

Continuity and Change in Hertfordshire Agriculture 1550–1700: I – Patterns of Agricultural Production*

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Abstract

The rural economies of the London area have long been seen as having responded particularly vigorously to the commercial opportunities created by the rapid growth of London in the early-modern period. This paper, the first of two, presents the results of an analysis of archdeaconry court probate inventories of farmers from the county of Hertfordshire. Topics covered include the relative importance of various cereal crops and of different types of livestock, the innovation of new fodder crops, the importance of particular types of farm enterprise, and patterns of geographical specialization. The results are used to discuss the chronology and geography of developments in agricultural production, and to compare these with the accounts of agrarian historians. It is concluded that these accounts do not adequately describe the chronology and geography of production changes. This has implications for explanations of the causes of agricultural change based on inferences from trends in grain and livestock prices.

AMONG the welter of advice and comment in Thomas Tusser's *Five Hundred Points of Good Husbandry* of 1573, his comment on his progress in life

To carke and care and ever bare,
With loss and paine, to little gaine,¹

might often have struck a sympathetic chord among agrarian historians of the early modern period. Twenty years on from the appearance of *The Agrarian History of England and Wales*, volume IV, and other important works² in the mid-1960s our theoretical and empirical knowledge of agricultural change has significantly, but very unevenly, increased. While the efforts

of Dr Thirsk and her collaborators have immeasurably increased our appreciation of the diversity of early-modern agriculture, and of the attitudes of contemporaries towards it, a number of key topics – particularly yield and productivity trends and their causes – remain highly problematic. The recent appearance of volume V of the *Agrarian History*³ provides a convenient point at which to take stock of debates on early modern agricultural change.

It is disappointing that the volume does not squarely address the hypotheses advanced by E L Jones and by A H John that this period was one of major agricul-

* An early version of part of this paper was presented at the British Agricultural History Society conference at Newton Abbot in April 1986. The author is grateful to participants there, particularly Mark Overton, for helpful comments and suggestions.

¹ T Tusser, *Five Hundred Points of Good Husbandry*, Oxford, 1984, p 205. 'To carke' is to be anxious.

² J Thirsk (ed), *The Agrarian History of England and Wales* (hereafter *AgHEW*), volume IV, 1500–1640, Cambridge, 1967; E Kerridge, *The Agricultural Revolution*, 1967; E L Jones (ed), *Agriculture and Economic Growth in England, 1660–1815*, 1967.

³ J Thirsk (ed), *AgHEW*, V, 1640–1750, Cambridge, 1984, in two volumes. Amongst reviews, see M Havinden, 'Evolution or revolution?: agriculture's critical period, 1640–1750', *Jnl Hist Geog* 12, 1986, pp 204–10, M Overton, 'Depression or revolution? English agriculture, 1640–1750', *Journal of British Studies* 25, 1986, pp 344–52, E A Wrigley, 'Early modern agriculture: a new harvest gathered in', *Ag Hist Rev* 35, 1987, pp 65–71, and R B Outhwaite, 'Review article. English agricultural efficiency from the mid-seventeenth century: causes and costs', *Historical Journal* 30, 1987, pp 201–9. In *AgHEW* V (i), Hertfordshire is discussed at length in R C Richardson, 'Metropolitan counties: Bedfordshire, Hertfordshire, and Middlesex', pp 239–69.

tural change.⁴ Briefly, Jones and John each suggest that a recession in grain prices from the 1640s (rather than the preceding boom period for grain producers) stimulated arable sector technological innovations designed to raise grain yields. This apparently perverse response of expanding output in response to low prices was, they argued, rational for commercial farmers whose physical or social environment prevented a switch towards more pastoral farming. Thus these accounts provide expectations of both the chronology (later seventeenth century onwards) and geography (principally light-soiled downlands) of new or intensified husbandry practices.

Several studies at a regional or local scale have directly considered these topics.⁵ In the main these have rejected accounts of agrarian change which overemphasize either the pre-1650 period or the post-1750 period as the pre-eminent times of changing production patterns or technical innovations. It has become widely accepted that, in many areas at least, the later seventeenth and early eighteenth centuries witnessed some major changes in farming

organization and farming practices, including intensified regional product specialization.

Simultaneously, several aggregate-level statistical and econometric analyses have suggested major changes in the performance of the English agrarian economy at this time.⁶ Substantial productivity improvements, both per acre and per man, appear to have been achieved. These set England apart from the general experience of late seventeenth- and early eighteenth-century Europe. Even if there remained obstacles to continued expansion beyond 1740, the English agrarian economy seems to have achieved higher grain yields, and to have maintained a very much larger non-agricultural population than hitherto. Unfortunately, econometric approaches have yet to be closely integrated with work specifying precisely how this improvement was achieved in particular farming systems. This is due partly to the deficiencies of agricultural sources, and partly to scepticism about the validity of heroically specified agricultural variables within highly aggregate econometric work. Nevertheless, perhaps the most important task facing agrarian historians is to achieve a closer integration between models of long-term economic and social change, and particular developments in yields, production patterns and techniques.

It should be noted straight away that this paper does not aim to provide a comprehensive account of agrarian change in Hertfordshire, but rather to focus more

4 A H John, 'The course of agricultural change, 1660-1760' in L S Pressnell (ed), *Studies in the Industrial Revolution*, 1960, pp 125-55; A H John, 'Agricultural productivity and economic growth in England, 1700-1760', reprinted in Jones (ed), *Agric and Econ Growth*, pp 172-93; E L Jones, 'Agricultural and economic growth in England, 1660-1750: agricultural change', reprinted in Jones (ed), *Agric and Econ Growth*, pp 152-71; E L Jones, *Agriculture and the Industrial Revolution*, Oxford, 1974. Convenient summaries are provided by P K O'Brien, 'Agriculture and the industrial revolution', *Econ Hist Rev*, 2nd ser, xxx, 1977, pp 166-81; C Clay, *Economic Expansion and Social Change: England 1500-1700*, Cambridge, 1984, I, pp 126-41; M Overton, *The Agricultural Revolution in England: the Transformation of the Rural Economy, 1500-1830*, Cambridge, 1987.

5 Lack of space precludes an exhaustive list, but the two most important regional-level studies have been those of Yelling and Overton. Among recent papers are J Yelling, 'Livestock numbers and agricultural development 1540-1750: a study of east Worcestershire', in T Slater and P Jarvis (eds), *Field and Forest: an Historical Geography of the West Midlands*, Norwich, 1982, pp 281-300; M Overton, 'Estimating crop yields from probate inventories: an example from East Anglia, 1585-1735', *Jnl Econ Hist* 39, 1979, pp 363-78; M Overton, 'Agricultural revolution? Development of the agrarian economy in early modern England', in A R H Baker and D J Gregory (eds), *Explorations in Historical Geography: Interpretative Essays*, Cambridge, 1984, pp 118-39; M Overton, 'The diffusion of innovations in early modern England: turnips and clover in Norfolk and Suffolk, 1580-1740', *Transactions of the Institute of British Geographers*, new series 10, 1985, pp 205-21.

6 E A Wrigley, 'Urban growth and agricultural change: England and the continent in the early modern period', *Journal of Interdisciplinary History*, 15, 1985, pp 683-728, especially pp 695-705; E L Jones, 'Agriculture, 1700-1800' in R Floud and D McCloskey (eds), *The Economic History of Britain since 1700 I*, 1981, pp 66-86; R V Jackson, 'Growth and deceleration in English agriculture, 1660-1790', *Econ Hist Rev*, 2nd series, XXXVIII, 1985, pp 333-51; P K O'Brien, 'Agriculture and the home market for English industry, 1660-1820', *Eng Hist Rev* 100, 1985, pp 773-800; N F R Crafts, 'English economic growth in the eighteenth century: a re-examination of Deane and Cole's estimates', *Econ Hist Rev*, 2nd series, XXIX, 1976, pp 226-35; N F R Crafts, 'British economic growth, 1700-1831: a review of the evidence', *Econ Hist Rev*, 2nd series, XXXVI, 1983, pp 177-99.

narrowly on aspects of production. Developments in agricultural production are approached here through a statistical analysis of farmers' probate inventories, to illustrate the sorts of developments which inventories are capable of revealing.⁷ Probate inventories are relatively uninformative about tenurial and organizational aspects of agrarian change and these will not be discussed in any detail. The restricted focus of this paper is deliberate. I regard a large-scale analysis of probate inventories as important and worthwhile for at least two reasons.

First, it has appeared to several historians that large-scale quantitative analyses of probate inventories may provide a wide range of new data against which divergent interpretations of the development of early modern agriculture can be evaluated. In *Economic History Review* recently, Outhwaite suggested that 'inventory analysis techniques . . . look particularly promising [in confirming or denying assertions about changes in cropping and livestock patterns], and hold out promise for systematic regional investigations from the mid-sixteenth century onwards'.⁸ Similarly Thirsk expects the computer handling of data from large numbers of inventories to enable 'much more comprehensive analyses' of patterns of farming activities.⁹

Moreover the development of new techniques for the statistical analysis of inventory data, mainly by Mark Overton,¹⁰ offers an approach to some hitherto unresolved problems, such as trends in crop

yields. This is *not* to suggest, as some agricultural historians have implied, that the availability of better agricultural statistics would of itself resolve major agricultural debates. But more reliable estimates of yield levels and other measures of farming activity do mean that the terrain for debate is better defined. Neither is it my intention to claim that inventories provide some 'privileged' kind of data on these topics compared with other sources, but merely to emphasize the broad temporal, social and geographical coverage of the farming population that they provide.

However, since there have as yet been few large-scale inventory studies, it is difficult fully to evaluate their worth. Economic historians such as Holderness have made sceptical comments about the value of inventories, describing their use as the framework of recent studies as 'problematical' and 'restrictive',¹¹ but without elaborating why these limitations apply more severely to studies based on probate inventories than to studies based on any other (scarcer) source. Thus the second aim of the paper is to provoke some debate over how useful the results are, and to highlight questions whose solutions will require inventory data to be related to data from other sources such as farm accounts, legal and estate records, diaries, husbandry manuals and so on.

Obviously, an overall verdict on the usefulness of inventories will also depend on the ways in which we choose to define and conceptualize agricultural change and the economic, social and cultural processes which it involves. Those predisposed to see agricultural change as a basically technical process are likely to be more enthusiastic than those for whom changes in agricultural production are basically a function of changing power-relations within society as a whole. However, this interpretative

⁷ For detailed discussion see M Overton, 'English probate inventories and the measurement of agricultural change', *AAG Bijdragen*, 23, 1980, pp 205-15; M Overton, 'Probate inventories and the reconstruction of agricultural landscapes', in M Reed (ed), *Discovering Past Landscapes*, 1983, pp 167-94.

⁸ R B Outhwaite, 'Progress and backwardness in English agriculture, 1500-1650', *Econ Hist Rev*, 2nd series, XXXIX, 1986, p 18.

⁹ J Thirsk, *England's Agricultural Regions and Agrarian History, 1500-1750*, 1987, p 20.

¹⁰ M Overton, 'Computer analysis of an inconsistent data source: the case of probate inventories', *Jnl Hist Geog* 3, 1977, pp 317-26; Overton, 'English probate inventories and agricultural change'; Overton, 'Estimating crop yields'.

¹¹ B A Holderness, 'Review of periodical literature: 1500-1700', *Econ Hist Rev*, 2nd series, XL, 1987, p 102.

dispute is an argument which the analysis of empirical data is not capable of resolving, and which requires debate beyond the scope of this discussion.

This discussion consists of two papers. The first, below, concentrates on changing patterns of aggregate production and their geography in the county of Hertfordshire, a short distance to the north of London, between 1550 and 1700. Important new information relating to agriculture in south-east England is presented and discussed. Most of the topics dealt with are familiar from existing work using inventories, though some of them are here approached in new ways. Section I discusses trends in farm size, measured through total valuations of crops and livestock. Patterns of cropping, livestock ownership, and the innovation of new fodder crops are outlined in section II. The geographical distribution of particular product specializations is mapped in section III. Cluster analysis is used to determine the relative importance of different farm-types in section IV, and these are mapped to further identify patterns of regional specialization in section V. The second paper, 'Trends in crop yields and their determinants', will address a variety of questions concerning aspects of grain output and productivity.

I

The present results derive from about 2150 Hertfordshire probate inventories proved in archdeaconry courts, the lowest level of the multi-tiered English probate system, between 1550 and 1699.¹² These inventories provide varying levels of information and

detail, and not all of them provide information for each topic to be discussed. As can be seen from Table 1 the majority of farmers' inventories date from the seventeenth century. Prior to this time fewer inventories are available because the survival of the various archdeaconry court records is rather patchy. Prior to 1607, the only inventories available are from the archdeaconry of St Albans, mainly in south-west Hertfordshire.¹³

The core of this paper is provided by the 1300 or so inventories relating to 'active' farmers, and made during the late-spring

TABLE 1
Mean Inventory Valuations of Farmers'
Personal Estates (£)

	Yemen			Husbandmen		
	Total	Farm	No	Total	Farm	No
1540-49	32	20	(2)	21	12	(6)
1550-59	49	22	(19)	29	22	(22)
1560-69	68	34	(9)	53	30	(13)
1570-79	132	74	(17)	56	37	(12)
1580-89	131	77	(26)	70	40	(12)
1590-99	139	79	(23)	39	20	(20)
1600-09	128	77	(48)	42	19	(25)
1610-19	144	78	(81)	37	20	(55)
1620-29	196	123	(70)	47	22	(66)
1630-39	194	116	(88)	41	19	(68)
1640-49	204	116	(85)	61	26	(47)
1650-59	208	145	(20)	51	22	(13)
1660-69	176	109	(85)	75	35	(60)
1670-79	281	169	(76)	94	50	(50)
1680-89	275	152	(82)	87	42	(51)
1690-99	285	194	(68)	87	61	(41)

Source: archdeaconry court probate inventories of active farmers. 'Total' = total gross value of inventory; 'Farm' = value of grain and fodder (both growing and stored), and livestock, but excluding farm equipment and gear; 'No' = number of inventories.

¹² The archdeaconry court inventories used in this study are preserved in the Hertfordshire County Record Office, County Hall, Hertford (hereafter HCRO). The series for the archdeaconries of St Albans (from 1538) and Huntingdon (from 1607) are filed separately, apart from the wills to which they relate. The office holds a card index by surname only for all its holding of probate documents. An index for the period 1550-1700 by parish and by occupation compiled by the author is available in typescript.

¹³ For the boundaries of probate jurisdictions in the county see C Humphrey-Smith (ed), *Atlas and Index of Parish Registers*, Chichester, 1984. Wills from eastern parishes in the archdeaconry of Middlesex are preserved at the Essex County Record Office at Chelmsford, but without inventories.

to late-autumn period.¹⁴ By an 'active' farmer I mean someone whose inventory suggests that the ascription of the term 'yeoman' or 'husbandman' was not solely a status label, and that they were not retired. A farmer was deemed to be retired if he fulfilled three of the following four criteria: first, that he owned little or no stored grain and no crops; second, that he possessed not more than two animals of any kind; third, that he possessed no farm equipment or tools; and fourth, that he did not live in his own house, but in a single lodging room in somebody else's house. Thus the retirement threshold set is low. The 'active' farmer category does include some small farms, although the smallest farms are excluded from calculations in sections IV and V.

Table 1 summarizes aggregate trends in the gross total value of the inventories of 'active' yeomen and husbandmen, and in the total value of their crops and livestock. Given that price levels changed over time, it is necessary to distinguish between inflation and increasing personal wealth as causes of the rising valuations in Table 1. The total valuations of crops and of livestock in each inventory were deflated by price series, for 'all arable crops' and 'all livestock' respectively, derived from *The Agrarian History of England and Wales*.¹⁵ The adjusted amounts have then been recombined and indexed to produce the graphs in Fig 1. Although these are national rather than local price series, general trends in farm valuations may be distinguished.

Among yeomen, whose numerical and landholding importance relative to husbandmen was becoming increasingly

marked,¹⁶ valuations in real terms increased in two phases either side of a period of relatively stable valuations: first in the third quarter of the sixteenth century, and again in the late seventeenth century. Husbandmen's farm valuations were also increasing in these periods, but had collapsed in the aftermath of several poor harvests in the late 1580s and 1590s. These economic difficulties may have helped to reinforce trends towards a closer relationship between wealth and the definition of status by contemporaries. However, changing use of terminology can only account for a small element of overall trends in yeomen's wealth. Whilst it would be naive to expect more than a broad correlation between farm valuations and farm size, Fig 1 is probably indicative of the direction of trends in mean farm size among inventoried farmers. Farm valuations of course depended on factors other than size, but the use of valuations does deal with farms as working units, whereas the analysis of farm size from sources such as survey field books and rentals is bedevilled by the likelihood of widespread sub-letting. A detailed elaboration of trends in landholding structure needs to be pursued through more intensive local studies, integrating inventories and other documentary sources.

II

The relative importance of crops and livestock in farm valuations illustrates the predominantly arable nature of agriculture within the county. Making allowance for different rates of price inflation for crops

¹⁴ A detailed analysis of the agricultural activities of tradesmen and craftsmen in this area is in preparation. The major conclusion of this analysis is that craftsmen and tradesmen in Hertfordshire had very limited agricultural activities compared with more remote areas where the 'dual economy' household was more normal, as discussed by Joan Thirsk, 'Industries in the Countryside', in F J Fisher (ed), *Essays in the Economic History of Tudor and Stuart England*, Cambridge, 1961, pp 70-88.

¹⁵ P J Bowden, 'Statistical appendix', in *AgHEW* volume IV; P J Bowden, 'Statistical appendix', in *AgHEW* volume V.

¹⁶ Among the adult male population of the county as a whole, I estimate that the approximate proportions designated 'yeoman' and 'husbandman' were respectively 27% and 15% in 1540-79, 26% and 11% in 1580-1609, 25% and 8% in 1610-39, 20% and 8% in 1640-69, 11% and 4% in 1670-99. These figures are derived from occupational indexes for a sample of parishes. They are compiled using occupational information from several sources applied to lists of adult males derived from parish registers (plus an estimate of the farm servant group) and population listings, although the latter are very scarce.

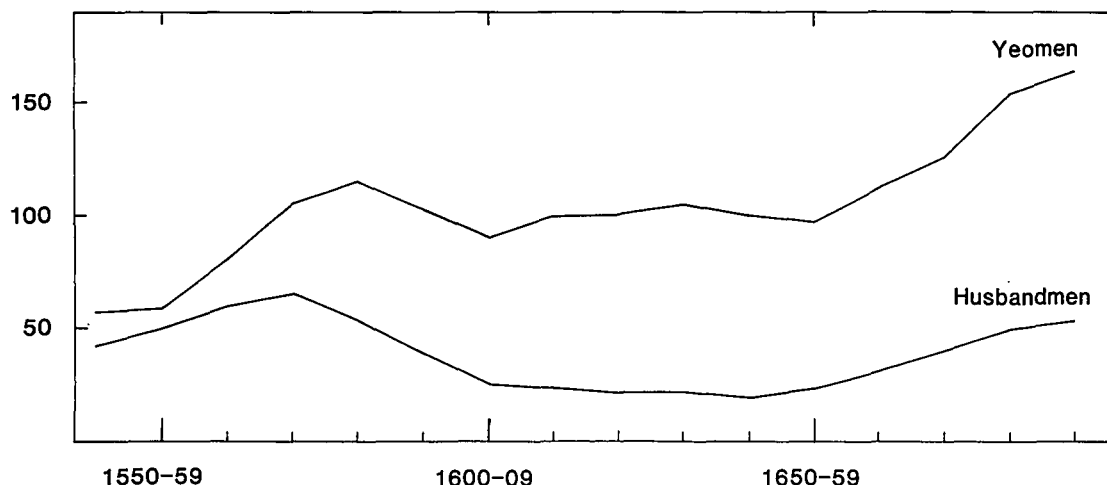


FIGURE 1

Combined crop and stock valuations in real terms, 1540-1699. Inventory valuations adjusted for inflation. Three-decade moving average, indexed relative to Yeomen 1620-29 = 100

and livestock, the arable emphasis of Hertfordshire agriculture increased steadily during the sixteenth century, by the end of which crops accounted for over 60 per cent of farm valuations. The rate of increase slowed during the seventeenth century, levelling off at just over 70 per cent of farm valuations. This level was maintained even when price relatives were moving against grain products after 1650.

Within this general picture of arable specialization, changes in the relative importance of the major arable crops are summarized in Fig 2. The major feature of the period was an increase in the area devoted to barley. At an aggregate level this was at the expense of rye, although at a regional level there were some areas where barley cultivation also expanded to replace wheat and other areas where wheat replaced rye. By the 1690s the cultivation of rye had all but disappeared from Hertfordshire, having lingered longest on poor soils in the south-west. By then barley was more widely cultivated than wheat in many northern districts: a development intimately related to the increasing scale and sophistication of the malting industry

in centres like Hitchin and Ware. Thus Richardson's claim that 'wheat and oats were certainly the main crops grown in Hertfordshire in the seventeenth century' is at best an oversimplification.¹⁷ Not too much significance should be attached to small changes in the level of these graphs, but we can also pick out a small overall decline in the cultivation of oats and an overall increase in the proportion of cropped land under peas, beans and other pulses.

While the increase in the proportion of cropped acreages under pulses was relatively modest, their cultivation became much more widespread among farmers. From being grown on under half of inventoried farms before 1580, they were grown on more than three-quarters of inventoried farms a century later. Since cultivation levels were similar in both the archdeaconry of St Albans and the archdeaconry of Huntingdon, the increase is not an artefact produced by the uneven geographical coverage of inventories before 1607. Among both yeomen and

¹⁷ Richardson, 'Metropolitan counties', p. 243.

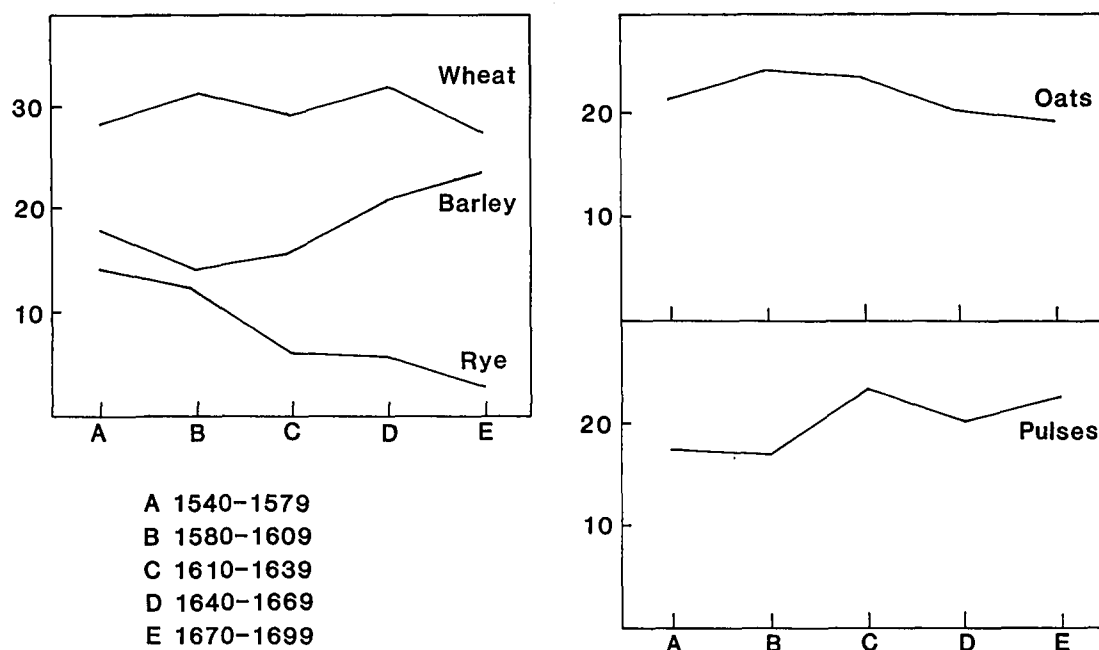


FIGURE 2

Relative importance of cereal crops shown as percentage of cereal area in summer inventories

husbandmen, the proportion growing pulses increased steadily: from just under 50 per cent of each group in the period 1540-79, to over 75 per cent of yeomen and about 55 per cent of husbandmen in 1610-39, and 85 per cent and 80 per cent respectively in 1670-99.

Although there was little difference between the two status groups in terms of their cultivation of all pulses (mainly peas) this was in marked contrast to the cultivation of the more highly-valued pulses such as lentils, vetches and tares. Initially, these were grown by yeomen far more often than by husbandmen. In 1610-39 just over a quarter of yeomen's inventories included these pulses, compared with just under 10 per cent of husbandmen's. By the last thirty years of the century the gap had narrowed. After 1670, roughly 30 per cent of yeomen and 25 per cent of husbandmen were growing lentils, vetches or tares.

A similar pattern of narrowing social differentiation in the cultivation of pulses emerges when we turn to variations in

their cultivation according to farm size. Taking total cropped acreage as a measure of farm size, variations in the cultivation of pulses among farms of different sizes were modest, especially after about 1610. The same was not true, though, of the relative importance of barley on farms of different sizes. Throughout the period, larger farms devoted considerably more of their cropped area to barley than did smaller farms. Indeed, variations in the importance of barley with increasing farm size became more pronounced over time. By the period 1670-99 farms with fewer than 10 acres under crops devoted on average less than 10 per cent of their area to barley, those with 10-19 acres devoted just under 15 per cent, those with 20-49 acres devoted just over 20 per cent, and those farmers with more than 50 acres under crops on average devoted well over 25 per cent of this to barley. These figures are particularly relevant with regard to total output per farm because, as we shall see, barley produced higher yields per acre than

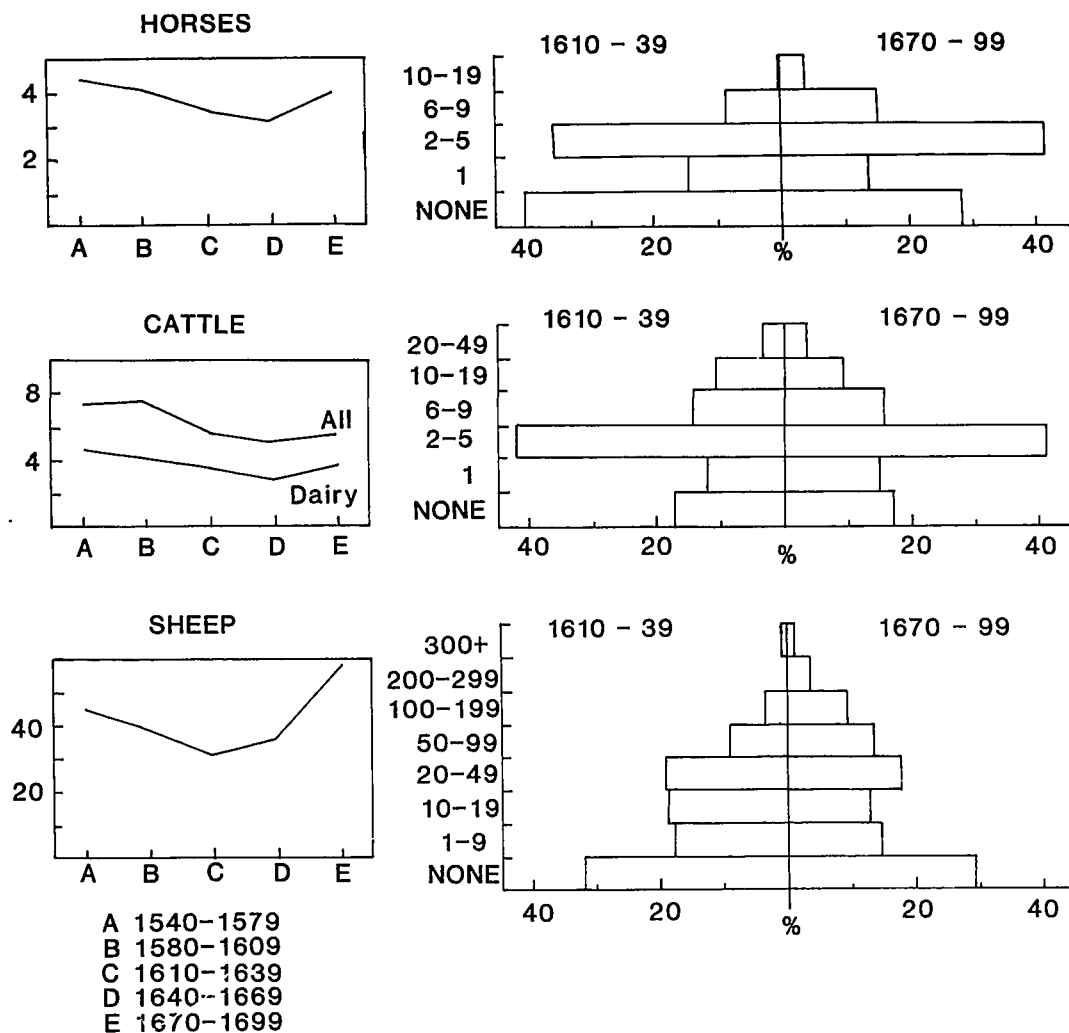


FIGURE 3
Mean size of livestock holdings and the size-distribution of herds and flocks

other arable crops.¹⁸ This implies that total arable output per acre increased quite sharply with farm size.

As with different arable crops, so the relative importance of different types of livestock varied over time. Fig 3 depicts trends in the numbers, and the size-distribution where available, of horses, cattle and sheep. The mean herd and flock sizes on the left-hand side of Fig 3 are the means for those farmers who had some of the

relevant livestock: those farmers with none are excluded from the calculation of mean herd and flock sizes. The pattern that emerges is a familiar one, notably from the work of Yelling, with mean herd sizes declining by at least one-third between the middle of the sixteenth century and the middle of the seventeenth. After about 1620, however, hitherto similar trends for the different livestock types diverged.

First, the ownership of horses became more widespread after about 1640 as the top right-hand diagram of Fig 3 illustrates.

¹⁸ Discussed below in section VII.

The proportion of farmers with no horses dropped by nearly half between 1610-39 and 1670-99; and average herd size increased because there were more large holdings, with six or more horses. There was no such recovery in the size of cattle herds, and the mean number of cattle possessed by farmers remained stable through the seventeenth century. This stable herd size was underlain by a very stable size-distribution of herd sizes: the pyramids of herd size-distributions in 1610-39 and 1670-99 are almost identical. This aggregate stability nevertheless concealed a shift away from cattle breeding and rearing towards dairying. By the close of the seventeenth century dairy cattle accounted for about 70 per cent of cattle enumerated. This was rather above their relative frequency in the late sixteenth century.

The most dramatic indication of growing livestock numbers per farm comes from the mean size of sheep flocks, which increased during the seventeenth century, especially after 1670, to reach new levels higher than those at any earlier period in this study. However the rise in mean flock size was not associated with an increase in the number of farmers keeping some animals, as was the case with horses. After about 1640 there was a sharp increase in the proportion of farmers with large flocks of fifty or more sheep, but almost as many farmers as before had no sheep at all. Farmers with fifty or more sheep comprised 13 per cent of all farmers with sheep in 1610-39, but 27 per cent of all farmers with sheep in 1670-99. So compared with other branches of livestock farming, sheep farming was becoming an increasingly specialized activity.

It is notoriously difficult to turn estimates of the livestock held per inventoried farmer into overall trends in the number of livestock in an area,¹⁹ since changes in

mean farm size could reinforce, or cancel out, or outweigh trends in livestock per farm. If we take the attempt to calculate farm values in real terms in Fig 1 as a crude surrogate for farm size, two conclusions follow. First, if mean farm size among farmers was increasing at all between 1550 and about 1580 (or beyond), then the decline in livestock numbers in the county as a whole was more precipitous than that in livestock per farmer shown in Fig 3. Secondly, there are strong indications that mean farm size in the last three decades of the century (my period E) was significantly larger than before.²⁰ Naturally, the effect of this is to lessen the apparent increase in the numbers of horses and sheep in the county, and it can be suggested that numbers of cattle continued to decline after 1650 rather than stabilizing. Overall then, any aggregate increase in livestock numbers in the late seventeenth century was probably on a modest scale. Accounts of agrarian change which invoke substantial increases in livestock numbers in arable-dominated areas of the metropolitan counties seem to be of limited relevance here.²¹

In Hertfordshire, as in East Anglia,²² both new grass substitutes and root crops (mainly turnips) were more widespread by 1700 than they had been a century earlier, with most of the increase recorded in inventories occurring after 1670 (Fig 4). Of the two groups of crops, by far the commoner were clover, sainfoin and the other grass substitutes. By the end of the seventeenth century, about 8 per cent of

of changing land-use patterns, to multiply densities up to obtain total livestock numbers (suggested by Yelling, 'Livestock numbers and agricultural development'). A second is to estimate the average herd and flock sizes for different occupational groups (gentry, clergy, yeomen, husbandmen, tradesmen, craftsmen, labourers, etc) and to use estimates of the occupational composition of the population to combine the figures for each group to obtain total livestock populations.

²⁰ Growing farm sizes in the late seventeenth century are noted by G Longman, *A Corner of England's Garden: An Agrarian History of South West Hertfordshire 1600-1850*, Bushey, 1977, p 40.

²¹ John, 'Course of agricultural change', pp 124-33; Jones, *Agriculture and the Industrial Revolution*, pp 72-8.

²² Overton, 'Diffusion of innovations', p 208.

¹⁹ The total number of livestock in the county could be estimated very approximately in one of two ways. One way is to develop indices of livestock density per cultivated acre, and via a model

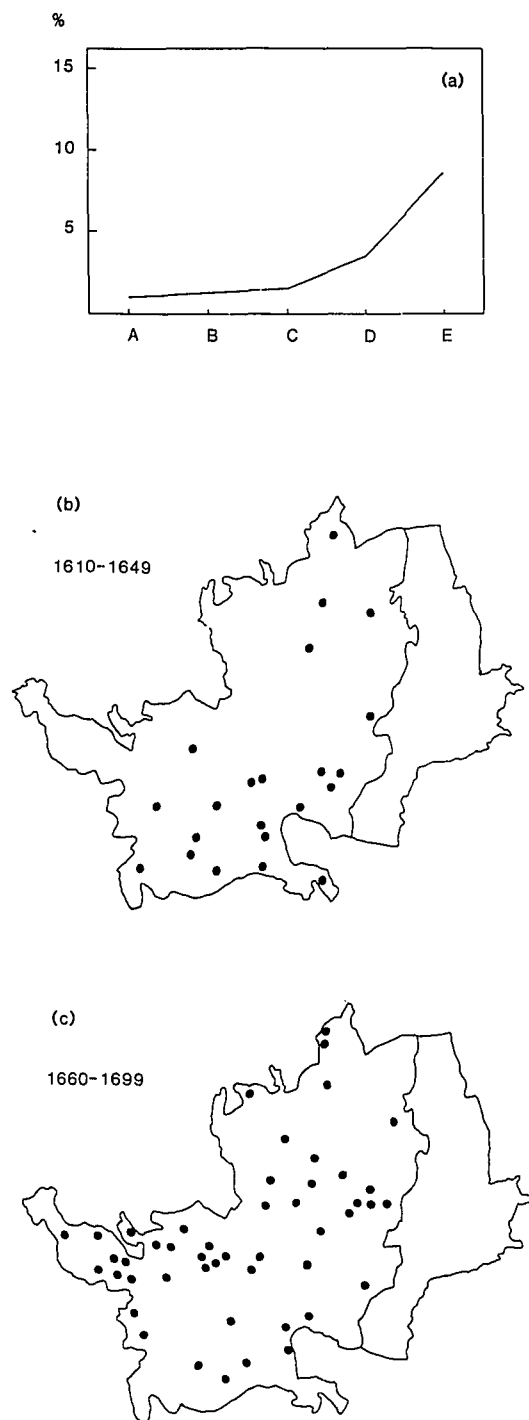


FIGURE 4
Cultivation of grass substitutes. (a) Percentage of farmers growing grass substitutes (A to E denote time periods as in Fig 2); (b) and (c) Location of farms where grass substitutes recorded

farmers possessed one or more grass substitute crops but only 3 per cent appear to have been growing turnips. Early innovations of new grasses were most frequent in southern areas where fodder production and stock fattening had long been a prominent element of farming, although these early references almost invariably involve only a very small acreage or quantity of seed. After 1660, however, their recording became more widespread, and the larger acreages involved suggest that some farmers were growing these crops as an integral part of crop rotations, rather than on odd areas of spare ground. In the later decades of the century, the grass substitute crops remained scarce only on the northern chalk soils. By contrast, even in the 1690s, very few farmers grew turnips on a large scale, which suggests that they did not at this time play a significant part in crop rotation systems.

III

Obviously, we need to do more than examine agricultural changes at an aggregate level over the whole county. Discussions of agricultural change have long focused on the appropriateness of particular innovations or techniques to particular types of physical and social environment. Clearly, aggregate patterns or trends in as large an areal unit as a county may be an illusion produced by the averaging together of very different patterns and trends in different localities. Where were particular activities concentrated? What were the relationships among the physical environment, economic setting, agrarian context, and agricultural production? Did these relationships change over time?

Discussions of the geography of agricultural change have often been couched in general terms (as in simple distinctions between downland and clayland farming, or between largely open and largely

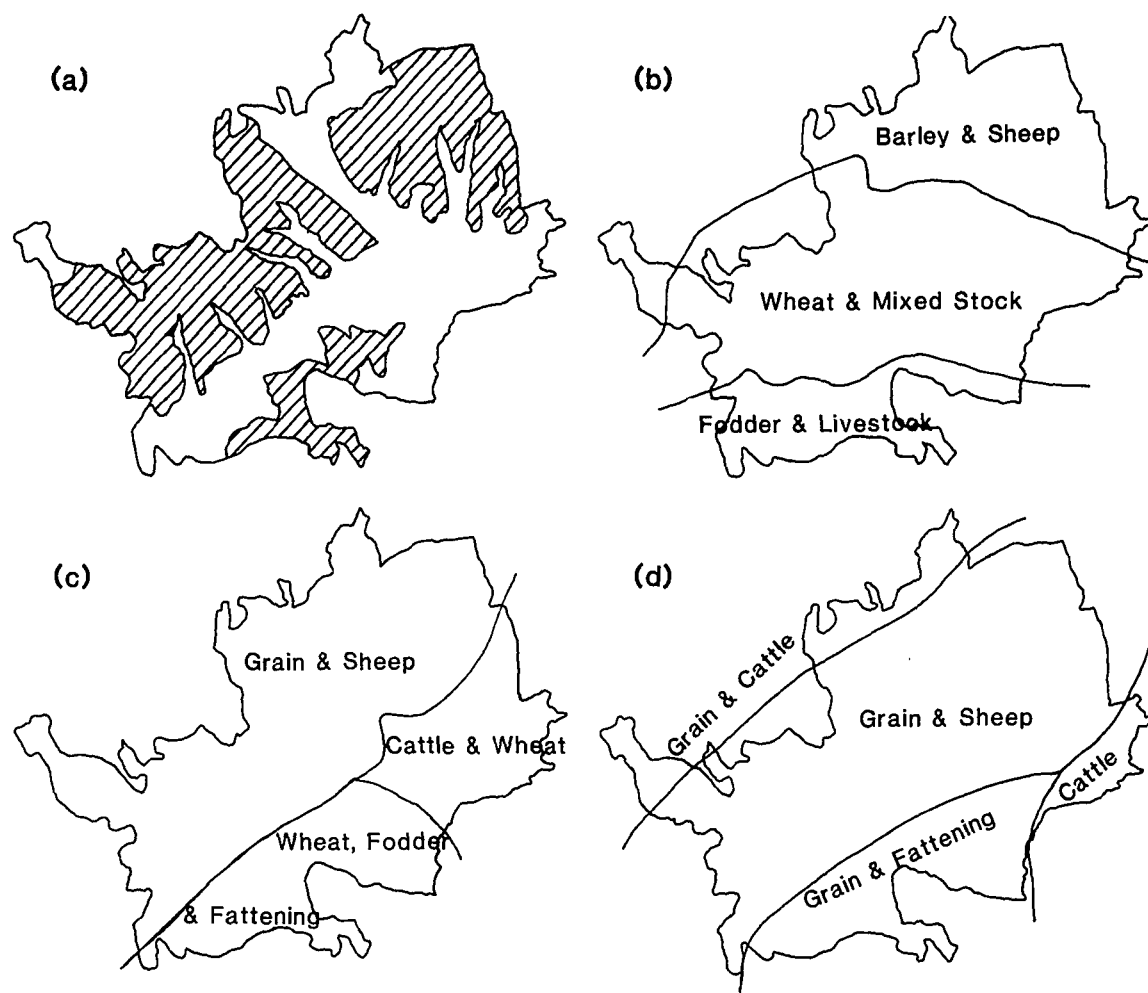


FIGURE 5

Proposed farming regions in Hertfordshire. (a) Relief, shaded area indicates the approximate extent of land above 250 feet; (b) to (d) Approximate extent of agricultural regions in the classifications proposed by Thirsk (1967), Kerridge (1967) and Richardson (1984). The main product specializations discussed by these authors are indicated.

enclosed areas),²³ but three more specific agricultural regionalizations of England have been proposed in the last twenty years.²⁴ These each include an attempt to delimit 'agricultural regions' in this area, and the geography of agricultural change (Fig 5).

Thirsk²⁵ (Fig 5b) recognizes three farming regions in Hertfordshire by 1640. In the south, from Watford to Cheshunt, horse-breeding and the cultivation of oats for fodder were specialities. Wheat was the main cash crop, with other grains (mainly barley) fed to poultry and young pigs. 'In short . . . a region of mixed farming, where nearly all the arable crops except wheat were used for the production of

²³ Overton, 'Agricultural revolution?', p 126; J Yelling, *Common Field and Enclosure in England 1450-1850*, 1977, p 190.

²⁴ The schemes are summarized, with some general comments on agricultural regions and their delineation, in Thirsk, *English Agricultural Regions*, pp 23-36.

²⁵ Thirsk, *AgHEW* volume IV pp 50-2.

stock.' A mixed farming system also occupied the loams and clays of central Hertfordshire, but concentrating on fattening bullocks bought as stores, with wheat as a cash crop. Large sheep flocks, '50 to 100 animals or more', were common, but valued more for manure than wool. Finally on the northern chalk hills 'prevailed . . . the sheep-corn husbandry of wolds and downland'. Sheep were folded on the arable, with wheat and barley the main cereals. Malting was important based on both local produce and barley carried from Cambridgeshire. These developments owed much to demand from London markets, with return manure shipments by road and barge of growing importance. Some places saw conversion to pasture in the sixteenth century, with both convertible husbandry and new fodder crops such as turnips evident in the south by 1640.

Kerridge²⁶ (Fig 5c) adopts a slightly different three-fold division. Most of Hertfordshire was 'Chiltern country', dominated by sheep-corn husbandry with barley and a little wheat as market crops, and some dairying or stock fattening. Further east, more wooded areas were the location for intensive wheat cultivation, stock-fattening and some dairying. Closer to London, in the south,

despite all local peculiarities, the vale was fashioned into a distinctive farming country by the presence of the great and growing city . . . drawn into the supply of food and fodder . . . and received in return an abundance of the city's natural produce of refuse and muck.

The major features of this area were market gardening, wheat and hay production, and specialized types of stock fattening.

Richardson²⁷ (Fig 5d) also emphasizes how the demands of the metropolitan food market led to a largely arable specialization, even on poor soils. Across the county as a whole he suggests that wheat and oats

were the most important crops, followed by rye (which was declining in importance) and barley, with some peas also. Of the two most important areas in Richardson's scheme the first was a broad swathe of central and northern Hertfordshire (by no means confined to the chalk uplands as the text asserts), where 'sheep-corn husbandry was the general practice and barley a major crop' for malting. The second was further south where access to London encouraged specialization in 'the breeding of horses; the fattening of pigs, lambs and bullocks; and the growing of oats'. In several parts of this area, though, hay was more important than any arable crop, and wheat and especially rye were in part replaced by fodder crops during the period 1640-1750 as overall tithed areas grew. There were two minor areas of specialization in cattle fattening: around Tring in the west and, more intensively, in the Lea and Stort valleys, an area for which, unfortunately, no probate inventories survive. Here especially, but also more widely, back carriage of soot, night-soil and other waste in carts and barges that had carried hay, grain or malt to London made an important contribution to manuring both grassland and arable. This was a notable factor in the rise of intensive market gardening in the late seventeenth and early eighteenth centuries.

Inventory data dealing with single aspects of agricultural production such as particular types of crops or livestock are easy to map, and such maps are easy to interpret in broad regional terms. Fig 6 illustrates three changes in aggregate production patterns which had particular geographical impacts. First, the increasing cultivation of barley, which at an aggregate level was largely at the expense of rye (Fig 2) was, at a regional level, more complicated than this simple substitution. In some parts of Hertfordshire, especially central and southern districts, rye was largely replaced by more winter wheat. Further

²⁶ Kerridge, *Agricultural Revolution*, pp 56-9, 89-91, 173-80.

²⁷ Richardson, 'Metropolitan counties', pp 239-69.

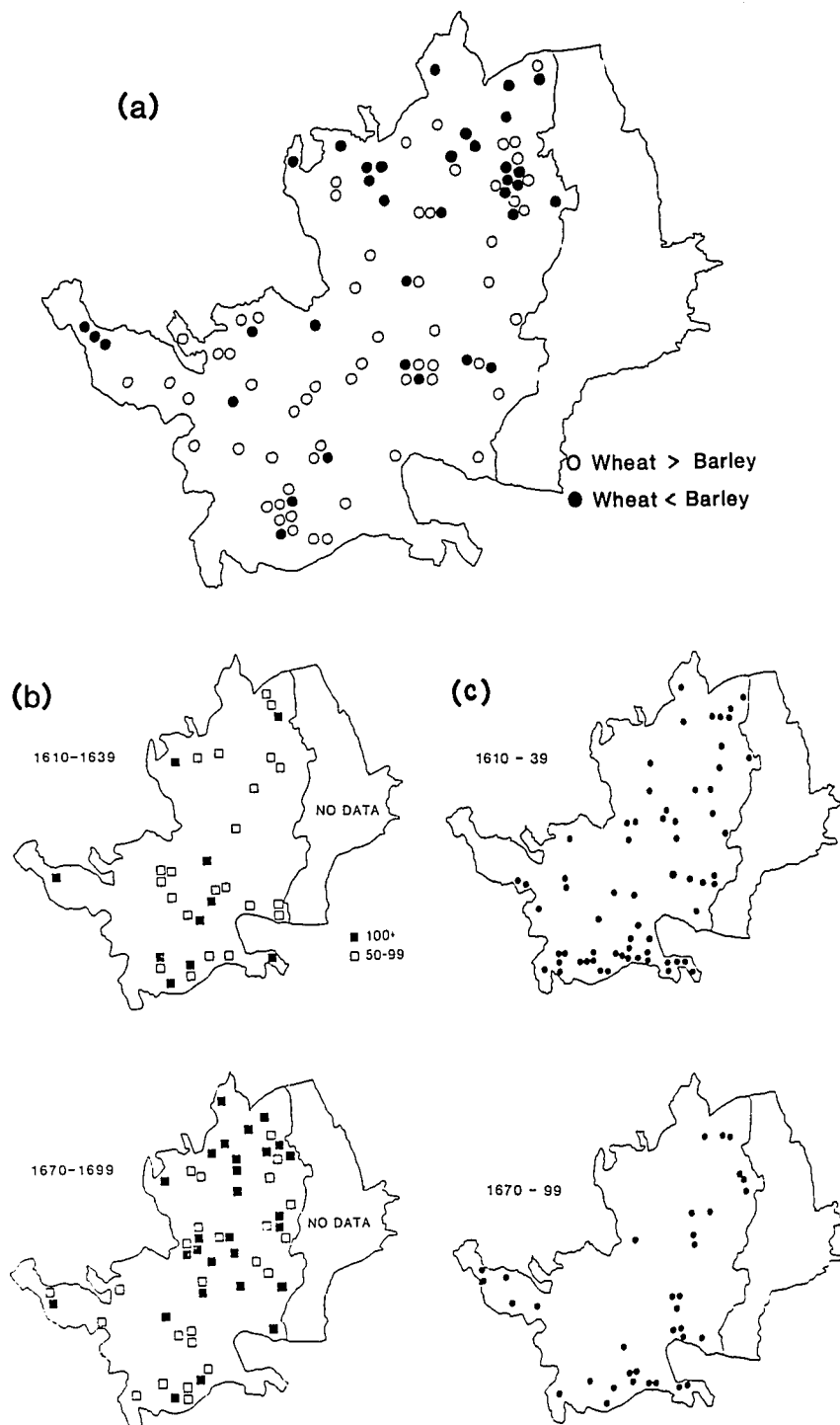


FIGURE 6

Distribution of selected specializations. (a) Farms with major concentration on wheat or barley, 1660-1699; (b) Location of farms with large sheep flocks specified in inventories; (c) Location of farms with major cattle holdings specified in inventories

north and in the extreme west barley acreages increased at the expense of both rye and wheat. Fig 6a shows how, by 1660–99, the acreage under barley exceeded that under wheat in much of northern Hertfordshire. Thus any marked differential improvement in barley or wheat yields would have affected farmers in some areas much more than others.

Secondly, and turning to livestock, the substantial late seventeenth-century increase in the mean size of sheep flocks also had a very uneven impact across the county. Like the relative importance of barley, large sheep flocks were increasingly a feature of northern Hertfordshire. In comparing the distribution of large sheep flocks in 1610–39 and 1670–99 (Fig 6b), the shift from a slight southern concentration to a marked northern and central concentration is very striking, especially taking account of the largest flocks of 100 or more sheep, shown here by the solid symbols. The broad regional association of sheep and barley is hardly surprising of course, but the chronology of their concentration in northern Hertfordshire is noteworthy. The emergence of the classic downland sheep-corn economies in the Hertfordshire Chilterns emerges as very much a late seventeenth-century phenomenon, half a century later than was suggested by Dr Thirsk in her pioneering survey of regional agrarian economies twenty years ago.

Finally, the substantial decline in the number of farms on which cattle or cattle and fodder accounted for a high proportion of the farm valuation, had an even clearer geographical impact. Fig 6c plots the location of such farms for the periods 1610–39 and 1660–99. Their geographical distribution underwent a sharp contraction during the seventeenth century. Moreover, this contraction was associated with much clearer regional specialization: with cattle breeding and rearing in the west around Tring, and a heavy concentration on dairy-

ing in the south from Rickmansworth eastwards to Hatfield.

These three examples illustrate the emergence of new, or more sharply defined, regional specializations in farm output. However they are by no means typical, in that several other changes exhibited no such clear geographical patterns. These three examples illustrate what *sometimes* happened to the geography of particular aspects of production as individual farms became more specialized. It should not be supposed that increased geographical differentiation at a regional level was an inevitable outcome of agricultural changes on early-modern farms. We should not always expect clearer *regional* patterns of production just because *individual* enterprises were becoming more specialized.

IV

One of the difficulties of large-scale inventory studies is that it is much easier to generalize about single aspects of farms than about the overall characteristics of individual farms. Only simple techniques are required to investigate the balance of crops and stock, the relative importance of different grains or of different types of livestock, or what proportion of inventories mention particular innovations or items of equipment. On the other hand, many discussions of agrarian change are couched mainly in terms of the overall character of farms as productive units, being at least as much concerned with changes in how the components of a farm interrelated with one another, as with the growing or diminishing importance of individual elements of production.

Thus the production of meaningful explanations of agricultural change requires us to situate aggregate changes in crop and livestock production within patterns of the changing importance of different types of farms. For example, if an area

containing a mixture of grain-oriented, mixed, and stock-oriented farms experienced a decrease in the mean number of cattle per farmer, this could have arisen in a number of ways. It might be part of a general shift from stock farming to mixed farming or from mixed farming to grain farming or both of these; or it might be due to a shift from cattle to other livestock types within a stable overall pattern of grain, mixed and stock farming.

The need to analyse several aspects of farms simultaneously has prompted several agricultural geographers in Britain to explore various methods of cluster analysis.²⁸ This is a statistical technique which can be used to group together similar types of farms into 'natural groups' such that the objects (in this case farms) in each group have similar characteristics to one another and the average characteristics of the groups are as different from one another as possible.²⁹ In this study, the farm characteristics used were the proportion of combined crop and stock valuations on each farm made up by fodder, grain, horses, cattle, and sheep. A total of 501 farmers' inventories from the summer months in the periods 1610-39 and 1660-99 (with valuations standardized by price indices to maintain comparability) were classified in this way. Farms valued at below £10 have been excluded to prevent 'farms' of, say, half an acre of crops and one cow from masking the pattern of substantial farm enterprises.

The characteristics of seventeen groups identified during the cluster analysis are shown in Fig 7. Examination of the number of farms in each cluster provides a preliminary identification of which were the major types of farm enterprise. Although some of the farm type clusters

were very small, all of the cluster groups contained farms from both early in the century and later.

The cluster groups can be classified according to the mix of elements in their valuations. This has been done in Table 2, in which the frequencies of farm types from 1610 to 1639 (237 farms) and from 1660 to 1699 (264 farms) are compared in order to identify changes in the importance of different farm types. It is immediately apparent that there were many similarities between the two periods. Such stability suggests some significant continuities in the types of farming enterprise present in Hertfordshire during the seventeenth century.

Of the changes that occurred, the most significant was a shift to more grain-dominated farms, despite the movement of price

TABLE 2
Frequency of Occurrence of Farm Types
Identified in Fig 7

Group	Number in 1610-39	Number in 1660-99
A	5	11
B	28	19
C	36	49
D	33	56
E	6	14
F	21	30
G	5	7
H	13	7
I	30	24
J	5	11
K	13	6
L	5	9
M	12	8
N	7	2
O	14	2
P	1	5
Q	3	4
Grain farms	1610-39 43% of farms	Average £110
	1660-99 51%	£203
Mixed farms	1610-39 32% of farms	Average £ 71
	1660-99 31%	£ 73
Stock farms	1610-39 25% of farms	Average £ 29
	1660-99 18%	£ 29

²⁸ Overton, 'Reconstructing agricultural landscapes'.

²⁹ D Wishart, *CLUSTAN User Manual*, 3rd edition, Edinburgh, 1978: using iterative relocation, which produces tight 'minimum variance' clusters, and was preferred to hierarchical algorithms which cannot reallocate cases among clusters as the cluster groups become larger.

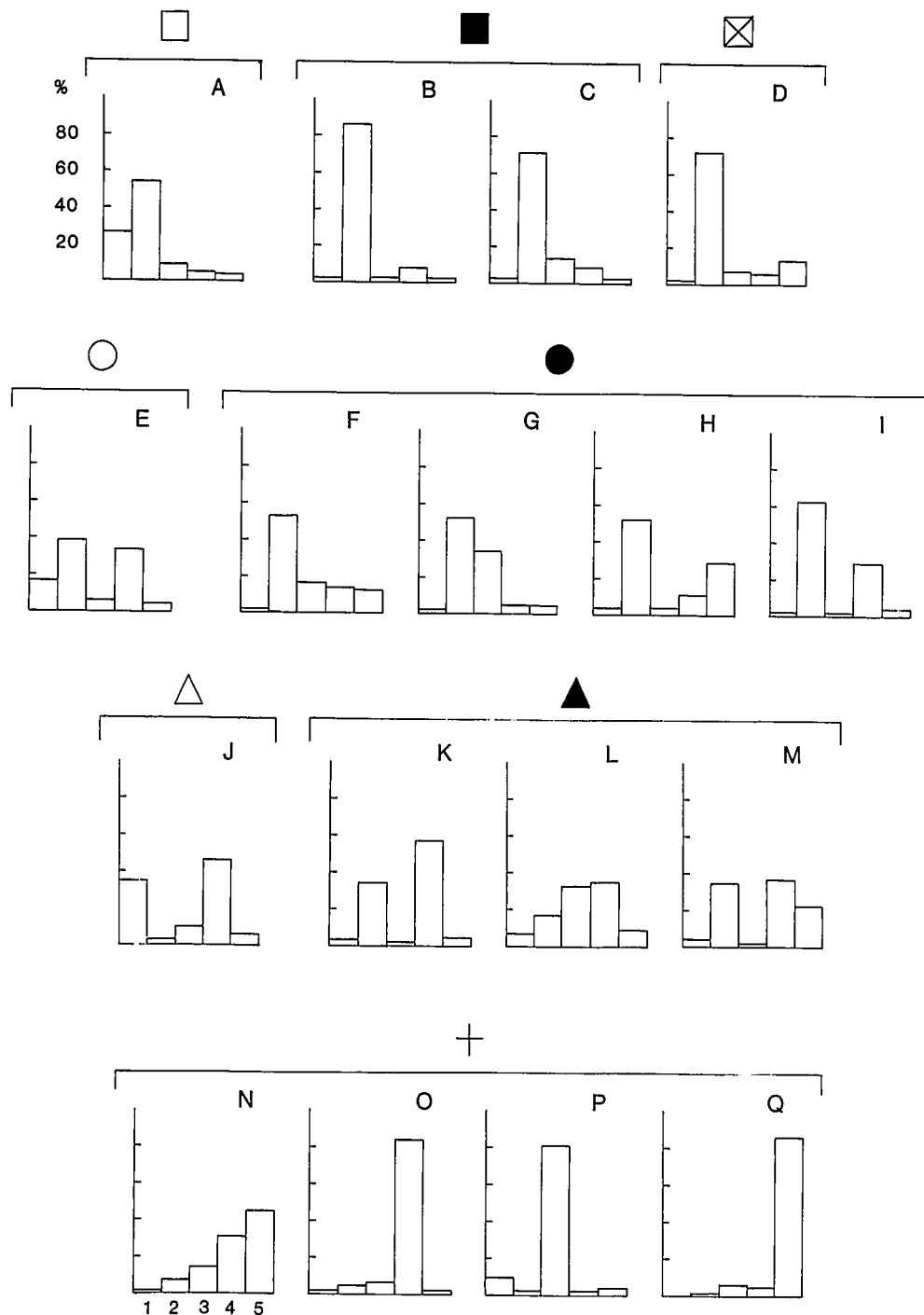


FIGURE 7

Characteristics of 'farm type' groups produced by cluster analysis. Grain specialists are indicated by a square symbol, mixed farms by circles, and stock farms by triangles or crosses. These symbols are used in the mapping of farm types in Fig 8.

Column 1 = fodder, column 2 = corn, column 3 = horses, column 4 = cattle, column 5 = sheep

relatives to favour the producers of pastoral products. Whereas 43 per cent of farms from 1610 to 1639 fell into the grain-oriented groups (A through D), the equivalent figure for 1660-99 was 51 per cent. This increase was not due to the scaling of crop valuations for inflation: indeed the results using unscaled valuation figures show a larger shift (42 per cent to 54 per cent). Most of this increase was due to a rise in the number of farms on which substantial grain acreages were found in conjunction with considerable numbers of sheep (type D).

In aggregate terms, the increase of grain-oriented farms was at the expense of stock farms, and particularly of specialist cattle farms. The decline in cattle ownership suggested in the discussion to Fig 3 was squarely concentrated amongst specialized stock farms, rather than mixed farms. Other than in group D (sheep-corn) farms, the number of farms on which sheep were a significant component of total farm valuation fell. This accords with the suggestion made above that, despite growing sheep flocks per farmer, there was no major increase in the number of farmers with flocks.

Within the framework of the cluster analysis groups, other characteristics of farms, such as wealth or the presence of certain innovations, may easily be analysed. This reveals that the trend towards larger farms was much more pronounced for some types of grain-oriented enterprises than for farms with a mixed or stock emphasis. Among inventories compiled between 1610 and 1639, the mean farm valuations were £110 for grain-oriented farms, £71 for mixed farms, and £29 for stock-oriented farms. For the period from 1660 to 1699 the equivalent figures were £203, £73, and £29. Thus the capital value of crops and livestock for the three groups of farms changed respectively by +103 per cent, +3 per cent and not at all. Likely changes in the exact representativeness of

the inventory sample mean that these figures are very approximate, but the general pattern is undeniably that considerable capital intensification had occurred on grain-oriented farms.

The main settings for the appearance of much larger farms can be specified more precisely by disaggregating the farm valuations of different types of grain-oriented farm. The major area for growth undoubtedly concerned the sheep-corn farms of cluster group D. Not only did this group greatly increase in size (from thirty-three to fifty-six farms), but it also had easily the highest farm valuations: £169 in 1610-39, and £290 in 1660-99. The comparable figures for other grain-oriented farm types were £82 in 1610-39 and £141 in 1670-99. This is consistent with the notion, discussed in section II, that the intensification of the classic downland barley-sheep husbandry was a late seventeenth-century development.

The innovation of new fodder crops³⁰ was reflected in an increase in the proportion of farms in groups to which fodder contributed a significant component of total farm value (A, E, J). There were sixteen farms from 1610 to 1639 in these groups, but thirty-six from 1660 to 1699. It is also revealing to compare the relative importance of cattle farms (I, K, L, M, N, O) and cattle-fodder farms (E, J). The former totalled eighty-seven in 1610-39 and fifty-six in 1660-99, while the latter groups contained eleven farms in 1610-39 and twenty-five in 1660-99. The majority of farmers growing new fodder crops were mixed or stock-oriented, with fewer fodder innovators amongst grain specialists. In 1610-39 5 per cent of grain specialists and 10 per cent of mixed farmers or stock specialists appear in 'high fodder' categories (A, E, J). For 1660-99 the equivalent figures are 8 per cent and 20 per cent. Such a pattern lends weight to the arguments of

³⁰ Discussed in section II above.

those who suggest that new fodder crops were not primarily introduced to raise arable yields.

V

The results of the cluster analysis identification of farm types are also of considerable use in reconstructing changes in the geography of early modern agriculture. The mapping of different types of farms provides a perspective on the accuracy both of contemporary accounts of regional farming practice, and of the regionalization schemes put forward by agricultural historians. Unfortunately, the large number of cluster groups produced means that many different symbols are needed if the distinctiveness of different farm types in terms of all five component characteristics is to be preserved. This of course produces maps that are difficult to interpret quickly. For Fig 8, therefore, the seventeen cluster groups have been amalgamated into eight larger groups as shown on Fig 7.³¹ Similar shaped symbols identify farms according to grain/mixed/livestock emphases, and sheep-corn farms and those on which fodder was an important component of valuations have been distinguished by differences in internal shading.

The patterns resulting from the mapping of farm types can be compared with the regionalization schemes suggested over the last twenty years by Thirsk, Kerridge, and Richardson (Fig 5). As with the earlier maps of single aspects of agricultural production, these maps provide a combination of confirmation and modification (in terms both of patterns and of the chronology of change) of proposed regionalizations. The most prominent feature is the delimitation of the approximate extent of southern stock-fodder systems, although we cannot draw precise boundaries because of uncer-

tainty over exactly where farms lay in large parishes such as Watford and Hatfield. The pattern of livestock specialization, measured here by relative values, parallels that of the largest flocks and herds (Fig 6) showing that the regional changes identified above are not an artefact of mapping large herds/flocks, but a more general feature of the composition of farm capital.

Obviously it is possible to use many more variables in the cluster analysis (for example by including the value of different types of crop or cattle separately), but this is unrewarding in the present case because fewer inventories provide all this extra information in sufficient detail, and because the number of cluster groups would become very large, with few farms in each group. Even in the present case though, with five variables per farm, a quite detailed picture of the geography of farm types can be built up, and this provides a starting point for discussion of the possible dependence of changes in the pattern on institutional changes such as enclosure, or the types of farm enterprises on which particular farming innovations were made. These are both questions on which intensive local work based on other sources should provide detailed answers.

VI

Elements of both continuity and change characterized agricultural production and its geography in Hertfordshire during the sixteenth and seventeenth centuries. The principal characteristics of agriculture and the broad outlines of agricultural change in the county conform with the generalizations made by agrarian historians on the basis of contemporary accounts, and anecdotal use of probate inventories and estate documents. However, these accounts do not accurately represent either the chronology of agricultural changes or their geographical pattern at more than a very general level. Unsurprisingly, the syste-

³¹ Maps distinguishing all of the groups shown in Fig 7 can be obtained from the author.

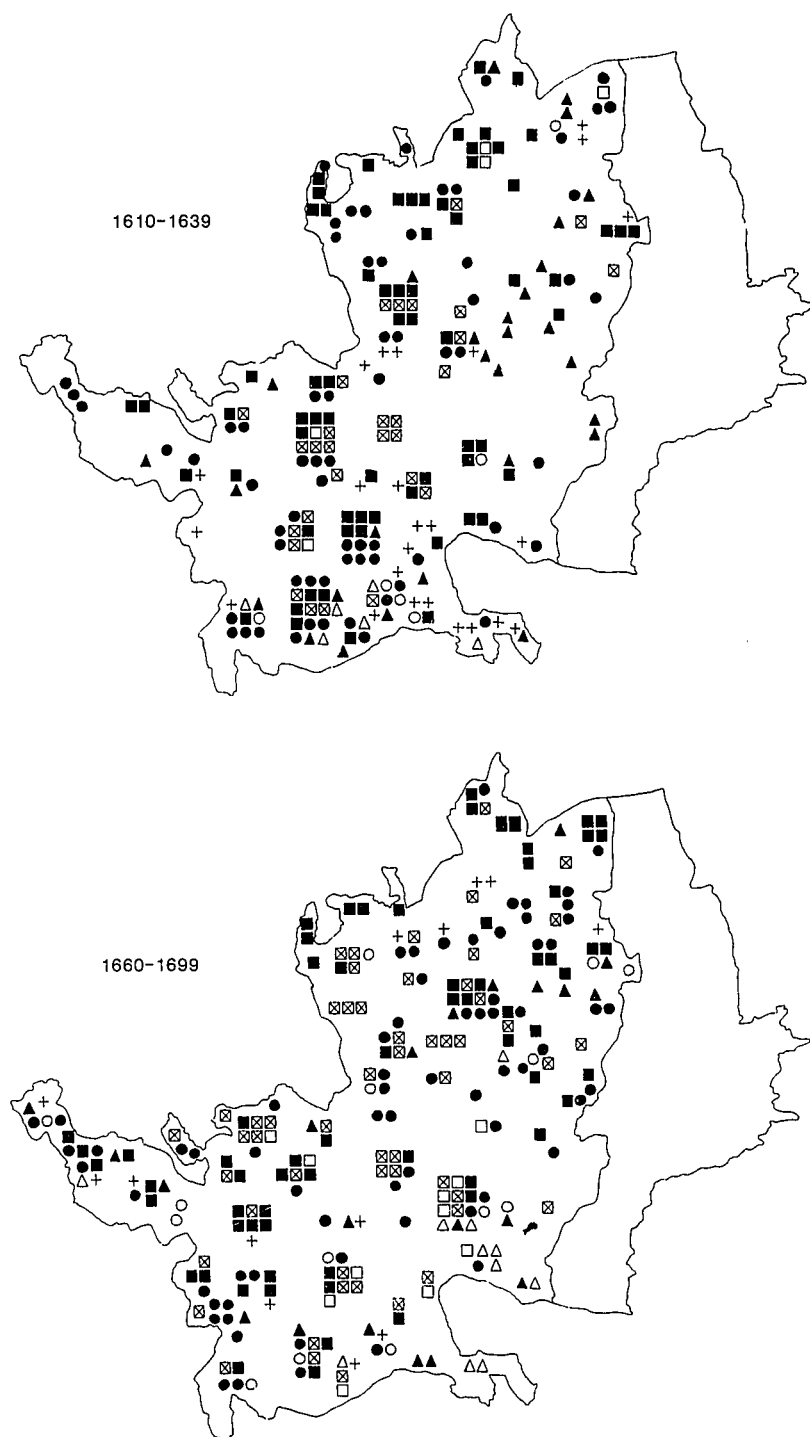


FIGURE 8

Distribution of farm types in seventeenth-century Hertfordshire. The symbols refer to single farm types or groups of farm types, as indicated in Fig 7. Farm types where fodder was significant are shown hollow, sheep corn farms (group D) are indicated by an internal cross

matic analysis of many hundred inventories suggests that both temporal and geographical variability in farming practices was considerable.

To recognize this temporal and geographical variation is important because it is more than a simple reflection of profuse documentation. It highlights some of the problems inherent in using 'the agrarian region' as the fundamental unit of analysis in discussions of the geography of early modern agriculture. Only sometimes were there areas over which husbandry practices and farming products were relatively uniform, even though it is true that broad features, like arable concentration, characterized wide areas. Some 'agrarian regions' thus defined were relatively ephemeral, which makes it difficult to incorporate them into a longer-term picture of the processes of change. In addition, clearer patterns of specialization at the level of the individual farm did not necessarily produce clearer patterns of specialization at a regional level, but could result in the coexistence of different types of specialization within an area which had hitherto contained a relatively homogeneous population of less specialized farms.

Several of the most notable changes in patterns of production can, as earlier historians have suggested, plausibly be seen as part of the growing commercialization of agricultural systems in south-east England. The clearest examples of this are provided by the large sheep-corn farms of northern and central districts, and by the contraction of cattle rearing and fattening with its replacement in the south-west of the county by dairying, sometimes on a large scale. Not that commercial agriculture was a novelty of the early modern period. The huge growth of London's population in the sixteenth century intensified the capital's influence on its hinterland, but this area had probably been involved in the supply of grain, malt, livestock and animal products for several centuries.

Residual areas of isolated 'primitive' farming were rare and disappeared rapidly. During the 1550s and 1560s, for example, most farmers in the southern parish of Northaw, a wooded, hilly area of very heavy soils, kept goats. Although extremely rare elsewhere in the county, goats in Northaw were numerous, and comprised a significant portion of total farm values.³² By the 1590s, however, goats had all but disappeared even here, and farmers in Northaw had expanded and diversified their arable cultivation which had hitherto consisted almost entirely of small areas of oats. Although the stock/fodder emphasis of the area remained, it was no longer as distinctive as in the mid-sixteenth century.

Inventory-based discussions of changing patterns of agriculture clearly raise questions about the processes of change. In the case of arable production, at least three topics require elaboration. First, there is the question of how changes in cropping were related to changes in crop rotations. Rotational changes would have important implications where the farming calendar was being modified. Thus where spring-sown crops replaced winter-sown crops, or vice versa, or where new roots such as turnips were grown as post-harvest catch crops, the availability of land for grazing might be affected. Whilst estate/farm accounts can reveal such changes in practice, very few survive for the range of farm sizes covered by archdeaconry court inventories.

Second, there is the crucial question of the role of enclosure, and the intensification of private property rights, in facilitating changes in land-use, cropping, or livestock husbandry. The configuration of both physical and organizational constraints on farmers was modified by either piecemeal or wholesale enclosures, but

³² Good examples are HCRO ASA25/28, ASA25/863, ASA25/1158, ASA25/1247.

even the broad chronology of enclosure is disputed. Recent suggestions that the seventeenth century saw the peak of English enclosure³³ clearly have important implications for views which stress organizational and structural changes in property rights as prerequisites for agricultural transformation. Here too, detailed work on other documentary sources is required, to build up place-specific 'biographies' of agrarian organization.

Finally, the importance of changes in

production patterns for aggregate trends in the agrarian economy depends partly on changes in productivity. Output increases could, to a certain extent, be produced by shifts between crop and stock types, and by geographical specialization, but in the absence of productivity increases, such output increases would be limited. But changes in the emphasis of agriculture combined with productivity improvements would have a much greater impact. Estimating the productivity of either crops or livestock has proved extremely difficult, and is likely to remain so. However, Overton has recently developed statistical means of estimating trends in crop yields from probate inventory data, and this method is applied and extended in the companion paper.

³³ J R Wordie, 'The chronology of English enclosure, 1500-1914', *Econ Hist Rev*, 2nd ser, XXXVI, 1983, pp 483-505; J Chapman, 'The chronology of English enclosure' and J R Wordie, 'The chronology of English enclosure: a reply', *Econ Hist Rev*, 2nd series, XXXVII, 1984, pp 557-9 and pp 560-2. For a very different view see J E Martin, *Feudalism to Capitalism: Peasant and landlord in English agrarian development*, 1983, pp 128-40.

Notes and Comments

(continued from page 54)

demographic data as well as stories and traditions relating to localities which date back to the eighteenth century and before. Subject searches can be made through retrieving documents or sentences from documents with descriptive fields. The information from the Memoirs can be made accessible both in printed transcriptions and on-line, both in text and index form.

Funding has been made available through the

ESRC (HOO 23 2035, HOO 23 2079), the DoENI, PRONI and the Esme Mitchell trust. To date, counties Antrim, Armagh, Fermanagh, Tyrone, and Monaghan have been transcribed and indexed (representing 10,000 ms sheets or 80 megabytes of information). Counties Down, Londonderry and Donegal will be worked on in the next eighteen months (Nov 1987 to April 1989). For information and listings contact Angeliq Day, Institute of Irish Studies, 8 Fitzwilliam Street, Queen's University of Belfast, BT9 5AW.

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