineteenth Century England and Wales*, Cambridge: Cambridge University Press.

Kussmaul, A. (1990), *A General View of the Rural Economy of England, 1538-1840*, Cambridge; Cambridge University Press.

Marshall, E.J.P., Wade, P.M. and Clare, P. (1978), "Land Drainage Channels in England and Wales", *The Geographical Journal*, 144, 254-263.

Overton, M. (1996), *Agricultural Revolution in England: The Transformation of the Agrarian Economy 1500-1850,* Cambridge: Cambridge University Press.

Overton, M. and Campbell, B.M.S. (1999), "Statistics of Production and Productivity in English Agriculture, 1086-1871", in van Bavel, B. J. P,. and Thoen, E., eds.., *Land Productivity and Agro-Systems in the North Sea Area (Middle Ages – 20th Century): Elements for Comparison*, Turnhout, Brepols, 189-208.

Overton, M. and Campbell, B.M.S. (1996), "Production et productivité dans l'agriculture anglais, 1086-1871", *Histoire et Mesure*, 11, 255-297.

Parliamentary Papers (1871), *Agricultural Returns for Great Britain for 1871*, Parliamentary Papers, LXIX.

Prince, H.C. (1989), "The Changing Rural Landscape, 1750-1850", in Mingay, G.E. (ed.), *The Agrarian History of England and Wales, Volume VI: 1750-1850,* Cambridge: Cambridge University Press, 7-83.

Sapoznik, A. (2008), "Using Tithes to Compare Landlord and Peasant Cropping Patterns at Fourteenth-Century Oakington", Economic History Society Annual Conference, Nottingham.

Turner, M.E. (1981), "Arable in England and Wales: Estimates from the 1801 Crop Return", *Journal of Historical Geography*, 7, 291-302.

Williamson, T. (2010), "The Origins of 'Champion' Landscapes in Midland England: New Evidence from Northamptonshire", unpublished paper presented at the conference *Rural History 2010*, University of Sussex, 13 September 2010.

Wrigley, E.A. (2006), "The Transition to an Advanced Organic Economy: Half a Millennium of English Agriculture', *Economic History Review*, 59, 435-80.

Young, Charles R. (1979), *The Royal Forests of Medieval England*, Philadelphia, University of Pennsylvania Press.