

The Demesne-Farming Systems of Post-Black Death England: A Classification¹

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Abstract

What was the character of English demesne-farming systems in the half century or so after the Black Death and how does this compare with their character before? Data from three major samples of accounts (representing Norfolk, a ten-county area around London, and the country as a whole) are analysed in an attempt to answer this question. To clarify developments demesnes are classified into seven basic types, replicating the methodology used to develop an equivalent typology for the earlier period. The same methodology is also used to test the relative merits of regionally- versus nationally-derived classifications, with the latter being shown to possess significant advantages over the former. Each of the resultant seven national farming types is both mapped and described and the paper concludes with a consideration of what their configuration reveals about the changing agricultural geography of England in this post-plague era of population decline and economic contraction.

IN few periods have farmers had to contend with demand shifts as dramatic as those of the fourteenth century.² Between 1315 and 1375 the country's population, along with that of much of north-west Europe, was reduced by at least half.³ Suddenly there were significantly fewer mouths to be fed and, relatively, more land from which to feed them. Concomitant

shifts in factor prices rendered land far cheaper than it had been at the peak of rural congestion at the beginning of the century, and labour much dearer (although the immediate post-Black Death labour laws endeavoured to restrain the inflationary wage rise).⁴ Higher land to labour ratios and rising wage rates meant improved living standards and better diets for the majority. Christopher Dyer's analysis of harvest diets, for instance, demonstrates that by the close of the century workers were eating less bread and consuming more meat and ale.⁵ Moreover, the food and drink were of a higher quality: wheaten

¹ The research for this paper was undertaken in conjunction with the project 'The Geography of Seigneurial Land-ownership and Land-use, 1270-1349', funded by the Leverhulme Trust and based in the Department of Economic and Social History, The Queen's University of Belfast. We are also grateful for assistance and cooperation received from Dr James Galloway, Dr Derek Keene, Professor John Langdon, Dr Margaret Murphy, Miss Olwen Myhill, Miss Jenitha Orr, and Professor Mark Overton. Responsibility for any errors, of course, remains our own.

² The much discussed late seventeenth-century demand shift was much smaller: see E L Jones, 'Agriculture and economic growth in England, 1660-1750: agricultural change', *J Econ Hist*, XXV, 1965, pp 1-18 (reprinted in E L Jones, *Agriculture and the Industrial Revolution*, Oxford, 1974, 1-18); A Kussmaul, 'Agrarian change in seventeenth-century England: the economic historian as paleontologist', *J Econ Hist*, XLV, 1985, pp 1-30; H J Habakkuk, 'The agrarian history of England and Wales: regional farming systems and agrarian change, 1640-1750', *Econ Hist Rev*, 2nd series, XL, 1987, pp 281-96. Not until the revolution in world food markets of the late nineteenth century was a comparable shock experienced, although on that occasion its origin lay with supply rather than demand.

³ Evidence of the English demographic experience is reviewed in R M Smith, 'Human resources', in G Astill and A Grant, eds, *The Countryside of Medieval England*, Oxford, 1988, pp 183-212; R M Smith, 'Demographic developments in rural England, 1300-48: a survey', in B M S Campbell, ed, *Before the Black Death: Studies in the 'Crisis' of the Early Fourteenth Century*, Manchester, 1991, pp 25-77.

⁴ A crude comparison of demesne land values in a ten-county area around London for the periods 1270-1339 and 1375-1400 (using valuations given in extents attached to *Inquisitiones post mortem*) indicates a 27 per cent decline in the unit value of arable, a 19 per cent decline in the unit value of meadow, and an 18 per cent decline in the unit value of pasture (Feeding the City I, IPM database; Feeding the City II, IPM database). Over the same period the real wage rate of a building craftsman rose by 33 per cent (E H Phelps Brown and Sheila V Hopkins, 'Seven centuries of the prices of consumables, compared with builders' wage-rates', *Economica*, XXII, 1956, pp 296-314, Appendix B (reprinted in E M Carus-Wilson, ed, *Essays in Economic History*, 1962, pp 179-96). For rural wage rates and the impact of the Statutes of Labourers, see D L Farmer, 'Prices and wages, 1350-1500', in E Miller, ed, *The Agrarian History of England and Wales*, III, 1348-1500, (hereafter *Ag Hist III*) 1991, pp 467-90.

⁵ C Dyer, 'Changes in diet in the late Middle Ages: the case of harvest workers', *AHR*, 36, 1988, pp 21-37; *idem*, *Standards of Living in the Later Middle Ages: Social Change in England c 1200-1520*, 1989.

bread replaced that baked from rye and barley, beef displaced bacon, and ale supplanted cider. These demographic and dietary changes imply an agriculture in which animals assumed an enhanced importance and in which the calorifically extravagant brewing-grains occupied an enlarged share of a reduced cropped acreage as the imperative to maximize the area devoted to the vital bread grains was relaxed.⁶ It also implies an agriculture in which farmers traded down to less labour intensive and more land extensive systems of production, a development which should further have favoured livestock over crops and will have had important implications for land and labour productivity.⁷ To what extent are these agricultural developments borne out by the evidence?

Systematic, quantifiable data of agricultural production are solely available for the demesne sector. At the opening of the fourteenth century, when direct demesne management was at its height, this sector probably comprised just under a third of the total arable area, but by the close of the century that share had undoubtedly shrunk as narrowing profit margins and greater economic uncertainty encouraged growing numbers of landlords to lease out their demesnes.⁸ It is the accounts rendered

annually for those manors whose demesnes landlords kept in hand which are medieval historians' principal source of agricultural information.⁹ Patterns of documentary creation and survival mean that a wider cross-section of estates is documented at the end of the fourteenth century than the beginning, although after 1375 the actual number of documented demesnes progressively diminishes as direct management more and more became the exception rather than the rule, increasingly confined to the home farms of lay and ecclesiastical households. Reconstructing the composition of demesne production from a national sample of accounts must therefore, perforce, draw upon a smaller potential sample for the post-Black Death period than is available before, in the heyday of direct demesne management.

Two national samples of accounts, one comprising 389 documented demesnes for the period 1250–1349 the other comprising 297 demesnes for the period 1350–1449, provide a basis for quantifying the main changes in demesne production which occurred between the opening and close of the fourteenth century (Table 1).¹⁰

⁶ The conversion of raw barley to ale resulted in a loss in available kilocalories of approximately 70 per cent: B M S Campbell, J A Galloway, D Keene, and M Murphy, *A Medieval Capital and its Grain Supply: Agrarian Production and Distribution in the London Region c 1300*, (hereafter *A Medieval Capital*) Historical Geography Research Series, 30, 1993, p 34.

⁷ Livestock and their products required less labour per unit of output than crops. By 1851 Gregory Clark reckons that 'output per worker in animal husbandry was about 80 per cent greater than in arable cultivation': 'Labour productivity in English agriculture, 1300–1860', in B M S Campbell and M Overton, eds, *Land, Labour and Livestock: Historical Studies in European Agricultural Productivity*, Manchester, 1991, p 231. For the relationship between land, labour, and other forms of productivity, see M Overton and B M S Campbell, 'Productivity change in European agricultural development', in Campbell and Overton, *Land, Labour and Livestock*, pp 1–50.

⁸ The proportion of a third is based on the evidence of the surviving 1279 Hundred Rolls: E A Kosminsky, *Studies in the Agrarian History of England in the Thirteenth Century*, 1956, pp 87–95. The priors of Norwich, for instance, slashed by half the area which they cultivated directly between the 1340s and 1390s, and by 1430 had abandoned direct management entirely: Bodleian Library, Oxford, Ms Rolls, Norfolk 20–47; Norfolk Record Office (hereafter NRO), DCN

1/1, 40/13, 60/4, 60/8, 60/10, 60/13, 60/14, 60/15, 60/18, 60/20, 60/23, 60/26, 60/28, 60/29, 60/33, 60/35, 60/37, 61/35–6, 62/1–2; DCN R233 B 4626, L'Estrange IB 1/4, 3/4, 4/4, NNAS 5890–918 20 D1–3; Raynham Hall, Norfolk, Townshend Mss. On the farming out of manors see, B F Harvey, 'The leasing of the Abbot of Westminster's demesnes in the later Middle Ages', *Econ Hist Rev*, 2nd series, XXII, 1969, pp 17–27; R A Lomas, 'The Priory of Durham and its demesnes in the fourteenth and fifteenth centuries', *Econ Hist Rev*, 2nd series, XXXI, 1978, pp 339–53; R R Davies, *Lordship and Society in the March of Wales 1282–1400*, 1978, p 113; J N Hare, 'The demesne lessees of fifteenth-century Wiltshire', *AHR*, XXIX, 1981, pp 1–15; M Mate, 'The farming out of manors: a new look at the evidence from Canterbury Cathedral Priory', *J Med Hist*, 9, 1983, pp 331–44.

⁹ R H Hilton, 'The contents and sources of English agrarian history before 1500', *AHR*, III, 1955, 3–19; P D A Harvey, ed, *Manorial Records of Cuxham, Oxfordshire*, Oxfordshire Record Society, 50, and Royal Commission on Historical Manuscripts joint publication, 23, 1976; *idem*, *Manorial Records, Archives and the User*, 5, 1984.

¹⁰ The national samples of manorial accounts were generously made available by Professor John Langdon of the Department of History, University of Edmonton. The bulk of these accounts are listed in Appendix C, part 2, of his unpublished PhD thesis, 'Horses, oxen, and technological innovation: the use of draught animals in English farming from 1066 to 1500', University of Birmingham, 1983. Data for some additional demesnes have also been incorporated. The crop and livestock profiles of each demesne, which provide the building blocks of these aggregate estimates, comprise the

Comparison of these two samples confirms that demesnes curtailed the scale of their arable operations and devoted more of their resources to pastoral husbandry. The mean cropped acreages of demesnes retained in hand were reduced by approximately a fifth. This was achieved partly by withdrawing land from cultivation and converting it to grass, partly by lengthening or increasing fallows and thereby cropping land less frequently, and partly by leasing portions of demesne arable to tenants.¹¹ Within the arable sector demesnes maintained the relative share of the cropped acreage devoted to wheat – the premier bread grain regularly consumed by a growing proportion of the population – but cut back on that devoted to the cheaper and coarser bread grains, notably rye and the various winter mixtures which commonly included rye. Oats, too, declined in both relative and absolute importance, possibly because of the withdrawal of cultivation from poorer soils and the shortening of some of the more intensive rotations (in which oats had often been the final course) but also because of its substitution with other spring-sown grains.¹² Barley and dredge, for instance, both gained in their relative and absolute shares of the cropped acreage. Although oats had long been used for brewing, ale manufactured from barley and dredge was increasingly favoured by a population whose thirst for quantity combined with quality was steadily rising.¹³ If the cultivation of brewing grains was on the increase so too was that of legumes, although here the connection with rising living standards and improving diets is less obvious.

mean of each individual variable calculated across the sampled accounts for that demesne. The relationships between variables have been calculated using these mean values.

¹¹ All three strategies were employed on the bishop of Ely's demesne at Brandon, Suffolk, where the accounts record the areas *friscus* (ie unsown for more than one year), farmed out, and sown: Chicago University Library, Bacon Roll 643, 650–60.

¹² M M Postan, *The Medieval Economy and Society: An Economic History of Britain in the Middle Ages*, 1972, p 52.

¹³ J A Galloway, D J Keene, M Murphy, and B M S Campbell, 'Changes in grain production and distribution in the London region over the fourteenth century', unpublished manuscript.

Legumes – collectively beans, peas and vetches – almost doubled their share of the sown acreage; a greater relative gain than that of any other crop. Hitherto large-scale legume cultivation had been mainly restricted to the most intensive of husbandry systems, where they provided a partial substitute for fallows, helped restore nitrogen levels within the soil, and provided a nutritious source of human and animal food.¹⁴ Nevertheless, healthy as they were, legumes were not held in high dietary esteem due to their strong association with the pottages and coarse breads of the poor and fodder for animals.¹⁵ Higher living standards are, therefore, hardly likely to have encouraged greater per capita consumption of legumes. Nor can their wider cultivation be attributed to a general adoption of more intensive methods of cultivation, for, on the whole, the opposite was the case.¹⁶ Rather, legumes benefited from the expansion of pastoral farming (and especially heightened demesne investment in cart horses) with its correspondingly greater demand for fodder crops.¹⁷ In effect, sowing land with legumes represented an alternative to converting it to grass and was especially attractive to those who wished to keep their arable options open. Indeed, in areas of entrenched commonfield agriculture, where there were institutional obstacles to the conversion of

¹⁴ B M S Campbell, 'Agricultural progress in medieval England: some evidence from eastern Norfolk', *Econ Hist Rev*, 2nd series, XXXVI, 1983, pp 26–46; *idem*, 'The diffusion of vetches in medieval England', *Econ Hist Rev*, 2nd series, XLI, 1988, pp 193–208.

¹⁵ '... what had been baked for Bayard was boon to many hungry, And many a beggar for beans obediently laboured, And every poor man was well pleased to have peas for his wages': William Langland: *Will's Vision of Piers Plowman*, trans E Talbot Donaldson, ed by E D Kirk and J H Anderson, New York, 1990, lines 193–5, pp 65–6.

¹⁶ See below, p 148.

¹⁷ On the connection between legumes and the use of horses see, Campbell, 'Diffusion of vetches', pp 205–6; L W Hepple and A M Doggett, *The Chilterns*, Chichester, 1992, pp 94–5; *Ag Hist III*, p 271. On the considerable fodder requirements of cart horses see K Biddick, *The Other Economy: Pastoral Husbandry on a Medieval Estate*, Berkeley and Los Angeles, 1989, pp 116–21. On the increasing use of horses post 1349 see, J L Langdon, *Horses, Oxen and Technological Innovation: The Use of Draught Animals in English Farming, 1066–1500*, 1986, pp 95–7; B M S Campbell, 'Towards an agricultural geography of medieval England', *AHR*, 36, 1988, pp 91–3.

TABLE I
The changing composition of seigneurial agricultural production c 1300–c 1400

Mean per demesne	National samples of demesnes						Feeding the City samples of demesnes ^a		
	Core demesnes only			All demesnes					
	1250– 1349	1350– 1449	% change	1250– 1349	1350– 1449	% change	1288– 1315	1375– 1400	% change
Percentage of sown acreage:									
wheat	31.0 <i>16.3</i>	30.4 <i>14.9</i>	–2	31.7 <i>16.0</i>	30.9 <i>14.5</i>	–3	32.8 <i>14.2</i>	32.3 <i>14.0</i>	–2
rye	4.7 <i>9.4</i>	2.0 <i>5.5</i>	–57	5.2 <i>9.5</i>	2.9 <i>7.5</i>	–44	6.4 <i>11.3</i>	2.2 <i>6.5</i>	–66
winter mixtures	2.1 <i>6.7</i>	1.3 <i>4.1</i>	–38	2.3 <i>6.7</i>	1.9 <i>5.4</i>	–17	3.9 <i>8.8</i>	2.1 <i>5.4</i>	–46
barley	16.0 <i>17.3</i>	23.0 <i>19.4</i>	+44	15.7 <i>16.0</i>	22.2 <i>18.0</i>	+41	11.2 <i>11.1</i>	18.3 <i>14.8</i>	+63
oats	33.6 <i>20.0</i>	23.8 <i>17.3</i>	–29	31.1 <i>19.2</i>	22.8 <i>16.7</i>	–27	30.0 <i>15.7</i>	22.6 <i>17.1</i>	–25
spring mixtures	3.7 <i>10.0</i>	5.0 <i>11.6</i>	+35	3.8 <i>9.5</i>	4.9 <i>11.3</i>	+29	6.6 <i>10.6</i>	8.2 <i>14.8</i>	+24
legumes	7.9 <i>8.6</i>	13.9 <i>12.0</i>	+76	9.5 <i>9.4</i>	13.9 <i>11.5</i>	+46	9.2 <i>8.9</i>	14.4 <i>10.5</i>	+57
Sown acreage	184.9 <i>112.9</i>	147.8 <i>82.5</i>	–20	193.1 <i>118.5</i>	151.7 <i>85.9</i>	–21	224.9 <i>127.7</i>	171.0 <i>81.5</i>	–24
Percentage of livestock units ^b :									
horses	15.5 <i>12.3</i>	14.3 <i>17.6</i>	–8	15.5 <i>11.6</i>	13.1 <i>14.7</i>	–15	18.3 <i>13.1</i>	16.1 <i>13.9</i>	–12
oxen	42.5 <i>29.6</i>	27.3 <i>26.2</i>	–36	40.4 <i>28.0</i>	24.9 <i>23.4</i>	–38	28.3 <i>18.8</i>	17.5 <i>15.5</i>	–38
adult cattle	14.3 <i>16.4</i>	16.6 <i>19.6</i>	+16	15.4 <i>15.8</i>	20.4 <i>18.6</i>	+32	19.8 <i>15.6</i>	23.9 <i>21.0</i>	+20
immature cattle	8.1 <i>9.4</i>	7.5 <i>9.3</i>	–7	9.1 <i>9.8</i>	9.1 <i>9.4</i>	±0	8.6 <i>7.6</i>	6.7 <i>7.6</i>	–22
sheep	16.6 <i>21.6</i>	31.1 <i>28.5</i>	+87	16.3 <i>20.3</i>	29.2 <i>25.1</i>	+79	20.8 <i>19.2</i>	31.2 <i>21.2</i>	+50
swine	3.0 <i>5.7</i>	3.1 <i>4.7</i>	+3	3.3 <i>5.2</i>	3.3 <i>4.4</i>	±0	4.2 <i>4.6</i>	4.6 <i>5.8</i>	+10
Livestock units ^b	59.3 <i>51.0</i>	73.1 <i>54.6</i>	+23	62.7 <i>50.4</i>	79.2 <i>56.8</i>	+26	66.8 <i>47.7</i>	80.3 <i>50.8</i>	+20
Stocking density ^c	34.5 <i>25.1</i>	56.2 <i>56.5</i>	+63	35.4 <i>25.9</i>	61.2 <i>58.8</i>	+73	35.3 <i>35.1</i>	57.9 <i>49.0</i>	+64
Number of demesnes	261	182	–30	389	297	–24	183	125	–32

Means in roman; standard deviations in italic.

^a Covering Beds, Berks, Bucks, Essex, Herts, Kent, Middx, N'hants, Oxon, and Surrey.

^b [horses × 1.0] + [(oxen + adult cattle) × 1.2] + [immature cattle × 0.8] + [(sheep + swine) × 0.1].

^c livestock units per 100 sown acres.

Source: National samples of accounts, 1250–1349 and 1350–1449; Feeding the City I, accounts database; Feeding the City II, accounts database.

arable to grassland, increased fodder cropping offered the readiest means of raising livestock numbers.¹⁸

Whereas arable cultivation contracted in scale and shifted in focus pastoral husbandry underwent a wholesale expansion. On the face of it the 25 per cent rise in the number of livestock units stocked per demesne was roughly commensurate with the 20 per cent contraction in cropped acreage, but the magnitude of this rise is almost certainly understated, for the growing practice of leasing out dairy herds masks many of the younger cattle from view, in much the same way that sheep disappear from accounts on those estates – and the number was growing – which managed their flocks on an intermanorial basis and accounted for them separately.¹⁹ Since with less land under the plough draught requirements were if anything contracting (that contraction being more pronounced in the case of oxen than of horses), the gain in livestock units principally represented an increase in the number of non-working animals being stocked.²⁰ The latter's share of total livestock units rose from 42 per cent to 58 per cent, with the bulk of that

gain being accounted for by a marked rise in the number and size of sheep flocks. Whereas non-working cattle and swine more-or-less maintained their existing importance, sheep – notwithstanding serious outbreaks of murrain in the 1360s and depressed wool prices from the late 1370s – almost doubled their share of livestock units.²¹ Sheep, significantly, were managed by predominantly extensive methods and their rising numbers probably reflect a corresponding expansion in temporary and permanent pasture.²²

The net effect of these developments was to render the pastoral sector less subservient to the arable and ensure that demesne agriculture in general became more mixed. By the end of the fourteenth century stocking densities, as measured by the number of livestock units per sown acre, were at least 60 per cent higher than they had been at the beginning.²³

How reliable and representative are these trends? Spatial and institutional bias in the creation and preservation of manorial accounts means that a truly random sample of all demesnes is unattainable. Nor are the samples which underlie Table 1 as large, comprehensive, and sharply focused as might have been possible given unlimited research time and resources and adequate

¹⁸ B M S Campbell, 'A fair field once full of folk: agrarian change in an era of population decline, 1348–1500', *AHR*, 41, 1993, p 63; *Ag Hist III*, pp 216, 229. The post-1349 rise in fodder cropping is analogous to that which occurred post 1640, B M S Campbell and M Overton, 'A new perspective on medieval and early modern agriculture: six centuries of Norfolk farming c 1240–c. 1850', *Past and Present*, 141, 1993, pp 59–60, 87–8, 90–2.

¹⁹ The livestock units employed are as follows: horses, 1.0; oxen, bulls, cows, 1.2; immature cattle, 0.8; sheep, 0.1; swine, 0.1 (see B M S Campbell, 'Land, labour, livestock, and productivity trends in English seignorial agriculture, 1208–1450', in Campbell and Overton, *Land, Labour and Livestock*, pp 156–7). The two Feeding the City samples of accounts (see below note 28) indicate a rise in the proportion of demesnes farming dairies from 13 per cent in the period 1288–1315 to 34 per cent in the period 1375–1400. For examples of centralized sheep accounting see F M Page, "'Bidentes Hoylandie': a medieval sheep farm", *Econ Hist*, 1, 1929, pp 603–5; R A L Smith, 'The estates of Pershore Abbey', unpublished MA thesis, University of London, 1939, pp 215–16; R H Hilton, 'Winchcombe Abbey and the manor of Sherborne', *Univ Birmingham Hist Jnl*, 2, 1949–50, pp 50–2; Davies, *Lordship and Society*, p 119; NRO, L'Estrange Collection IB 3/4.

²⁰ On the ratio of oxen to horses post 1350 see Langdon, *Horses, Oxen and Technological Innovation*, pp 95–7; Campbell, 'Towards an agricultural geography', pp 91–3.

²¹ T H Lloyd, 'The movement of wool prices in medieval England', *Econ Hist Rev, Supplement VI*, 1973, pp 19–20. For associated changes in the relative price of sheep see Farmer, 'Prices and wages', pp 458, 508–12.

²² B M S Campbell, 'The livestock of Chaucer's reeve: fact or fiction?', in E B Dewindt, ed, *The Salt of Common Life: Individuality and Choice in the Medieval Town, Countryside and Church. Essays presented to J Ambrose Rafis on the Occasion of his 70th Birthday*, Kalamazoo, 1995, pp 271–305. For direct evidence of the expansion of pasture see E Miller, ed, 'The occupation of the land', in *Ag Hist III*, pp 34–174.

²³ The rise in stocking densities was to be sustained until well into the fifteenth century: Campbell, 'Land, labour, livestock, and productivity trends', pp 153–8; *Ag Hist III*, p 314; M Overton and B M S Campbell, 'Norfolk livestock farming 1250–1740: a comparative study of manorial accounts and probate inventories', *J Hist Geog*, 18, 1992, pp 386–92.

calendaring of manorial records.²⁴ As it is, a broad geographical coverage was in both cases only achieved by casting a wide chronological net. This poses greatest problems in the later period, since the agricultural changes which occurred between 1350 and 1449 were more profound than those between 1250 and 1349. It was after 1375 in particular that changing factor and commodity prices really began to bite, accelerating the landlords' retreat both from the more intensive forms of production and, ultimately, from direct management. From this date, therefore, it becomes increasingly difficult to find usable accounts for many parts of the country. A third of sampled demesnes have a mean date of account from before this critical economic watershed and two-thirds from after, although most of the latter bunch into the final quarter of the fourteenth century. After 1400 there is a significant tailing off in documented demesnes as direct management increasingly became the exception rather than the rule. The sampled demesnes are therefore chronologically weighted towards the late fourteenth century with the 1380s both the modal and median decade. The corresponding modal and median decades in the earlier sample are the 1280s and 1290s. In their average characteristics the two samples therefore broadly encapsulate conditions roughly a century apart. The changes that emerge from comparison of these two samples are consequently those which took place primarily between the late thirteenth and the late fourteenth centuries.

Even with such a wide chronological net the geographical coverage of both samples remains patchy, and would have

become unacceptably so had comparison been restricted to demesnes common to both periods. Not only do these amount to less than half the total but almost all belonged to perpetual institutions and are consequently especially atypical of the demesne sector at large.²⁵ To insist upon continuity of documentation would exclude much of the west and north-west of the country, where direct demesne management was never as widely and firmly established as in the south and east. As it is, the many demesne vaccaries and bercaries of these upland margins are largely masked from view and it is the mixed-husbandry of the more favoured lowland areas that tends to be best documented.²⁶ Nevertheless, even within the arable and lowland south and east, and especially after 1349, there are some remarkable inconsistencies in the pattern of account roll survival. Norfolk, for instance, is exceptionally well covered (as it is in the earlier period) whereas neighbouring Lincolnshire is barely represented at all. In many counties – Huntingdonshire, Middlesex, Somerset, Suffolk, Wiltshire, and Worcestershire – the sampled manors are decidedly bunched according to the location of estates with extant documentation, but in Devon and Cornwall, the Welsh borders, and the whole of the north-west such estates are few and far between and much less representative both of the broad spectrum of ownership types and the general character of husbandry in these regions.²⁷ Some of these deficiencies might be rectified by a more systematic archival search for extant

²⁴ Tracking down manorial accounts for demesnes still in hand is no simple task, even within a single repository. The starting point for any search is the National Register of Archives, Quality House, Quality Court, Chancery Lane, London. Listings of accounts by geographical area are especially rare. For a recent list of all known pre-1350 Kentish manorial accounts, see J A Galloway, M Murphy, and O Myhill, *Kentish Demesne Accounts up to 1350: A Catalogue*, 1993.

²⁵ See, for example, B M S Campbell, 'Measuring the commercialisation of seigneurial agriculture c 1300', in R H Britnell and B M S Campbell, eds, *A Commercialising Economy: England 1086–1300*, Manchester, 1994, pp 132–93.

²⁶ M A Atkin, 'Land use and management in the upland demesne of the De Lacy estate of Blackburnshire, c 1300', *AHR*, 42, 1994, pp 1–19; H P R Finberg, *Tavistock Abbey: a Study in the Social and Economic History of Devon*, 1951; I Kershaw, *Bolton Priory: the Economy of a Northern Monastery 1286–1325*, 1973, pp 30–112.

²⁷ H S A Fox has tracked down most of the post-1349 grange accounts for Devon and Cornwall: for his list see *Ag Hist III*, p 305.

accounts but many are irremediable due to the inherent patchiness of account survival.

Considerable comfort may therefore be taken in the evidence of two independent and chronologically and geographically more sharply focused samples of demesnes for the ten counties of Bedfordshire, Berkshire, Buckinghamshire, Essex, Hertfordshire, Kent, Middlesex, Northamptonshire, Oxfordshire, and Surrey, which confirm the nature and magnitude of virtually all the changes that have been described (Table 1). The earlier of these two samples embraces some 183 demesnes and relates to the period 1288–1315 at the climax of thirteenth-century demographic and commercial expansion; the later sample (hereafter referred to as the Feeding the City II sample) comprises some 125 demesnes and focuses on the years 1375–1400 when demesne producers were contending with price deflation and wage inflation. Both samples are the best that surviving documentation allows, with the individual manor means being based upon up to three annual accounts whenever possible.²⁸ Particular confidence can therefore be placed in the aggregate trends that they reveal, the more so as these are borne out by a comparison of 57 demesnes common to both samples. Overall, demesnes within these 'metropolitan counties' cropped 24 per cent less arable, stocked 20 per cent more livestock units,

and registered a 64 per cent improvement in stocking densities (proportions remarkable close to those obtained from the national samples – Table 1) at the end of the fourteenth century than at the beginning.²⁹ Within the arable sector – as was the case nationally – wheat maintained its share of the cropped acreage while the respective shares of rye and rye mixtures fell and those of barley and dredge rose. Legumes again expanded in importance, increasing their share of the cropped acreage by over half. Their expansion is probably linked to the greater relative importance attached to horse power in these counties after 1349. Nevertheless, it was the non-working animals that were the principal beneficiaries of the general growth in flocks and herds. Their share of livestock units rose from 53 to 66 per cent. The bulk of this gain came from the increase in sheep numbers. Whereas cattle and swine registered virtually no change in importance sheep expanded from 21 to 31 per cent of livestock units.

It is improbable that such far-reaching changes affected all demesnes equally. What effect did they have upon the types and distributions of farming systems?

I

There is no simple or perfect method of classifying temperate agricultural systems, where the enterprise of individual farms is subject to almost infinite variation within the narrow bounds set by the limited available range of crops and animals. Yet without classification generalization is impossible and the pattern of farming systems too kaleidoscopic to comprehend. These inherent problems are greatly com-

²⁸ The two Feeding the City accounts databases were created by Dr James A Galloway and Dr Margaret Murphy (with some assistance from Miss Olwen Myhill) and derive from the projects 'Feeding the City (I)', funded by the Leverhulme Trust, and 'Feeding the City II', funded by the Economic and Social Research Council (Award No R000233157). Both were collaborative projects between the Centre for Metropolitan History, Institute of Historical Research, University of London and the Department of Economic and Social History, The Queen's University of Belfast, the former codirected by Dr Derek Keene and Dr Bruce Campbell, the latter by Drs Keene, Campbell, Galloway, and Murphy. The Feeding the City I accounts are listed in Appendix I of *A Medieval Capital*; a handlist of the Feeding the City II accounts is available from the Centre for Metropolitan History. Both accounts databases have been incorporated within the Pre-Black Death England Database being created at the Department of Economic and Social History, The Queen's University of Belfast. The Feeding the City II accounts database has been deposited at the ESRC Data Archive, Essex University.

²⁹ An alternative system of livestock units, graded to take account of the age and sex of animals and based on the internal evidence of sale and purchase prices, indicates an 18 per cent gain in livestock units and 63 per cent improvement in stocking densities. Limiting comparison to the 57 demesnes common to both Feeding the City databases yields more modest gains of 7 per cent and 48 per cent respectively.

pounded when the variables upon which classification is to be based are constrained by available historical evidence. Hence the ingenuity and effort displayed by British agricultural historians over the past thirty years, commencing with the major early modern contributions of Joan Thirsk and Eric Kerridge, in their endeavour to identify and describe farming types and farming regions.³⁰ Hitherto the problem has mostly been tackled at a county or regional level, these different regional solutions then being aggregated to provide an overall national picture, as in the case of volumes II, III, IV, and V of the *Agrarian History of England and Wales*.³¹ This has obvious limitations, for national systems of classification should ideally be based upon the systematic application of a consistent set of criteria at a national scale. Moreover, the units of classification should be the fundamental units of agricultural production – that is, farms not farming regions – and the resultant typologies should reflect properties inherent to those farms, independent of such external forces as soils, climate, or distance from the market, which may have influenced the type of farming.³² Whether or not specific farming types were associated with, or exclusive to, particular regions can then be established by mapping the resultant typology. That is the method adopted here, building upon the procedure already developed and employed to classify

the pre-1350 national sample of demesnes.³³

Using a common method to derive independent classifications from similarly structured sets of data is the best way to analyse the changing geography of agriculture. Even so, comparison between the two periods 1250–1349 and 1350–1449 is far from unproblematic since, for the reasons already given, the data on which the classifications rest are not the product of random sampling. Indeed, such sampling is inappropriate where it is known that the available documentation is shot through with geographical, institutional and temporal bias.³⁴ Tests of statistical significance have therefore been rejected as a valid comparative technique in favour of the more intuitive and exploratory approach elaborated in this paper.³⁵ Used in this way, the results do nevertheless point to the more important changes which probably occurred and offer a simplified typology of the principal farming systems in operation at the time.

The literature on the derivation of agricultural typologies is considerable.³⁶ The range of criteria which ought ideally to be included comprise the crop and livestock association, the methods used to grow the crops and produce the stock, the intensity of labour, capital, and organizational inputs and associated rates of output, and whether or not production was for consumption or

³⁰ Systematic regional description of past farming systems really begins in 1967 with the simultaneous publication of J Thirsk, 'The farming regions of England', in J Thirsk, ed, *The Agrarian History of England and Wales*, IV, 1500–1640, 1967, pp 1–112, and E Kerridge, *The Agricultural Revolution*, 1967, pp 41–180.

³¹ H E Hallam, ed, *The Agrarian History of England and Wales*, II, 1042–1350, 1988, pp 272–496; *Ag Hist III*, pp 175–323; Thirsk, *Agrarian History*, IV, pp xxi, 1–112; J Thirsk, ed, *The Agrarian History of England and Wales*, VI, 1640–1750: *Regional Farming Systems*, 1984. For critiques see, respectively, B M S Campbell, 'Laying foundations: the Agrarian History of England and Wales, 1042–1350', *AHR*, 37, 1989, pp 190–1; Campbell, 'A fair field', pp 62–3; E L Jones, 'The condition of English agriculture, 1500–1640', *Econ Hist Rev*, 2nd series, XXI, 1968, pp 615–16; M Overton, 'Depression or revolution? English agriculture, 1640–1750', *J Brit Studies*, 25, 1986, pp 345–7.

³² D B Grigg, *The Agricultural Systems of the World: An Evolutionary Approach*, 1974, pp 2–3.

³³ J P Power and B M S Campbell, 'Cluster analysis and the classification of medieval demesne-farming systems', *Trans Inst Brit Geogr*, new series, 17, 1992, pp 227–45. The classifications yielded by this method represent an improvement upon those offered in B M S Campbell and J P Power, 'Mapping the agricultural geography of medieval England', *J Hist Geog*, 15, 1989, pp 24–39. Using the pre-1350 classification to classify post-1349 farming systems is obviously inappropriate given the absolute and relative changes in farm enterprise which had taken place.

³⁴ For the mismatch between the social distribution of landed incomes and the institutional distribution of documented demesnes in the Feeding the City I accounts database, see Campbell, 'Measuring the commercialisation of seigneurial agriculture', p 140.

³⁵ On the precondition of randomness for the application of significance tests see, D Ebdon, *Statistics in Geography: a Practical Approach*, 1977, pp 12–19.

³⁶ Grigg, *Agricultural Systems*, pp 2–4.

exchange. Here, however, classification is based exclusively upon the crops grown, the livestock reared, and the ratio of the latter to the former since these are the most readily available quantifiable criteria for the majority of documented demesnes. They also provide an indirect index of the character and intensity of production and convey some impression of the nature and degree of economic specialization. In this context it would have been a great advantage to be able to include some index of the proportion of the total arable area that was actually cropped, but too few accounts contain this information.³⁷ Better recorded are seeding rates, plough type, and size of plough team; had they been included a more subtly differentiated classification might have resulted.³⁸

Since the aim is to produce a classification based upon demesne enterprise rather than demesne size it is necessary to express each of the four crop and five livestock variables in relative rather than absolute terms, taking care to calculate these relative measures in such a way that closed numbers are not a problem.³⁹ (Percentages have merely been used in Tables 2 and 3 to summarize the final results.) This also has the merit of controlling for customary acres. Only the tenth variable – the number of livestock units per 100 cropped acres – is susceptible to variations in acre size. As a further safeguard, a principal components analysis was

conducted to remove correlations between variables and eliminate any bias arising from the uneven representation of crop and livestock variables. It is the scores derived from that that have been employed as the basis of classification. The choice of the number of principal component scores used proved to be critical. In the case of the pre-1350 classification it was the scores of the first six components that were used; these accounted for 83 per cent of the variance across the ten variables and yielded a 'stable' classification comprising eight basic farming types.⁴⁰ Post-1349, however, using the first six component scores (which account for 82 per cent of variance) yielded a 'stable' classification containing only three basic farming types, with the vast majority of all demesnes falling into a single mixed-farming category. Yet, while this result broadly supports the general observation that in this later period farming systems were less differentiated than they had been before, from a historical point of view a fuller break down of farming types is plainly desirable. The decision was therefore taken to eliminate the sixth and least significant principal component score and to use only the first five components, accounting for 74 per cent of total variance and yielding a 'stable' classification comprising seven basic farming types. The classification itself was derived using the statistical technique known as cluster analysis and, in fact, it has long been observed of cluster analysis that its operation can be ineffective if variables of relatively small significance (in this case the sixth component score) generate intermediate points between cluster groupings.⁴¹ To ensure that the resultant classification reflected real differences within the data rather than the type of clustering technique chosen three separate clustering techniques were applied – Ward's,

³⁷ *A Medieval Capital*, pp 129–33, 139–41.

³⁸ On seeding rates, see *A Medieval Capital*, pp 131, 136–8. On ploughs, plough teams, and farm vehicles, see Langdon, *Horses, Oxen and Technological Innovation*.

³⁹ All crops are specified in acres; all livestock are specified in livestock units (see above note 19). The variables are: R₁ = Log (winter grains/spring grains); R₂ = Proportion (wheat/winter grains); R₃ = Proportion (oats/spring grains); R₄ = Log (legumes/total grain); R₅ = Log (horses/oxen); R₆ = Log (non-working animals [horses + oxen]/working animals); R₇ = Log (immature cattle/adult cattle [omitting oxen]); R₈ = Percentage (sheep/non-working animals); R₉ = Percentage (swine/livestock units); R₁₀ = Log (livestock units/total sown). All zero values have been replaced with 0.01. Note, R₁₀ is incorrectly specified as Log(livestock units × 100/sown) in Power and Campbell, 'Cluster analysis', p 230.

⁴⁰ Power and Campbell, 'Cluster analysis', pp 230–2.

⁴¹ B S Everitt, *Cluster Analysis*, SSRC Reviews of Current Research, 11, 2nd ed, 1980.

TABLE 2
National farming types 1350-1449: mean characteristics of core demesnes

Mean per demesne	Farming type/cluster group							All core demesnes
	1	2	3	4	5	6	7	
Percentage of sown acreage:								
wheat	12.1	2.8	30.7	30.1	34.3	39.0	33.7	30.4
	5.6	5.2	8.5	9.2	15.5	10.9	14.4	14.9
rye	4.2	18.3	0.6	0.1	0.5	1.3	2.1	2.0
	5.2	13.8	2.1	0.4	2.3	3.5	5.1	5.5
winter mixtures	0.3	5.1	1.0	4.0	1.3	1.1	0.7	1.3
	0.7	10.5	2.6	8.1	3.2	3.3	3.5	4.1
barley	56.8	38.7	28.6	19.8	18.5	4.8	16.6	23.0
	9.3	19.7	13.7	12.1	10.4	9.7	17.0	19.4
oats	12.7	17.4	12.4	7.1	29.9	42.0	24.6	23.8
	5.0	9.1	9.6	7.1	16.9	11.2	19.3	17.3
spring mixtures	0.1	2.0	5.3	12.4	6.8	1.3	7.8	5.0
	0.4	4.6	11.0	14.5	13.5	3.1	16.0	11.6
legumes	13.7	1.5	21.2	26.5	8.8	10.5	14.5	13.9
	4.5	1.2	13.2	17.2	7.7	8.5	12.8	12.0
Sown acreage	146.0	109.4	186.1	134.8	123.0	157.7	136.3	147.8
	86.1	105.5	81.2	72.3	74.0	80.8	69.2	82.5
Percentage of livestock units ^a								
horses	16.5	11.9	7.7	32.4	9.4	10.1	29.9	14.3
	12.0	4.5	5.8	26.7	8.8	5.7	31.7	17.6
oxen	2.6	1.6	20.1	36.3	24.4	24.2	68.3	27.3
	2.8	3.9	13.2	28.7	12.2	17.2	31.5	26.2
adult cattle	48.1	29.9	12.3	6.0	2.9	35.0	0.7	16.6
	16.0	22.6	7.4	11.1	8.4	12.5	2.4	19.6
immature cattle	15.3	5.0	12.2	0.4	0.0	16.2	0.0	7.5
	6.7	5.2	9.0	0.7	0.0	8.4	0.0	9.3
sheep	13.6	51.4	44.3	7.0	62.0	12.2	0.0	31.1
	17.7	29.5	15.7	14.1	17.5	14.8	0.0	28.5
swine	3.9	0.3	3.5	17.8	1.3	2.3	1.1	3.1
	3.2	0.6	2.7	7.9	1.8	2.2	1.9	4.7
Livestock units ^a	51.3	71.2	118.4	26.4	73.9	85.9	22.5	73.1
	33.9	58.4	64.6	19.0	45.5	35.0	12.1	54.6
Stocking density ^b	38.3	59.9	69.3	20.0	77.2	63.7	18.3	56.2
	16.7	42.5	36.6	7.8	92.3	32.5	9.1	56.5
Number of demesnes	20	7	40	10	45	33	27	182

Means in roman; standard deviations in italic.

1 = intensive mixed-farming; 2 = light-land intensive; 3 = mixed-farming with sheep; 4 = arable husbandry with swine; 5 = sheep-corn husbandry; 6 = extensive mixed-farming; 7 = extensive arable husbandry.

^a [horses × 1.0] + [(oxen + adult cattle) × 1.2] + [immature cattle × 0.8] + [(sheep + swine) × 0.1].

^b livestock units per 100 sown acres.

Source: National sample of accounts, 1350-1449.

K-means, and Normix. Each farming system was then defined on the basis of those demesnes identically classified by all three cluster techniques (Table 2). In effect, this identified an unambiguous *core* of 182 clearly

differentiated demesnes. This is a smaller proportion of the total sample (61.3 per cent compared with 67.1 per cent) than the core of 261 pre-1350 demesnes and is consistent with the smaller number of principal

TABLE 3
National farming types 1350-1449: mean characteristics of core and peripheral demesnes

Mean per demesne	Farming type/cluster group							All demesnes
	1	2	3	4	5	6	7	
Percentage of sown acreage:								
wheat	15.1 7.1	6.3 6.6	32.2 9.5	32.0 10.6	34.8 15.0	36.6 13.3	33.7 14.4	30.9 14.5
rye	3.9 6.0	19.3 15.6	1.3 4.4	0.1 0.4	1.0 3.5	3.3 6.9	2.0 5.1	2.9 7.1
winter mixtures	1.8 4.5	6.8 13.1	1.6 4.5	3.3 7.9	1.6 3.9	1.9 4.9	0.7 3.5	1.9 5.4
barley	50.9 12.3	27.8 25.9	25.5 14.0	19.3 11.6	19.3 11.3	10.8 12.4	16.6 17.0	22.2 18.0
oats	12.2 6.5	25.1 18.7	15.2 11.8	7.2 7.5	27.0 17.1	33.1 15.6	24.4 19.4	22.8 16.7
spring mixtures	2.1 6.4	2.6 6.9	5.5 12.1	12.5 14.9	6.1 12.6	2.6 6.9	7.5 16.0	4.9 11.3
legumes	13.9 5.4	3.4 6.3	18.6 12.5	25.6 16.5	10.3 8.8	11.5 10.0	15.1 13.2	13.9 11.5
Sown acreage	155.4 88.1	120.2 87.4	185.1 96.7	132.3 70.9	129.5 73.9	147.6 81.1	135.6 69.3	151.7 85.9
Percentage of livestock units ^a :								
horses	16.5 10.5	10.1 4.1	7.5 5.2	29.6 26.2	10.4 9.0	11.1 7.1	29.9 31.7	13.1 14.7
oxen	7.3 10.1	5.6 8.2	19.0 12.6	39.4 29.5	23.9 12.2	24.3 19.2	68.1 31.5	24.9 23.4
adult cattle	43.3 16.1	29.0 18.0	18.4 11.4	5.0 10.9	5.7 13.6	31.5 20.0	0.7 2.4	20.4 18.6
immature cattle	16.1 7.7	8.0 7.7	12.3 8.4	0.3 0.7	<0.1 0.2	14.5 8.5	0.0 0.0	9.1 9.4
sheep	11.6 16.0	45.9 25.8	39.3 15.8	9.0 16.3	57.8 18.9	16.6 16.1	0.0 0.0	29.2 25.1
swine	5.3 4.3	1.3 2.2	3.6 3.0	16.6 8.0	2.1 2.9	2.1 2.2	1.4 2.4	3.3 4.4
Livestock units ^a	50.2 30.7	88.2 64.1	119.2 68.8	27.4 14.9	72.6 43.1	82.7 40.7	23.0 12.3	79.2 56.8
Stocking density ^b	36.4 18.1	72.5 40.3	76.8 58.6	21.3 8.0	71.7 84.8	68.0 52.3	18.7 9.4	61.2 58.8
Number of demesnes	32	14	77	12	56	78	28	297

Means in roman; standard deviations in italic.

1=intensive mixed-farming; 2=light-land intensive; 3=mixed-farming with sheep; 4=arable husbandry with swine; 5=sheep-corn husbandry; 6=extensive mixed-farming; 7=extensive arable husbandry.

^a [horses × 1.0] + [(oxen + adult cattle) × 1.2] + [immature cattle × 0.8] + [(sheep + swine) × 0.1].

^b livestock units per 100 sown acres.

Source: National sample of accounts, 1350-1449.

component scores employed and greater difficulty of distinguishing real differences in farm enterprise.

The common denominator of the

residuum of 115 non-core or *peripheral* demesnes is that there is a measure of disagreement between the three cluster techniques over their precise cluster mem-

bership.⁴² This disagreement is most effectively resolved using discriminant functions calculated from the core demesnes to determine which core group each peripheral demesne has the highest probability of membership (Table 3).⁴³ The discriminant functions serve three further useful purposes. First, they allow the second-choice classification of each demesne to be determined, in terms of the farming type to which it bears the next closest resemblance (Figs 6–12). This is helpful in determining the degree of similarity or dissimilarity between farming types. Second, direct comparison can be made between the pre-1350 and post-1349 classifications, using the pre-1350 discriminant functions to determine which pre-1350 farming type each post-1349 farming type most closely resembled, and vice versa (Table 4).⁴⁴ Third, they may be used to allocate additional demesnes to their appropriate cluster grouping, as more data become available.⁴⁵ Here they have been used to classify the independent samples of 125 demesnes within a ten-county area around London and 106 Norfolk demesnes (Table 5 and Figs 3 and 4), thereby lending a much sharper spatial focus to the analysis of variations in farming type. Independent classification of the Norfolk demesnes, replicating at county level the methodology employed at a national scale (Table 6 and Fig 5), provides a further insight into the appropriateness of the national typology.

⁴² In 182 cases (the core demesnes) there is agreement between three clustering methods, in 108 cases there is agreement between two, and in seven cases there is no agreement at all.

⁴³ Power and Campbell, 'Cluster analysis', p. 232. When applied to the 182 core demesnes the discriminant functions were 100 per cent successful at reclassifying them correctly.

⁴⁴ In fact, the discriminant functions published in Power and Campbell, 'Cluster analysis', p. 232, for the period 1250–1349 have been revised marginally on account of the addition of Hemsby, Norfolk (the most intensively cultivated and highest yielding of all known medieval English demesnes) to the original sample of 388 demesnes. Needless to say, Hemsby emerges as a core *intensive mixed-farming* demesne.

⁴⁵ For the relevant procedure and program see, K. C. Bardeley, 'Classifying the past: discriminant analysis and its application to medieval farming systems', *History and Computing*, 8.1, 1996, pp. 1–10.

II

Notwithstanding the significant shifts in the general emphasis of farming practice between 1250–1349 and 1350–1449, no fundamentally new demesne-farming systems came into being.⁴⁶ Rather, the existing range of farming systems was modified and developed. Eight basic farming types may be identified in the period 1250–1349 and these may be matched by seven in the period 1350–1449. How closely these two sets of farming system resembled one another can be established, as outlined above, by applying their respective discriminant functions to the mean characteristics of each farming type (Table 4). On this basis *arable husbandry with swine*, *sheep-corn husbandry*, and *extensive arable husbandry* emerge as farming systems common to both periods, with similar if not identical attributes. With the three pre-1350 and three post-1349 mixed-farming systems, however, the correspondence is less exact. The discriminant functions, for instance, reveal the *intensive mixed-farming* system of post-1349 to bear a closer resemblance to the *light-land intensive* system of pre-1350 than the *intensive mixed-farming* system of the same period. In fact, the *intensive mixed-farming* and *light-land intensive* systems of pre-1350 seem to coalesce into a single intensive mixed-farming system after 1349. Insofar as a *light-land intensive* system persisted as a separate system in its own right it was very much as a minority farming type, specific to certain environmental and economic contexts and retaining the more extreme characteristics of the *light-land intensive* system of before 1350. Similarly, the *mixed-farming with cattle* of before 1350

⁴⁶ Stock-only demesnes may have developed in certain fresh lowland contexts during the fifteenth century (eg N. W. Alcock, *Warwickshire Grazier and London Skinner 1532–155: The Account Book of Peter Temple and Thomas Heritage*, British Academy, Records of Economic and Social History, new series IV, 1981), following the wholesale abandonment of arable cultivation, but there are plenty of upland and marshland precedents for such exclusively pastoral enterprises.

TABLE 4

Match between national farming types 1250-1349 and 1350-1449 (established by applying discriminant functions to the mean characteristics of each farming type)

CORE DEMESNES ONLY

Farming type 1250-1349	Nearest equivalent farming type 1350-1449 ^a	Farming type 1350-1449	Nearest equivalent farming type 1250-1349 ^b
intensive mixed-farming	intensive mixed-farming	intensive mixed-farming	light-land intensive
light-land intensive	intensive mixed-farming	light-land intensive	light-land intensive
mixed-farming with cattle	extensive mixed-farming	mixed-farming with sheep	extensive mixed-farming
arable husbandry with swine	arable husbandry with swine	arable husbandry with swine	arable husbandry with swine
sheep-corn husbandry	sheep-corn husbandry	sheep-corn husbandry	sheep-corn husbandry
extensive mixed-farming	extensive mixed farming	extensive mixed-farming	extensive mixed-farming
extensive arable husbandry	extensive arable husbandry	extensive arable husbandry	extensive arable husbandry
oats and cattle	light-land intensive		

ALL DEMESNES

Farming type 1250-1349	Nearest equivalent farming type 1350-1449 ^a	Farming type 1350-1449	Nearest equivalent farming type 1250-1349 ^b
intensive mixed-farming	extensive mixed-farming	intensive mixed-farming	intensive mixed-farming
light-land intensive	intensive mixed-farming	light-land intensive	light-land intensive
mixed-farming with cattle	extensive mixed-farming	mixed-farming with sheep	intensive mixed-farming
arable husbandry with swine	arable husbandry with swine	arable husbandry with swine	arable husbandry with swine
sheep-corn husbandry	sheep-corn husbandry	sheep-corn husbandry	sheep-corn husbandry
extensive mixed-farming	extensive mixed-farming	extensive mixed-farming	extensive mixed-farming
extensive arable husbandry	extensive arable husbandry	extensive arable husbandry	extensive arable husbandry
oats and cattle	light-land intensive		

^a using post-1349 discriminant functions; ^b using pre-1350 discriminant functions.

Source: J P Power and B M S Campbell, 'Cluster analysis and the classification of medieval demesne-farming systems', *Trans Inst Brit Geogr*, new series, 17, 1992, Tables III, V, and VI; K C Bartley, 'Classifying the past: discriminant analysis and its application to medieval farming systems', *History and Computing*, 8.1, 1996, Tables 2 and 3.

finds its closest counterpart in the *extensive mixed-farming* of post-1349 rather than any more intermediate system. After 1349 it is *mixed-farming with sheep* which seems to fall somewhere between the intensive and extensive extremes of the mixed-farming spectrum since the discriminant functions reveal it to have combined many of the features of *extensive mixed-farming* with some of those of *intensive mixed-farming*. In fact, the discriminant functions identify a closer coincidence between the *extensive mixed-farming* of post 1349 and the *extensive mixed-farming* of pre-1350 than the *mixed-farming with cattle* with which the prominence of cattle within its pastoral profile might have suggested a closer match. Significantly, the only farming system to disappear entirely from view after 1349 is

the smallest and least satisfactorily defined pre-1350, namely *oats with cattle*⁴⁷.

Cluster One: 'intensive mixed-farming'

This is at once the most intensive and most arable of the three main mixed-farming systems which may be recognized post 1349. Its intensity is apparent from the choice of animals stocked and crops grown, while its strong arable emphasis is manifest in a mean stocking density below the national average and well below the stocking densities of the other mixed-farming systems (Table 2). It is also the most clearly defined of the three mixed-farming systems, insofar as there is a higher degree of

⁴⁷ Power and Campbell, 'Cluster analysis', pp 239, 241.

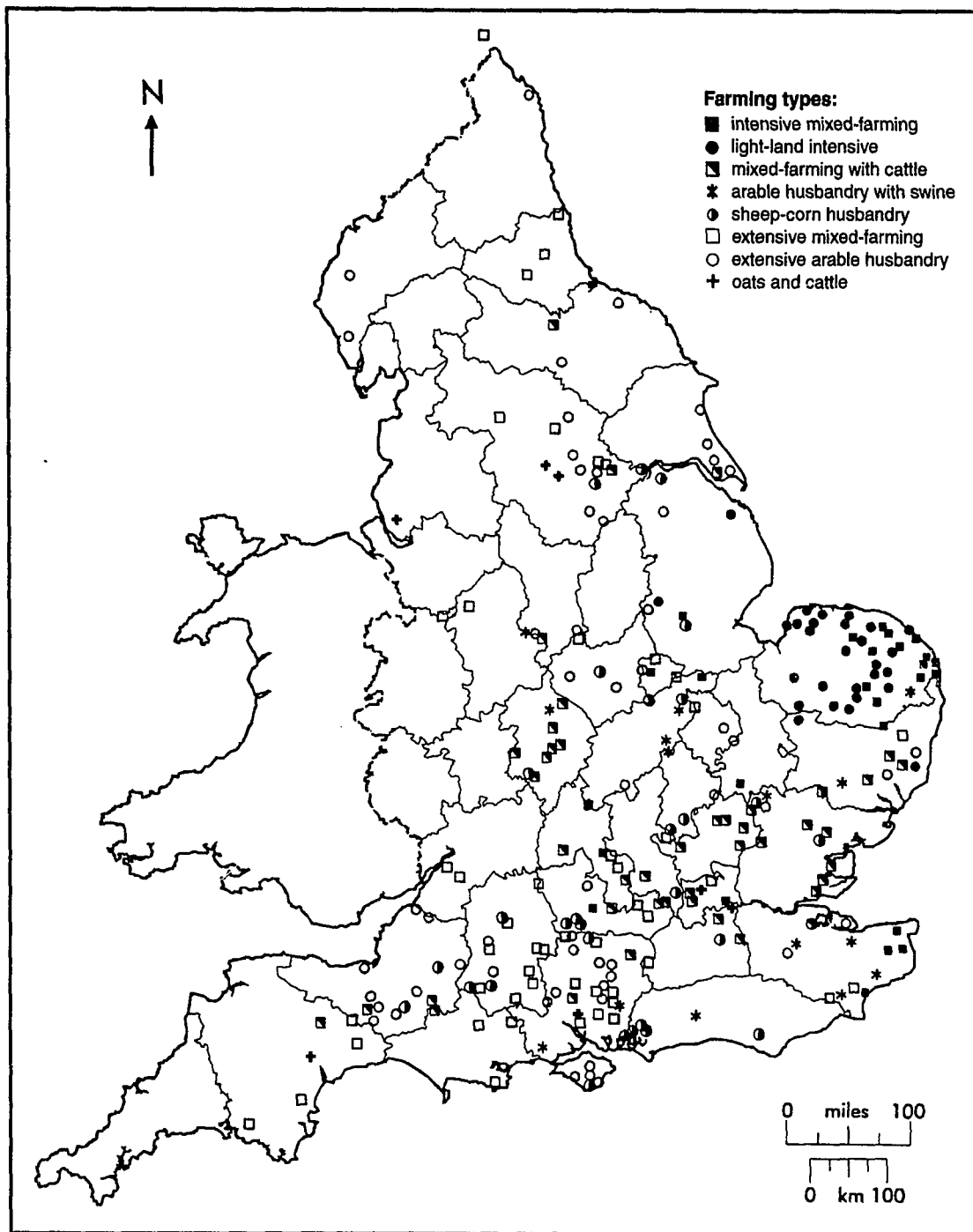


FIGURE 1
National farming types, 1250-1349: core demesnes.

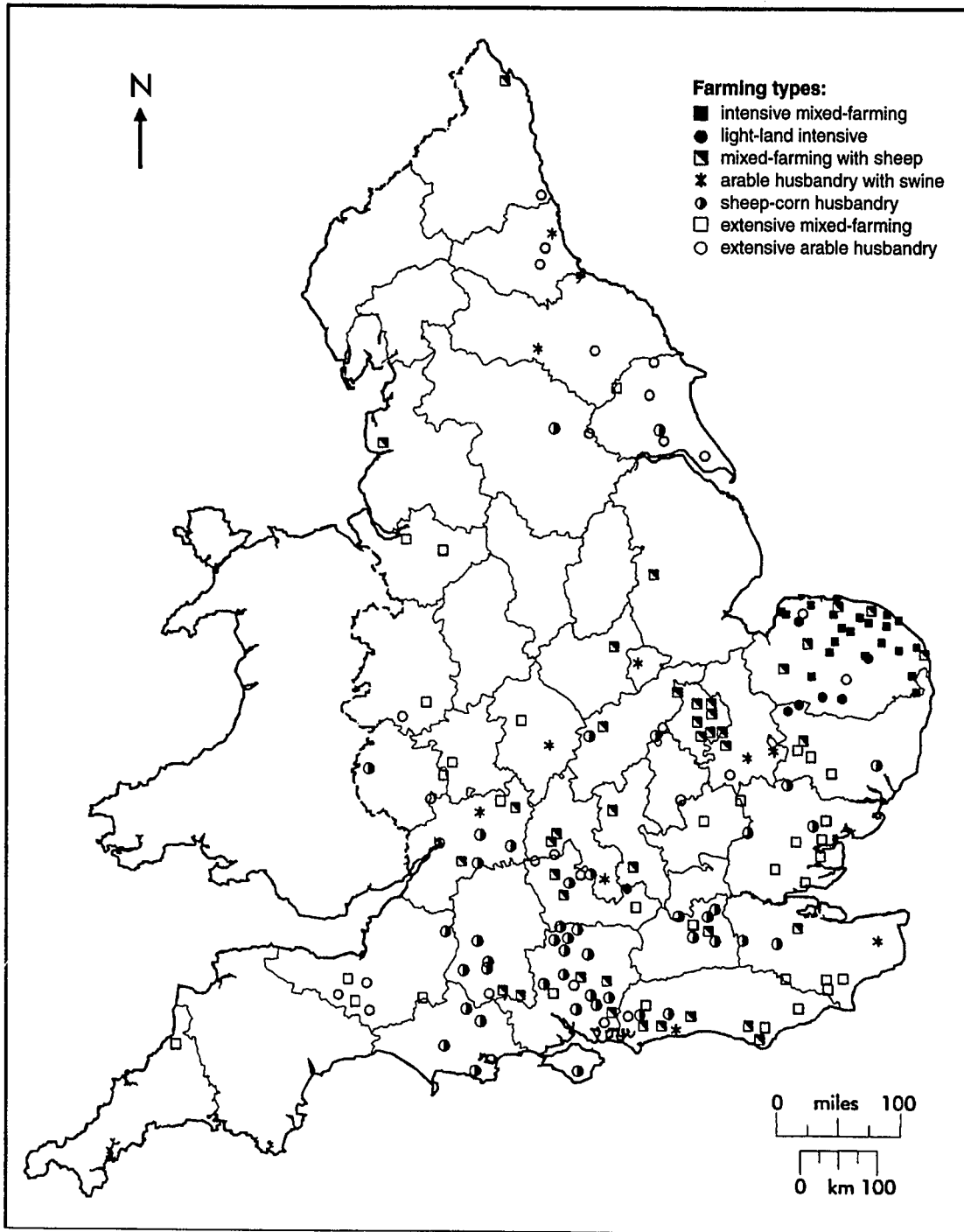


FIGURE 2
National farming types, 1350-1449: core demesnes.

TABLE 5
Farming types in the London region^a 1375-1400: national classification.
Mean characteristics of demesnes

Mean per demesne	Farming type/cluster group							All demesnes
	1	2	3	4	5	6	7	
Percentage of sown acreage:								
wheat	17.4	4.9	32.9	30.8	34.1	37.0	31.2	32.3
	7.2	9.7	10.1	14.9	16.8	8.9	14.3	14.0
rye	8.9	8.1	0.3	0.0	3.4	2.0	0.0	2.2
	10.6	16.1	1.3	0.0	6.7	5.7	0.0	6.5
winter mixtures	8.7	5.2	1.2	0.8	3.0	1.3	0.0	2.1
	10.6	10.3	3.8	1.4	6.1	3.3	0.0	5.4
barley	24.7	18.2	28.3	21.5	19.3	8.2	9.2	18.3
	13.6	16.6	11.0	17.5	15.2	7.6	15.1	14.8
oats	17.7	46.6	11.1	4.8	22.9	35.3	17.9	22.6
	6.0	19.5	8.1	4.9	15.4	12.9	21.1	17.1
spring mixtures	15.5	4.6	6.8	22.7	5.3	4.3	27.5	8.2
	13.7	5.8	11.9	27.3	6.6	9.1	29.4	14.8
legumes	7.1	12.5	19.4	19.6	12.1	12.0	14.2	14.4
	4.5	17.1	9.1	15.7	8.9	8.6	9.4	10.5
Sown acreage	201.6	78.5	186.0	175.6	154.1	175.1	183.3	171.0
	114.8	40.3	79.1	86.7	65.8	84.1	49.1	81.5
Percentage of livestock units ^a								
horses	13.7	6.8	11.4	34.5	14.9	13.0	50.4	16.1
	6.6	4.3	6.1	20.5	8.4	6.9	23.5	13.9
oxen	9.6	9.6	18.8	13.1	20.2	12.3	49.4	17.5
	10.5	7.9	12.5	15.1	15.1	9.6	24.0	15.5
adult cattle	35.8	37.7	16.5	7.6	14.5	42.1	0.0	23.9
	20.3	21.7	10.5	14.5	20.2	15.4	0.0	21.0
immature cattle	10.3	4.7	8.9	0.5	0.1	12.3	0.0	6.7
	4.9	6.0	5.8	1.2	0.4	8.1	0.0	7.6
sheep	27.1	40.1	38.3	25.4	47.0	18.4	0.0	31.2
	18.7	16.0	15.6	19.0	21.4	13.6	0.0	21.2
swine	3.6	1.0	6.2	19.0	3.3	2.0	0.3	4.6
	2.7	1.4	3.8	8.6	3.4	2.1	0.6	5.8
Livestock units ^b	123.6	77.1	103.5	42.5	59.9	88.0	19.4	80.3
	45.2	33.5	62.0	27.2	28.3	43.1	4.3	50.8
Stocking density ^c	76.3	118.5	62.0	24.3	56.5	59.9	10.9	57.9
	37.7	65.2	40.8	13.0	66.9	32.9	2.6	49.0
Number of demesnes	6	5	33	9	29	37	6	125

Means in roman; standard deviations in italic.

1 = intensive mixed-farming; 2 = light-land intensive; 3 = mixed-farming with sheep; 4 = arable husbandry with swine; 5 = sheep-corn husbandry; 6 = extensive mixed-farming; 7 = extensive arable husbandry.

^a Beds, Berks, Bucks, Essex, Herts, Kent, Middx, N'hants, Oxon, and Surrey.

^b [horses × 1.0] + [(oxen + adult cattle) × 1.2] + [immature cattle × 0.8] + [(sheep + swine) × 0.1].

^c livestock units per 100 sown acres.

Source: Feeding the City II, accounts database.

concurrence in cluster-group membership for this system than either *mixed-farming with sheep* or *extensive mixed-farming*. The three clustering techniques identify a core

of twenty demesnes, to which discriminant functions add a further twelve. The latter are less extreme in their characteristics – non-working animals were slightly less

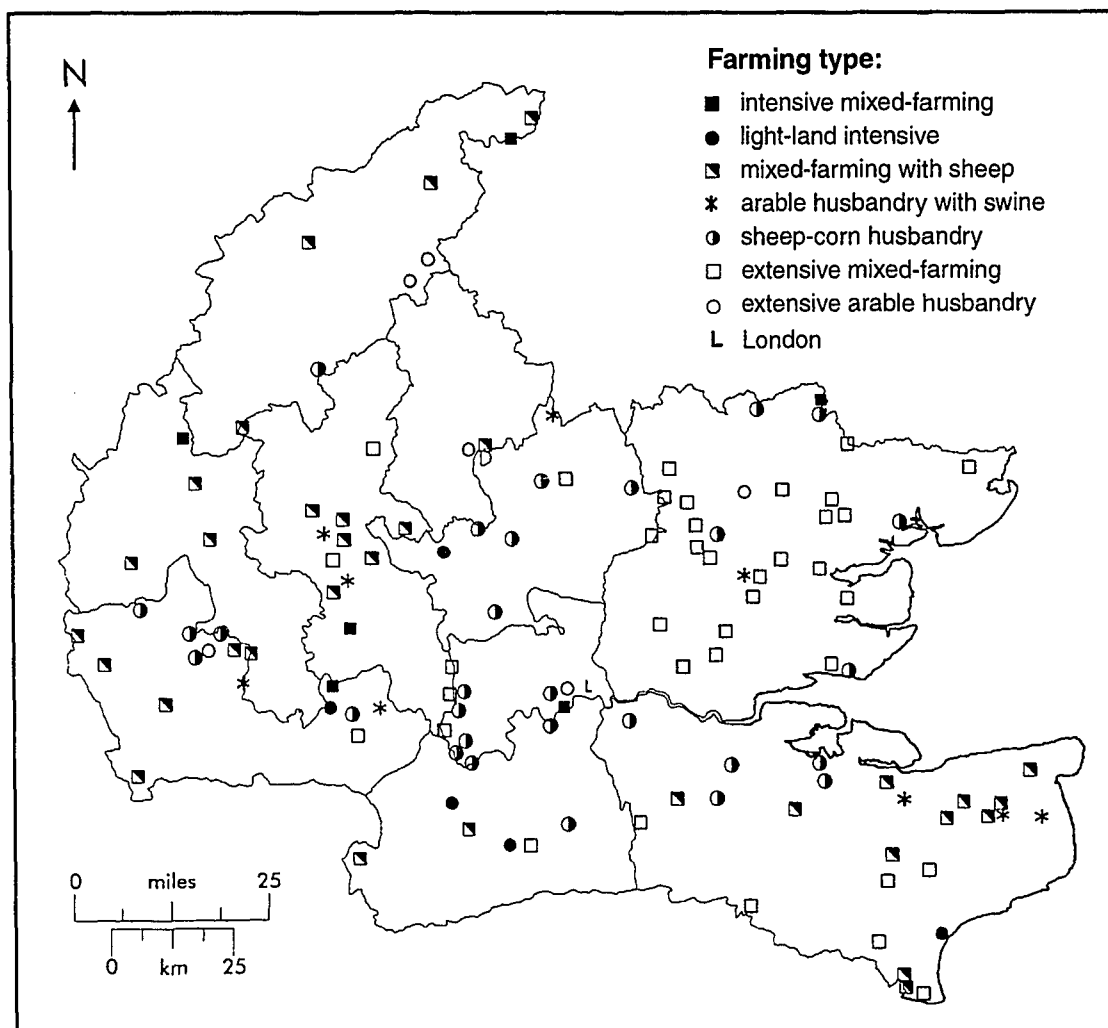


FIGURE 3

Farming types in the London region, 1375-1400: national classification.

important, greater use was made of oxen for draught, and the specialization in barley cultivation was less pronounced (Table 3) – and distributionally mostly peripheral to the main concentration of core demesnes (Figs 2 and 6). By implication, therefore, they were both less specialized and less intensive.

In part this farming system constitutes a modified version of the *intensive mixed-farming* that had evolved during the thirteenth century under the stimulus of rising population and expanding commercial

opportunities in areas of fertile and easily cultivated soil, high population density, and good market access (Table 4).⁴⁸ Certainly, several of the demesnes that practised *intensive mixed-farming* before 1350 also show up as *intensive mixed-farming* demesnes after 1349 (Figs 1 and 2).⁴⁹ Common denominators of both farming

⁴⁸ Power and Campbell, 'Cluster analysis', pp 233-6, 240-1; Campbell, 'Agricultural progress'.

⁴⁹ For example, Flegg, Halvergate, Hemsby, Martham, and Scratby in east Norfolk, Hindolveston and Hindringham in north-central Norfolk, and Hunstanton in north-west Norfolk.

systems were the priority given to wheat and barley among the winter and spring grains, the disproportionate share of the sown acreage devoted to spring crops, the prominence of horses among working animals, the exceptionally high proportion of non-working animals, and a specific pastoral specialism in cattle-based dairying. These features are all consistent with the relatively intensive use of land, labour, and capital and hence identify this as a comparatively intensive system of husbandry. But whereas before 1350 *intensive mixed-farming* was associated with a fairly equal reliance upon horses and oxen, above average stocking densities, and exceptionally high sowings of legumes (partly to sustain soil fertility and partly to sustain livestock numbers), after 1349 this ceased to be the case. Horses now became the almost exclusive source of draught power; livestock profiles although highly developed were nevertheless associated with stocking densities that were not only below the average for the period 1350–1449 but lower than those associated with pre-1350 versions of *intensive mixed-farming*; and, compared both with other contemporary farming systems and the *intensive mixed-farming* of pre-1350, legumes were no longer cultivated on such an impressive scale.⁵⁰ In these respects *intensive mixed-farming* had assumed some of the characteristics of the *light-land intensive* system which occupied a complementary distribution on the light soils of Norfolk in the period 1250–1349 (Table 4 and Fig 1). This light-land system made fuller use of horses for draught power than any other pre-1350 farming system and was also the system in which barley – grown largely for malting – assumed its greatest importance as a crop; both features which became more closely associated with

'intensive mixed-farming' demesnes in the period 1350–1449.

The geographical distribution of demesnes practising *intensive mixed-farming* after 1349 confirms the system's status as a fusion of the *intensive mixed-farming* and *light-land intensive* systems of 1250–1349. Every one of the core demesnes is in Norfolk (Fig 2). Applying discriminant functions to the peripheral demesnes within the national sample adds six more demesnes within the county together with a further six elsewhere, four of them with a strong East Anglian focus (Fig 6).⁵¹ Five others are identified by the application of discriminant functions to the Feeding the City II sample of demesnes (Fig 3).⁵² No other post-1349 farming system is spatially so sharply focused, with a marked concentration of demesnes in a single region and only a thin scatter of isolated examples elsewhere (Fig 2). Nor before 1350 was *intensive mixed-farming* so geographically specific in distribution or clearly defined in character (Fig 1). In the earlier period its association with Norfolk is strong but by no means exclusive, with Kent in particular showing up as a second important focus of *intensive mixed-farming*.⁵³ But after 1349 nowhere went further than Norfolk in the substitution of horses for oxen and reliance upon barley as the principal cash crop. It is these two features which identify the post-1349 version of *intensive mixed-farming* as a more-or-less exclusively Norfolk system (with just a hint of a secondary and far lesser focus in the Soke of Peterborough).

Norfolk is a county particularly well

⁵⁰ The advance of horses and retreat of legumes constitute a striking dichotomy. The former represents the continuation of a diffusion process which had begun in the late twelfth century (Campbell, 'Towards an agricultural geography', pp 91–4), the latter, a general throttling back in the intensity of husbandry (Campbell and Overton, 'A new perspective', pp 58–9, 74, 95–6).

⁵¹ Melton (Suffolk), Borley (Essex), Soham (Cambridgeshire), and Longthorpe in the Soke of Peterborough (Northamptonshire).

⁵² Adderbury (Oxfordshire) – a *light-land intensive* demesne in the national classification, Boroughbury (Northamptonshire), Culham (Berkshire), Ebury (Middlesex), and West Wycombe (Buckinghamshire) – an *extensive mixed-farming* demesne in the national classification.

⁵³ Power and Campbell, 'Cluster analysis', pp 233–6, 240–1; *A Medieval Capital*, pp 126, 132–3, 135–8, 140–1; P F Brandon, 'Farming techniques. South-eastern England', in Hallam, *Agrarian History*, II, pp 317–25.

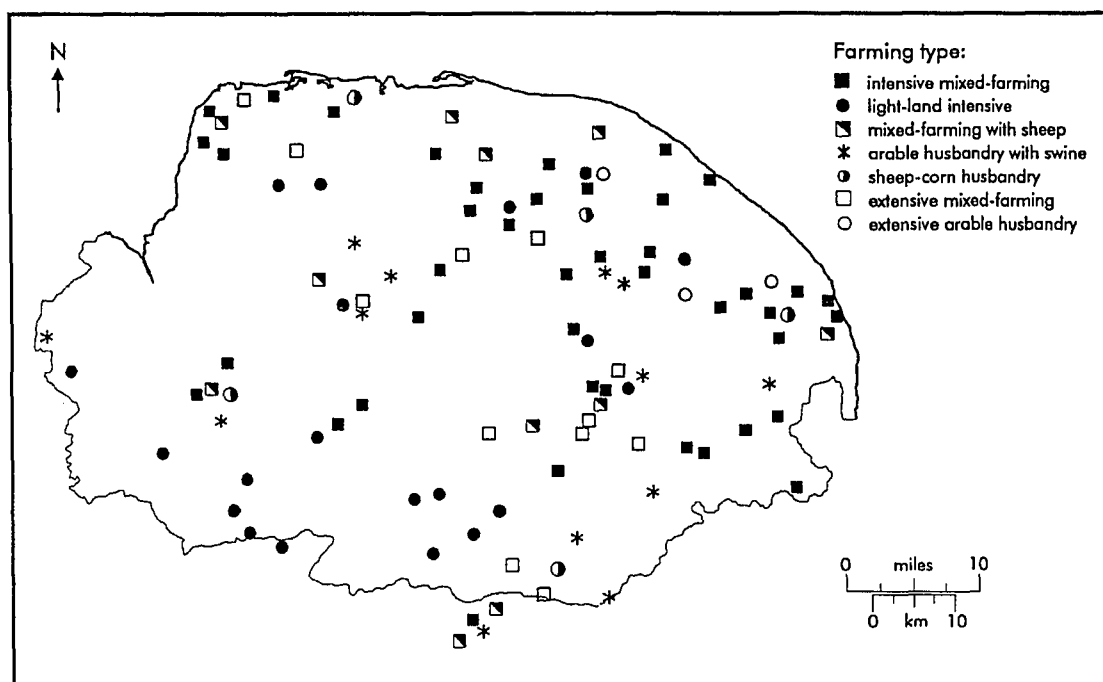


FIGURE 4
Norfolk farming types, 1350-1449: national classification.

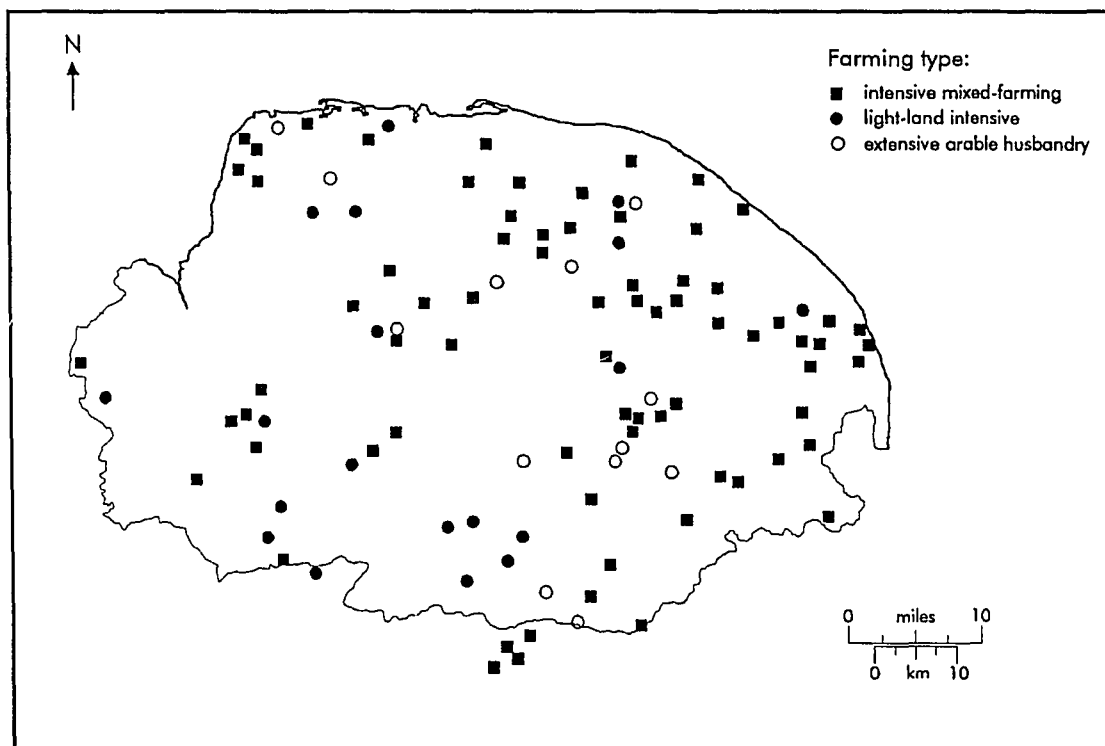


FIGURE 5
Norfolk farming types, 1350-1449: county classification.

served by manorial accounts, with 106 separately documented demesnes in the period 1350–1449 (in fact, five of these – Brandon, Hinderclay, Redgrave, Rickingham, and Wattisfield – being just across the county boundary into Suffolk).⁵⁴ These allow the county's agriculture to be explored in almost greater detail than that of any other part of the country, which is of some advantage given Norfolk's apparent agricultural distinctiveness. Independent classification of these 106 Norfolk demesnes, replicating the method applied at national level, provides an additional perspective on the county's farming systems (Table 6 and Fig 5). At a county scale of analysis the only stable cluster solution is a three-cluster solution which assigns 73 of the 99 core demesnes to a single farming type (to which discriminant functions add one more). So dominant is this single farming system – with three out of four demesnes practising it – that it constitutes a veritable 'Norfolk system'; a medieval precursor of the 'Norfolk system' for which the county was to become so renowned from the late eighteenth century on.⁵⁵ Like that more celebrated later system it was a mixed-farming system of above average intensity. The intensity of the system is apparent in its strong arable emphasis (attested by mean stocking densities 25 per

cent below the national average), in the predominance of spring-sown crops, and in the primacy accorded barley within the spring course and wheat within the winter. This marked imbalance in the spring and winter courses, coupled with moderate sowings of legumes, is consistent with the flexible and relatively intensive rotations and irregular and infrequent fallowing which may be independently documented from the accounts.⁵⁶ That, notwithstanding below average stocking densities, it is rightly regarded as a particularly highly developed form of mixed farming is borne out by the exceptionally developed character of its pastoral sector. This was dominated by non-working rather than working animals, especially dairy cattle, plus some sheep and swine. Cattle-based dairying is one of the most intensive and productive forms of pastoralism and its development was plainly facilitated by the heavy reliance upon horses for draught, for this helped reduce the number of animals it was necessary to keep for ploughing and carting, and horses, by consuming fodder crops, helped free-up scarce meadow and pasture for the cattle.⁵⁷ Geographically, examples of this farming system were to be found in virtually all parts of the county, with the conspicuous exception of the sandy Breckland and its margins in the south-west, but it was especially characteristic of an arc of country extending from the richly fertile deep loam soils of Flegg in the east to the shallower and sandier soils in the vicinity of Hunstanton on the north-west coast (Fig 5). This is the self-same area in

⁵⁴ The Norfolk accounts database was finalized by Dr Bruce M S Campbell whilst in receipt of a personal research grant from the Social Science Research Council. It contains information on crops and livestock extracted from all known extant grange accounts for the county. Unlike the national and Feeding the City accounts databases, therefore, the mean crop and livestock profiles of individual demesnes are based on all available surviving records. For the period 1350–1449 the database contains information extracted from accounts in the following public and private archives: Bodleian Library, Oxford, British Library, Cambridge University Library, Canterbury Cathedral Library, Chicago University Library, Elveden Hall (Suffolk), Eton College, Holkham Hall (Norfolk), Lambeth Palace Library, Magdalen College Oxford, Norfolk Record Office, Pomeroy & Sons, Wymondham, Public Record Office, Raynham Hall (Norfolk), and the John Ryland's Library, Manchester. A handlist of these accounts is available from Dr Campbell.

⁵⁵ William Marshall, *The Rural Economy of Norfolk*, 2 vols, 1787; Arthur Young, *General View of the Agriculture of the County of Norfolk*, 1804; Campbell and Overton, 'A new perspective', pp 92–4, 105.

⁵⁶ B M S Campbell, 'The regional uniqueness of English field systems? Some evidence from eastern Norfolk', *AHR*, XXIX, 1981, pp 16–28; *idem*, 'Agricultural progress', pp 28–9; *idem*, 'Arable productivity in medieval English agriculture', unpublished paper presented to the UC-Caltech conference on Pre-industrial Developments in Peasant Economies: the Transition to Economic Growth, Huntington Library, San Marino, May 1987, pp 31–6, 53–7; *Ag Hist III*, pp 199–202.

⁵⁷ Campbell, 'Towards an agricultural geography', pp 95–7; *idem*, 'Commercial dairy production on medieval English demesnes: the case of Norfolk', *Anthropozoologica*, 16, 1992, pp 107–118.

TABLE 6
Norfolk farming types 1350-1449: county classification.^a
Mean characteristics of core demesnes and of core and peripheral demesnes

Mean per demesne	Core demesnes only				All demesnes			
	Farming type/cluster group			Overall	Farming type/cluster group			Overall
	1	2	3		1	2	3	
Percentage of sown acreage:								
wheat	17.9	5.5	13.9	15.7	17.8	6.7	13.5	15.3
	9.4	5.4	12.8	10.4	9.4	6.6	12.3	10.3
rye	4.6	22.1	2.7	6.9	4.9	18.1	2.5	6.9
	7.4	10.8	5.0	10.0	7.6	12.4	4.9	9.9
winter mixtures	0.8	3.2	0.0	1.0	0.7	2.3	0.0	0.9
	2.0	10.2	0.0	4.3	2.0	8.9	0.0	4.2
barley	47.0	47.5	49.7	47.4	47.1	45.1	51.2	47.3
	15.2	16.1	9.6	15.8	15.1	18.2	10.5	15.4
oats	14.0	19.1	19.8	15.4	14.0	16.8	18.9	15.1
	8.3	8.9	9.7	8.9	8.2	9.0	9.8	8.8
spring mixtures	1.2	0.3	0.0	0.9	1.1	1.2	0.0	1.0
	4.0	0.9	0.0	3.5	4.0	4.3	0.0	3.8
legumes	14.5	2.3	13.9	12.7	14.5	4.5	14.0	12.6
	6.0	1.8	4.2	6.8	6.0	6.1	4.0	6.9
Sown acreage	143.2	139.5	81.7	135.2	143.2	127.2	79.4	132.5
	75.1	73.9	36.5	74.1	74.5	68.2	35.9	72.8
Percentage of livestock units ^b :								
horses	15.4	12.0	73.0	21.9	15.3	14.8	73.7	22.4
	8.1	4.3	23.2	32.3	8.1	8.4	31.1	23.3
oxen	6.7	1.4	17.3	7.2	6.6	2.8	16.0	7.1
	8.5	5.2	24.0	12.3	8.5	8.5	24.5	12.3
adult cattle	41.3	27.9	0.6	34.5	41.3	27.6	0.6	33.8
	17.1	28.7	2.1	22.6	17.0	29.8	2.0	23.3
immature cattle	14.0	4.7	0.0	11.0	13.9	4.1	0.0	10.4
	8.0	6.5	0.0	9.0	8.1	6.2	0.0	9.0
sheep	19.3	53.0	0.0	21.7	19.6	46.5	0.0	22.0
	22.1	33.1	0.0	26.8	22.1	36.1	0.0	27.3
swine	3.4	1.0	0.7	2.7	3.3	4.3	2.1	3.3
	3.9	1.7	1.3	3.6	3.9	13.5	5.0	6.8
Livestock units ^b	56.1	55.0	5.8	49.9	56.0	47.8	5.7	48.4
	37.5	30.0	2.6	35.7	34.3	29.1	2.5	35.2
Stocking density ^c	42.3	40.7	7.4	37.9	42.2	40.5	7.4	37.6
	20.9	15.9	2.2	22.1	20.8	23.8	2.1	23.1
Number of demesnes	73	14	12	99	74	19	13	106

Means in roman; standard deviations in italic.

1 = intensive mixed-farming; 2 = light-land intensive; 3 = extensive arable husbandry.

^a based upon independent cluster analysis of 106 Norfolk demesnes.

^b [horses × 1.0] + [(oxen + adult cattle) × 1.2] + [immature cattle × 0.8] + [(sheep + swine) × 0.1].

^c livestock units per 100 sown acres.

Source: Norfolk accounts database.

which the *intensive mixed-farming* demesnes identified by the national classification of farming systems are most strongly concentrated (Fig 4).

The discriminant functions allow a direct comparison of the national and county classifications of each of these Norfolk demesnes. Significantly, the national classification identifies a wider variety of farming types within this single county, with examples occurring of each of the seven principal farming types (Fig 4). Apart from anything else this exemplifies the superiority of national over regional or local classifications of farming types, at least where the statistical basis of the classification is provided by cluster analysis. This is because minority farming types need to be very strongly differentiated before their distinctive identity is recognized by all three cluster techniques. The wider and more representative the sample, therefore, the greater the prospect of distinguishing between genuine differences in farming system. Numerically, although examples of all seven national farming types may be found in Norfolk it is *intensive mixed-farming* which is by far the best represented. There are 42 examples of this farming system, each of them coinciding with one of the 74 *intensive mixed-farming* demesnes identified by the Norfolk classification. Moreover, the majority of the 42 *intensive mixed-farming* demesnes common to both classifications are concentrated within the same arc of country from Flegg in the east to the north-west coast around Hunstanton, which appears to have been the heartland of this peculiarly Norfolk mixed-farming system (Figs 4 and 5).

Nevertheless, although *intensive mixed-farming* had a stronger affiliation with a single region than any other post-Black Death farming system, it was not so unique that it lacked strong affinities with certain other farming types. Again, the discriminant functions help to identify the systems

which these *intensive mixed-farming* demesnes next most closely resembled (Fig 6): in two out of three cases this was *extensive mixed-farming*, and in a further one out of four it was *mixed-farming with sheep*. The same close association between systems at the intensive and extensive ends of the mixed-farming spectrum was evident in the period 1250–1349, and serves as a reminder that the three main mixed-farming systems are best regarded as subsets of a continuum.⁵⁸ Both before and after the Black Death intensive and extensive mixed-farming systems were alike in the relatively developed character of their pastoral husbandry (Table 2), the one with strong arable underpinnings, the other with a far greater grassland component. Geographically, the *intensive mixed-farming* demesnes which shared most in common with *extensive mixed-farming* formed a fairly concentrated block, to which demesnes with closer affinities to other systems were mostly peripheral (Fig 6). This was very much the case with the eight demesnes whose second-choice classification was *mixed-farming with sheep*, and even more so with those three demesnes whose second choice was *light-land intensive husbandry*.⁵⁹ The one demesne – Aldeby, Norfolk – with a resemblance to *arable husbandry with swine* was a small demesne which served as the home farm to a minor monastic cell with a regular need for fresh pork, but it was also locationally marginal to the main concentration of *intensive mixed-farming* demesnes. Generally, therefore, this analysis of second choices confirms that *intensive mixed-farming* only attained the status of a homogeneous regional farming type in eastern and northern Norfolk and that small but nonetheless real differences existed between the kind of *intensive mixed-farming*

⁵⁸ Power and Campbell, 'Cluster analysis', p 239.

⁵⁹ Taverham (Norfolk), Melton (Suffolk), and Milton (Oxfordshire) from the national sample and Adderbury (Oxfordshire), Culham (Berkshire), and Ebury (Middlesex) from the Feeding the City II sample.

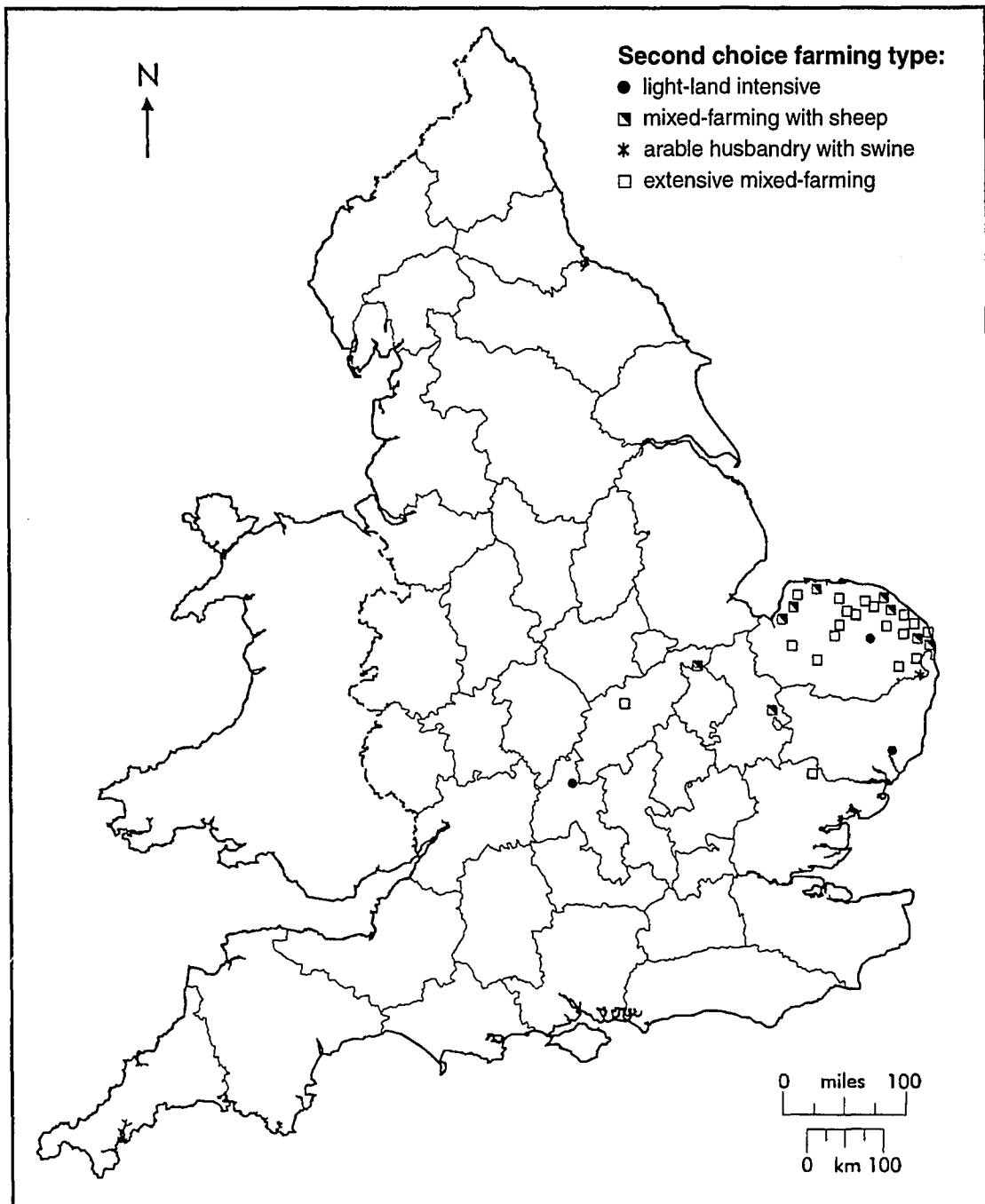


FIGURE 6
Intensive mixed-farming demesnes, 1350-1449 (core and peripheral demesnes indicating second choice).

practised here and that practised apparently in isolation elsewhere.⁶⁰

Cluster Two: 'light-land intensive farming'

Statistically, *intensive mixed-farming* may have been closer to *extensive mixed-farming* than any other farming system (Table 4), but agriculturally it was *light-land intensive farming* which was the next most proximate system both in terms of intensity and distribution (Table 2, Fig 2).⁶¹ Numerically, *light-land intensive farming* was very much a minority system and is represented in the national sample of demesnes by just a handful of examples. In part this is because the three clustering techniques differ most widely in their definition of this farming type with the result that a core of only seven demesnes is common between them, to which a further seven are added on the basis of their discriminant scores. But the comparative rarity of this farming type was also a function of its specialized character (Table 2). In no other system did working animals comprise such a small share of total livestock units and in none was the reliance upon horses for draught power so complete. Among non-working animals dairy cattle were plainly important, but sheep even more so; in fact, only on sheep-corn demesnes did sheep comprise a greater proportion of livestock units. Swine, in contrast, were mostly conspicuous by their absence. Arable husbandry was equally distinctive. This was the only farming system in which the area sown with rye generally matched or exceeded that devoted to wheat (maslin – a wheat-rye mixture – was also of some importance). Nevertheless, as with *intensive mixed-farming*, it was the spring sown grains that predominated, particularly

barley but also significant quantities of oats. Such a pronounced winter-spring imbalance again implies irregular and flexible rotations, although in the absence of significant sowings of legumes (which occupied a smaller share of the sown acreage than in any other system) fallows of varying frequency and duration are likely to have retained a prominent role in the maintenance of soil fertility. This was certainly the case at Brandon (Suffolk) and East Wretham and Eccles (Norfolk), which are known to have employed their sheep flocks to fold arable land left uncultivated for several years in succession, the duration of the 'fallow' depending upon the quality of the land.⁶²

Everything about this farming system marks it out as a response to the particular environmental problems presented by light land. Light and easily worked loamy and sandy soils, for instance, help explain the preference for small all-horse plough teams implicit in the modest, horse-dominated draught sector. Sheep also did well on light land, especially where there was much heath and rough pasture, and were an indispensable adjunct of arable husbandry since light sandy soils were quickly exhausted unless regularly dunged (the nightly folding of sheep on the arable performing this function admirably). Provided there was sufficient good grassland, especially in the better watered valley bottoms, cattle fared reasonably well, but in open heathy country with neither pannage nor legumes available in any quantity (peas and beans – widely used for feeding swine – did not do well on light soils) there was little basis for keeping swine. Light acidic soils also explain the predominance of rye over wheat at a time when its cultivation elsewhere was in decline as rising living standards allowed consumers to indulge a strong dietary preference for wheaten

⁶⁰ Closer examination confirms that these differences were further underscored by differences in productivity: B M S Campbell, 'Arable productivity in medieval England: some evidence from Norfolk', *J Econ Hist*, XLIII, 1983, pp 379–404.

⁶¹ The reference to light land is entirely descriptive: soil type is not a criterion of classification.

⁶² PRO, SC 6/1304/28–36; Chicago University Library, Bacon Roll 643, 645–60; Elveden Hall, Suffolk, Iveagh Collection 148 (Phillipps 26523); Eton College Records, Vol 30, 43–9; Raynham Hall, Norfolk, Townshend Mss.

bread. Similarly, barley and oats grew relatively well on light soils, whose low nitrogen content yielded a barley peculiarly well suited to brewing.⁶³ Before 1350 so great had been the commercial imperative to produce grain that stocking densities on *light-land intensive* demesnes had been conspicuously below-average, but thereafter they rose to around the national average as demesne managers lengthened fallows and converted to pasture land whose economic rent was now too low to warrant its continued use as arable.

That it is correct to diagnose this farming system as a light-land system is confirmed by the distribution of demesnes that practised it (Figs 2 and 7). Four of the seven core demesnes lie in or on the margins of the Breckland of East Anglia, a locality with some of the lightest and least fertile soils in the country whose distinctive medieval husbandry practices have been the subject of detailed study by Mark Bailey.⁶⁴ The other three are all located on soils of similar type.⁶⁵ Five of the seven peripheral demesnes (Fig 7) are also associated with light to medium soils.⁶⁶ Only Agney-and-Orgarswick in Romney Marsh and Popinho in the Norfolk Fens deviate from the light-land rule, a rule to which the three *light-land intensive* demesnes within the Feeding the City II sample all comply (Fig 3).⁶⁷

The restriction of every one of these

light-land intensive demesnes to East Anglia or the south-east of England nevertheless implies that environmental factors were by no means the sole influence upon their distribution. Economic factors were at least as important, for it was these which endowed this light-land system with its relatively intensive character. This intensity is apparent in the overwhelming preference for horses rather than oxen, the developed character of pastoral husbandry, the flexibility of arable rotations, and the importance of barley as a crop.⁶⁸ East Anglia, in particular, as John Langdon has demonstrated, was in the vanguard of the substitution of horses for oxen.⁶⁹ Along with much of the south-east, it lay outside the bounds of the regular commonfield system which allowed the evolution of more irregular and flexible forms of rotation, and was also early involved in an active regional and inter-regional grain trade which provided a stimulus to the commercial production of malting barley.⁷⁰ East Anglia was also the preserve of *intensive mixed-farming* and it was this farming system which was the second-choice classification of over half the *light-land intensive* demesnes (Fig 7). These demesnes formed a reasonably cognate group with a strong but by no means exclusive focus upon Norfolk and were complemented in distribution by seven others – six of them in west Norfolk – whose sheep farming was on such a scale that their second-choice classification was *sheep-corn husbandry*, an altogether more extensive system of farming. The remaining *light-land intensive* demesnes were also less intensive in character – two of them with a close resemblance to *mixed-farming with sheep* and four bearing a strong affin-

⁶³ M Bailey, *A Marginal Economy? East Anglian Breckland in the Later Middle Ages*, 1989, p 140.

⁶⁴ Brandon and Lakenheath (Suffolk) and East Wretham and Eccles (Norfolk); Bailey, *A Marginal Economy?*

⁶⁵ Bircham on the coarse loamy soils of the 'good-sands' region of north-west Norfolk, Costessey, a few miles west of Norwich, on free-draining acidic sandy soils formed from glacial outwash sands and gravels, and Culham in Berkshire on the coarse loamy and sandy soils that are a feature of the gravel terraces of the middle Thames valley.

⁶⁶ Feltwell (Norfolk) on the western edge of Breckland; Wrabness on the coarse sandy and loamy soils of north-east Essex, Pyrford (Surrey) on the light soils of the Wey valley, Petworth on the inferior sandy soils of the Sussex Weald, and Adderbury on the light loams of the wold country of north Oxfordshire.

⁶⁷ Wargrave, a near neighbour of Culham, Berkshire, on almost identical coarse loamy and sandy soils; Dorking, on broadly equivalent soils in the Surrey Weald; and Great Gaddesden in the Hertfordshire Chilterns, on loamy and clayey soils overlying chalk.

⁶⁸ The Feeding the City II accounts database indicates that barley was one of the most 'commercialized' of crops, with 41 per cent of net receipts sold (including sales of malted barley). Only dredge – a barley/oats mixture – was sold in greater proportions (58 per cent of net receipts).

⁶⁹ Langdon, *Horses, Oxen and Technological Innovation*, p 43; Campbell, 'Towards an agricultural geography', pp 91–3.

⁷⁰ H L Gray, *English Field Systems*, Cambridge, Mass, 1915, pp 305–402; Bailey, *A Marginal Economy?*, pp 140–3, 145–50.

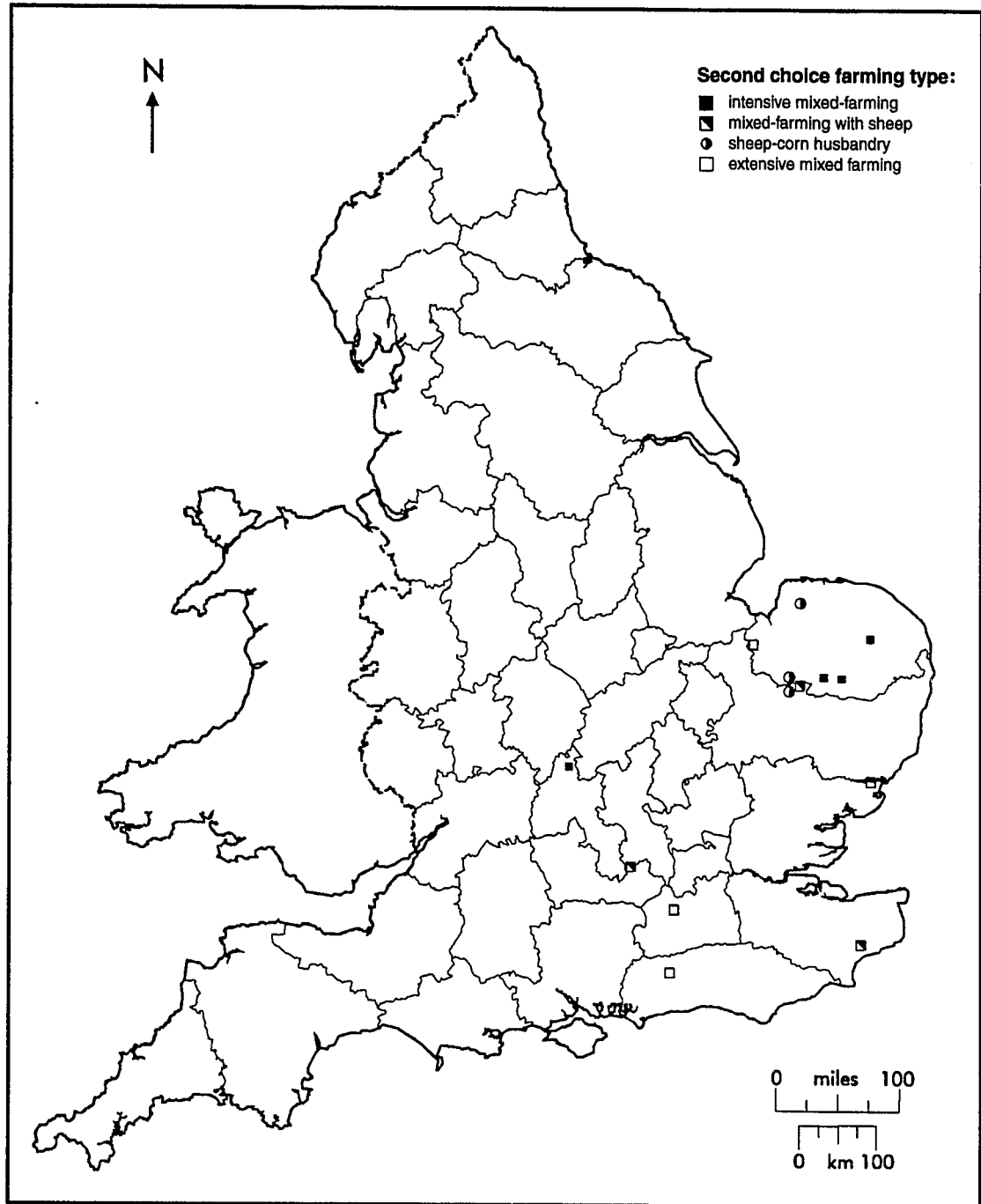


FIGURE 7

Light-land intensive demesnes, 1350-1449 (core and peripheral demesnes indicating second choice).

ity with *extensive mixed-farming* – and were distributionally peripheral to the main concentration of demesnes belonging to this farming type (Fig 7).

The exceptionally detailed Norfolk material brings at least that county's part of this overall picture into sharper focus. Of the 106 documented Norfolk demesnes discriminant functions reveal 20 to have practised some form of *light-land intensive farming* in the period 1350–1449. Half of these demesnes were located in the south-west and west of the county where their dominance was so great as to constitute a sub-regional farming type which clearly extended across the county boundary to embrace the adjoining area of light soils in north-west Suffolk (Fig 4). It is this 'Breckland' system of farming which has been discussed and described in detail by Bailey.⁷¹ Elsewhere examples of *light-land intensive farming* are more scattered, but then so too are patches of light soils in this pedologically most varied of counties. This implies that *light-land intensive farming* mostly occurred as a deviation from prevailing husbandry norms, which points to the paramountcy of environmental over economic factors in determining its detailed distribution. Its distinctiveness as a recognizable farming type in its own right is nevertheless confirmed by independent classification of these 106 Norfolk demesnes (Table 6, Fig 5). As already observed, replicating the methodology of the national classification at county level identifies only three basic farming systems: *intensive mixed-farming* is one, *light-land intensive farming* another. The latter system is represented by just 19 demesnes, a number which compares closely with the 20 identified within the county by the national classification. Fifteen demesnes are common to both classifications and consequently represent the most diagnostic

examples of this particular farming type. Seven are relatively scattered in distribution and may mostly be explained by localized occurrences of light or poor soil, but eight are located in or near Breckland and thereby confirm the distinctive agricultural character of this small but unique region (Figs 4 and 5).

Cluster Three: 'mixed-farming with sheep'

In contrast to *intensive mixed-farming* and *light-land intensive farming*, which were either regionally or environmentally circumscribed in distribution, *mixed-farming with sheep* was far more widely represented as a husbandry type (Fig 2). Its status as a mixed-farming system is apparent in the number and proportion of non-working animals that were stocked and the above average stocking densities to which these mostly gave rise, notwithstanding sown acreages which themselves were often above average (Table 2). The types and combinations of crops grown imply a relatively intensive agricultural regime, insofar as the acreage of spring-sown crops exceeded that of winter, wheat and barley (respectively, the most valuable and demanding winter and spring grains) were the two most important grains (with oats relegated to a relatively minor role), and roughly a fifth of the cropped acreage was sown with legumes.⁷² Nevertheless, such a pattern of cropping is also perfectly compatible with two-course rotations and, hence, relatively extensive systems of crop-

⁷¹ Bailey, *A Marginal Economy?*; *idem*, 'Sand into gold: the evolution of the foldcourse system in west Suffolk, 1200–1600', *AHR*, 38, 1990, pp 40–57.

⁷² Core demesnes known to have employed irregular rotations of above average intensity include Holywell (which Raftis believes to have been 'typical of the system on other Huntingdon demesnes') and Wistow, Hunts (J A Raftis, *The Estates of Ramsey Abbey: A Study in Economic Growth and Organization*, Toronto, 1957, pp 184–7; M P Hogan, 'Clays, culturae and the cultivator's wisdom: management efficiency at fourteenth-century Wistow', *AHR*, 36, 1988, pp 117–31); Felbrigg, Langham, and Ormesby, Norfolk (NRO, WKC 2/130/398 × 6, WKC 2/131/398 × 6; Raynham Hall, Townshend Mss; *Ag Hist III*, pp 200–2); and Alciston, Bosham, and Wiston, Sussex (P F Brandon, 'Demesne arable farming in coastal Sussex during the later Middle Ages', *AHR*, 19, 1971, pp 113–34; *Ag Hist III*, pp 273–5).

ping.⁷³ The latter is certainly more consistent with the intrinsically extensive character of the pastoral side of this farming system. Apart from the relatively high stocking densities, with all that they imply for a higher than average ratio of grassland to arable, there was a strong preference among working animals for oxen rather than horses and among non-working animals for sheep rather than cattle. Oxen and sheep were grassland animals and less labour and capital intensive in their requirements than horses and cattle.⁷⁴ Moreover, from the demographic composition of herds it would appear that the emphasis of cattle farming was not primarily upon dairying but upon the less intensive activity of rearing.

Many demesnes possessed these characteristics to some degree with the result that it is one of the least amenable farming systems to precise definition. The three different clustering techniques certainly differ quite considerably in the number of demesnes assigned to this cluster group: Normix assigns 61, Ward's 78, and K-means 128, nevertheless, only 40 demesnes are common between them. To this core group discriminant functions add a further 37 demesnes whose husbandry is less strongly differentiated – their stocking densities were, on average, higher, they kept more cattle and fewer sheep, and sowed more wheat and oats and less barley and legumes – and whose claim to belong to this farming type is correspondingly weaker (Table 3). Together, these core and peripheral demesnes constitute the second most common farming type within the national sample. Coincidentally, *mixed-farming with sheep* is also the second most

common farming type within the Feeding the City II sample of demesnes (Table 5).

That this was quintessentially a mixed-farming system and one that lay somewhere between the intensive and extensive extremes of the mixed-farming spectrum is confirmed by an analysis of second choices (Fig 8). Twenty-two of the 77 core and peripheral demesnes more closely resembled *intensive mixed-farming* than any other system, compared with 51 which bore a closer similarity to *extensive mixed-farming*. Of the remaining four, three had a second choice of *light-land intensive husbandry*, and one only a second choice of *sheep-corn husbandry*. The greatest problem of definition is therefore knowing where to draw the line between this and other more or less intensive mixed-farming systems. It is because there is such a continuous gradation from intensive, to semi-intensive/extensive, and ultimately to extensive mixed-farming systems that there is such limited congruence in how the three different clustering techniques define this intermediate category.

Geographically, demesnes practising *mixed-farming with sheep* were found in a wide variety of environmental, economic, and institutional contexts (Fig 2). They occur in the extreme north of the country, as at Holy Island off the Northumberland coast, and in the extreme south, as at Alciston and Bosham on the Sussex coast.⁷⁵ They show up in areas of fertile soil, such as Ormesby in the Broadland district of east Norfolk and a group of Ramsey Abbey demesnes in Huntingdonshire, and on thinner and lighter soils of far lower potential productivity, as at Felbrigg and Rougham in north Norfolk and Downton in south Wiltshire. The great majority are in the more developed and commercialized parts of the south and east, but outlying core demesnes also occur on the Fylde coast of

⁷³ Among core demesnes, those of the bishopric of Winchester at Hambledon, Hants, Witney, Oxon, and Downton, Wilts, appear to have practised three-course rotations, while the demesne at Bishopstone, Wilts, adhered to a two-course system: J Z Titow, 'Land and population on the Bishop of Winchester's estates 1209–1350', unpublished PhD thesis, University of Cambridge, 1962, pp 17–18.

⁷⁴ Campbell, 'The livestock of Chaucer's reeve'.

⁷⁵ For a case study of Alciston see *Ag Hist III*, pp 272, 273–5, 278, 281, 282.

Lancashire and on the Gloucestershire Cotswolds above Stroud. Peripheral demesnes extend this distribution north-east as far as Coldingham in Berwickshire, west into Worcestershire, and south-west into Somerset and Devon. In distribution they transcend the division between regular and irregular commonfield systems and insofar as there tends to be a common denominator it is accessibility to substantial permanent grazings. Those grazings, however, were of many types – fenland, coastal marsh, heathland, rough pasture, and, above all, the limestone pastures of downland and wold. *Mixed-farming with sheep* is therefore a national rather than regional farming type, although it was more characteristic of some regions and localities than others (Fig 2).

Mixed-farming with sheep assumed its most intensive form in Norfolk and Suffolk and immediately adjacent parts of the east midlands, for it was here that *intensive mixed-farming* comprised the predominant second-choice farming type (Fig 8). Six of the 22 demesnes with this second choice were in Norfolk, plus one each in Suffolk and Lincolnshire, two in Cambridgeshire, and seven in Huntingdonshire. They are thus complementary in distribution to *intensive mixed-farming* demesnes (Fig 6). Like the latter they were characterized by below average stocking densities and hence a stronger bias towards arable husbandry than was otherwise typical of this farming type. That bias was reinforced by a greater reliance upon horses than was normally the case. On the arable side these demesnes grew more barley than wheat and devoted a quarter of their sown acreage on average to legumes.⁷⁶ This implies relatively intensive and often quite irregular systems of cropping. Felbrigg in north-east Norfolk, for instance, is known to have operated a convertible-husbandry system whereby land was cropped for three or four years

and then left uncultivated for a corresponding period of time.⁷⁷ At Ormesby, however, in the same county – on some of the country's most fertile soils – land was cropped for six or more years in succession before being fallowed for one year only.⁷⁸ The group of Huntingdonshire demesnes belonging to Ramsey Abbey are also known to have been evolving towards more flexible and intensive systems of rotation during the middle years of the fourteenth century, as was the Crowland Abbey demesne of Oakington, Cambridgeshire.⁷⁹ At a further remove, Aylesbury and Water Eaton in Buckinghamshire, Cliffe and Ickham in Kent, and Chaceley in Gloucestershire all shared intensive features (Fig 8). Classification of all 106 documented Norfolk demesnes using the national discriminant functions identifies a total of ten *mixed-farming with sheep* demesnes within the county, plus Redgrave just over the county boundary into Suffolk. Distributionally they form a relatively light scatter and mostly seem to represent less intensive versions of the *intensive mixed-farming* which, as has been shown, was the county's dominant farming system (Fig 4). Corresponding classification of the Feeding the City II demesnes likewise brings the pattern within the ten counties around London into sharper focus (Fig 3). Particularly significant here is the group of four east Kent demesnes – Barton, Bekesbourne, Chartham, and Ickham – all located in an area with a strong tradition of more intensive husbandry.⁸⁰ Much the

⁷⁷ Campbell, 'Arable productivity in medieval English agriculture'; NRO, WKC 2/130/398 × 6, WKC 2/131/398 × 6.

⁷⁸ *Ag Hist III*, p 202; PRO, SC 6/939/1–8.

⁷⁹ Raftis, *The Estates of Ramsey Abbey*, pp 184–90; *Ag Hist III*, pp 214–16; F M Page, *The Estates of Crowland Abbey: A Study in Manorial Organisation*, 1934, p 119; J R Ravensdale, *Liable to Floods: Village Landscape on the Edge of the Fens AD 450–1850*, 1974, pp 115–20. For developments at Wistow, Hunts, see Hogan, 'Clays, culturae and the cultivator's wisdom'.

⁸⁰ *A Medieval Capital*, pp 131, 140–1; *Ag Hist III*, p 271, 272, 275–8, 282, 283.

⁷⁶ *Ag Hist III*, pp 214–16.

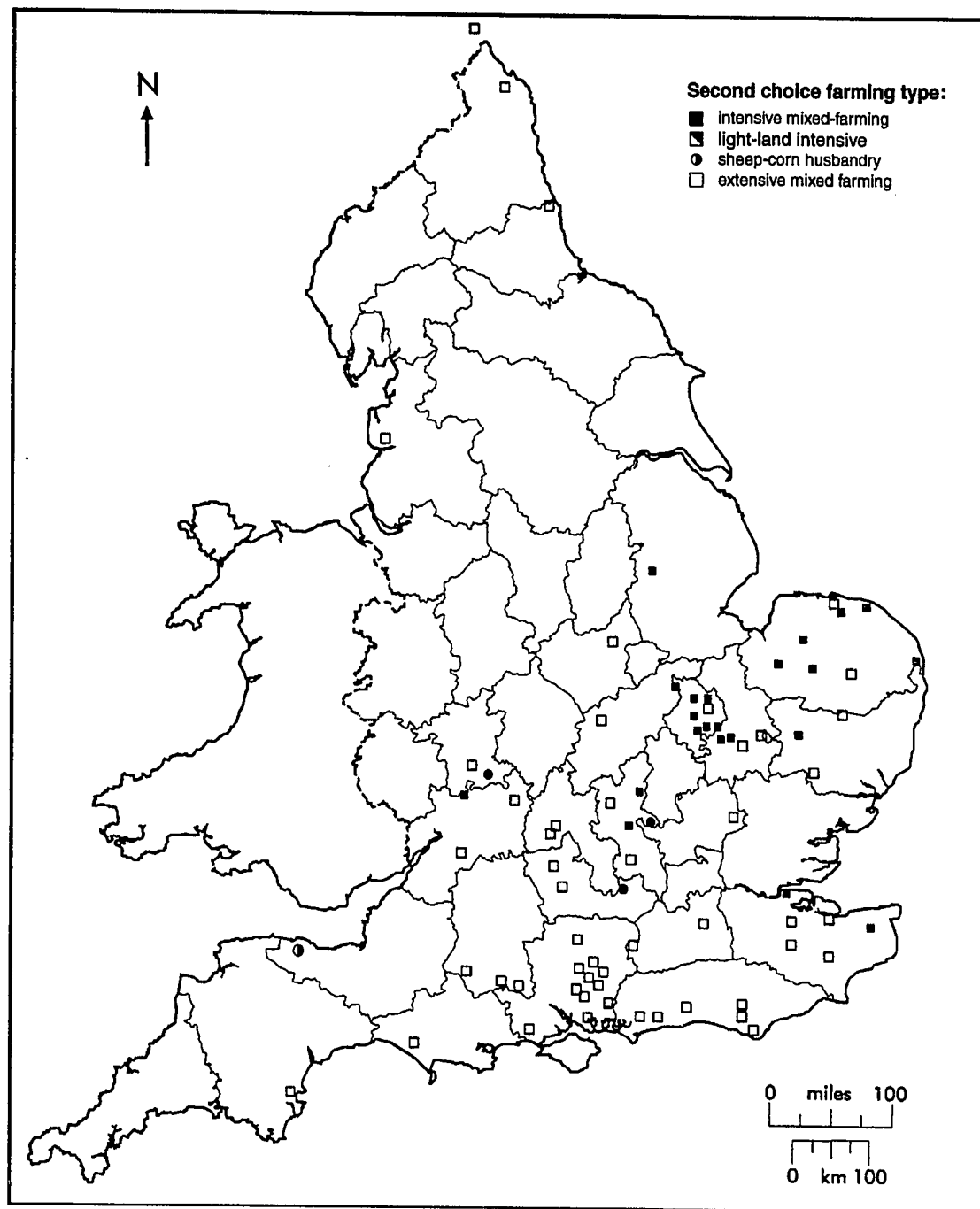


FIGURE 8

Mixed-farming with sheep demesnes, 1350-1449 (core and peripheral demesnes indicating second choice).

same applies to Eye and Maidwell in Northamptonshire.⁸¹

The majority of *mixed-farming with sheep* demesnes were, however, more extensive in their traits and closer in character to *extensive mixed-farming* (Fig 8). These demesnes stocked more animals and cropped fewer acres and hence supported stocking densities which were well above the national average. Oxen remained the fundamental source of most draught power and cattle herds appear to have been geared primarily to the breeding of replacement work animals. On the arable side these demesnes grew more wheat and oats and less barley and legumes and hence probably employed less intensive types of rotation.⁸² Demesnes of this type are particularly well represented in the south midlands and in southern England, with a string of examples extending along the chalkland belt from East Sussex through Hampshire into southern Wiltshire and beyond into Dorset and Devon. A scatter of examples even appears in East Anglia.⁸³ The Norfolk sample adds two further examples within this most intensively cultivated of counties (Fig 4) while the Feeding the City II sample confirms that a loose string of demesnes of this type followed the North Downs in Surrey and Kent (Fig 3). The same sample also yields further examples of *mixed-farming with sheep* in the wold and vale country north and west of the Chilterns.

Cluster Four: 'arable husbandry with swine'

This is another minority farming type, represented in the national sample by a comparatively small number of demesnes (Table 2). Normix identifies only ten demesnes of this type, K-means 21, and Ward's 23. A core of only 10 demesnes is

therefore common to all three cluster solutions to which only two further peripheral demesnes are added on the basis of the discriminant functions (Table 3). What sets these demesnes apart and justifies a separate farming classification are their absolutely low stocking densities, borne of the small numbers of animals kept, the predominance of working animals within the pastoral sector (with horses and oxen of almost equal importance), the dominance of the limited number of non-working animals by swine, and the devotion of a substantial proportion of the sown acreage to legumes (an important source of fodder for both horses and hogs).⁸⁴ This is also the farming system in which, on average, oats occupied their smallest, and dredge its largest, share of the sown acreage (the latter being very much a direct substitute for the former).

In the smallness of their livestock sector and consequent lowness of their stocking densities demesnes practising *arable husbandry with swine* bore their closest resemblance to the *extensive arable husbandry* of Cluster Seven; indeed, for six of the twelve the latter is their second-choice farming classification (Fig 9). But four demesnes displayed a stronger affinity with the *sheep-corn husbandry* of Cluster Five (the four which carried most sheep), and two had as their second choice the *mixed-farming with sheep* of Cluster Three. Significantly, these last six demesnes were those which grew legumes on the largest scale. Hardwicke (Gloucestershire) and Angmering (Sussex), for instance, devoted over a third of their sown acreage to this crop and it can be no coincidence that on both demesnes swine accounted for a greater proportion of livestock units than on any others in this cluster group.⁸⁵

Distributionally, this is the most dis-

⁸¹ The other isolated east midland demesnes of this type are Shillington (Bedfordshire) and Horsenden (Buckinghamshire).

⁸² *Ag Hist III*, pp 286-7.

⁸³ Langham and Wymondham (Norfolk), Acton and Redgrave (Suffolk), Burwell and Ditton Valence (Cambridgeshire), and Much Wymondley (Hertfordshire).

⁸⁴ On the use of legumes as fodder for horses and/or hogs see note 17 above; Biddick, *The Other Economy*, pp 122-3, 132, 202; *Ag Hist III*, pp 191, 270.

⁸⁵ See *Ag Hist III*, p 387, for the droving of swine from Hardwicke to Islip, Denham, and Westminster Abbey's kitchens.

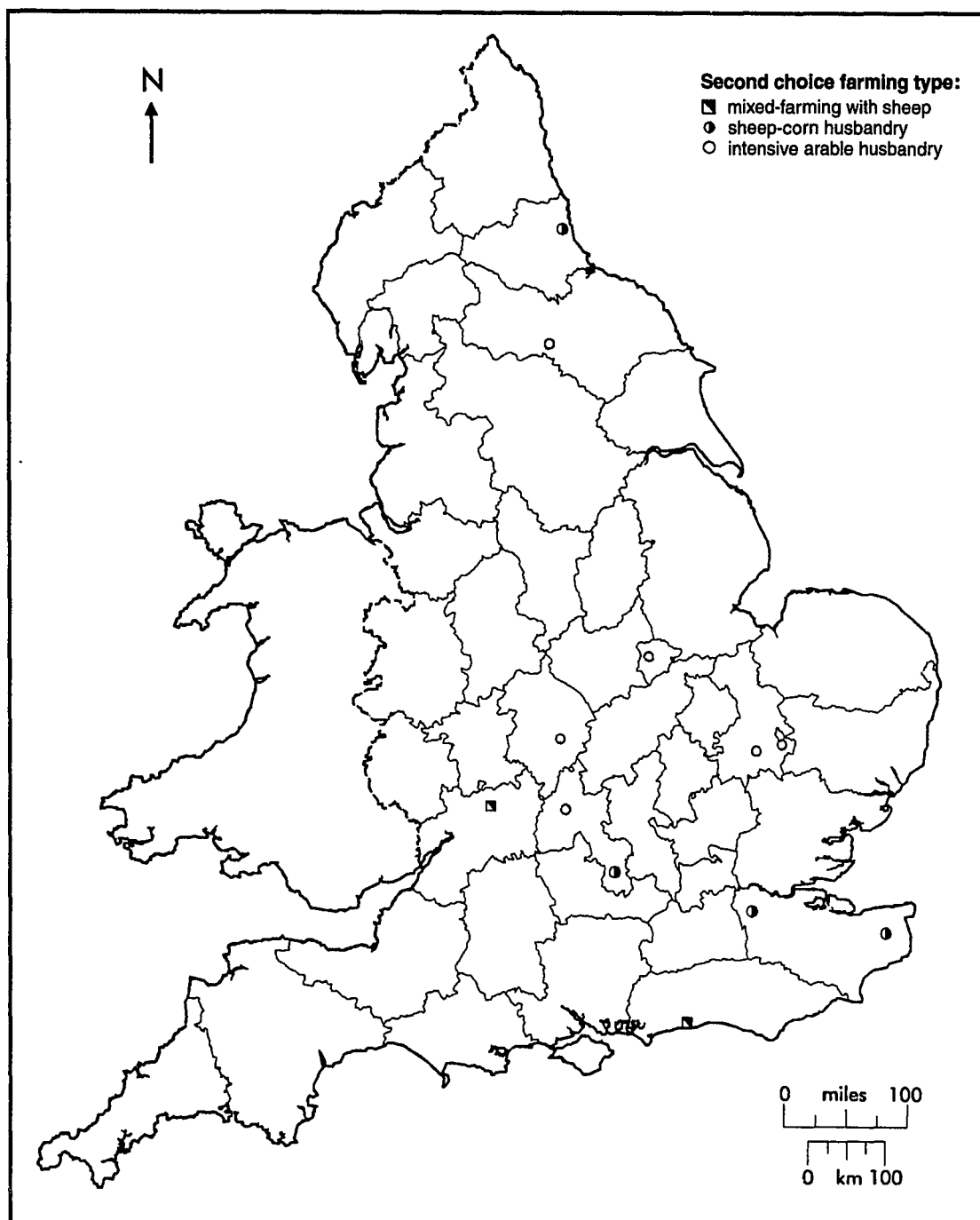


FIGURE 9

Arable husbandry with swine demesnes, 1350-1449 (core and peripheral demesnes indicating second choice).

persed of the seven farming types. The ten core and two peripheral demesnes are widely separate in space with the result that in no single locality was this the predominant farming type (Figs 2 and 9). The much fuller sample of demesnes for Norfolk and the ten-county area around London corroborate this conclusion (Figs 4 and 3), the former furnishing two and the latter eight examples.⁸⁶ It is possible that in some of these instances *arable husbandry with swine* represented a residual, and therefore somewhat artificial, farming system on demesnes which had opted to let their dairy herds at farm. But there were others – Potter Heigham and Hoveton in Norfolk are good examples – where it undoubtedly constituted a genuine specialism.

Swine were the only animal reared exclusively for their meat.⁸⁷ Permanent households with large numbers of mouths to feed consumed pork and bacon in significant quantities.⁸⁸ At Potter Heigham and Hoveton, both home farms of the Benedictine abbey of St Benet at Holme some three miles away, swine were stocked in large numbers and sty fed on the legumes grown on a correspondingly large scale.⁸⁹ Monkwearmouth (Durham), Oakham (Rutland), and Exning (Suffolk) probably similarly functioned as home farms to resident households, rearing pork for the table.⁹⁰ Sty-feeding swine in this way was a comparatively intensive activity, but swine could also be reared extensively on woodland pannage.⁹¹ The latter is probably

the method by which swine were fed at Monks Risborough, on the edge of Chiltern woodlands, and at West Tanfield in the North Riding of Yorkshire. More than any other farming type *arable husbandry with swine* is therefore to be explained by a combination of local and institutional factors.

Cluster Five: 'sheep-corn husbandry'

This is one of the most clearly differentiated of all the farming systems with the result that there is a remarkably close congruence in the result obtained from each of the three clustering techniques. The 45 core demesnes make this the largest of any of the core groups, but to these only a further 11 peripheral demesnes are added with the result that *mixed-farming with sheep* and *extensive mixed-farming* eventually emerge as more common farming types (Tables 2 and 3). The single most striking feature of this farming system is the exceptionally high proportion of livestock units – on average well over half – accounted for by sheep. Sheep, in fact, were kept to the virtual exclusion of other nonworking animals with the result that demesnes must have relied upon market purchase or inter-manorial transfer to obtain replacement draught animals, which in the majority of cases were predominantly oxen.⁹² The combination of sheep and oxen immediately identifies the pastoral component of this farming system as grass-based and essentially extensive and implies a heavy reliance upon permanent pasture. Since demesnes were themselves very unequally endowed with several and communal pastures, stocking densities, although on average well above the national mean, were highly variable. The sheep-farming component of this husbandry system therefore tended to attain its fullest development in localities with, for whatever reason, a high

⁸⁶ Bray (Berkshire), Monks Risborough (Buckinghamshire), Writtle Rectory (Essex), Ashwell (Hertfordshire), Adisham, Copton, and Eastry (Kent), and South Stoke (Oxfordshire).

⁸⁷ Campbell, 'Measuring the commercialisation of seigneurial agriculture', pp 164, 168.

⁸⁸ Biddick, *The Other Economy*, pp 37–40, 121; Dyer, *Standards of Living*, pp 59–60.

⁸⁹ NRO, Diocesan Est/11; Church Commissioners 101426 7/13, 2/13, 11/13.

⁹⁰ *Ag Hist III*, p 213.

⁹¹ Biddick, *The Other Economy*, p 45; *Ag Hist III*, pp 190, 243, 267, 417–18; D L Farmer, 'Woodland and pasture sales on the Winchester manors in the thirteenth century: disposing of a surplus or producing for the market?', in Britnell and Campbell, *A Commercialising Economy*, pp 105–7, 112–13.

⁹² *Ag Hist III*, p 298.

ratio of grassland to arable. As was consistent with a forage- rather than fodder-based pastoral sector, legumes – a key fodder crop – were grown on only a modest scale. True, oats, an alternative fodder crop, occupied a significant share of the sown acreage, but since these were only occasionally fed to sheep, and horses (which consumed them in greater quantity) were stocked in only modest numbers, it is probable that most of the oats harvest was destined for human consumption. In other respects there was little that was particularly distinctive about the cropping regime of these demesnes, which approximated remarkably closely to the national average (Table 2).

Not surprisingly, *sheep-corn husbandry* bore much in common with *mixed-farming with sheep* and in 22 cases this was the second-choice farming type (Fig 10). These were the demesnes with the smallest proportions of non-working animals, greatest proportions of sheep, and highest stocking densities. Eleven further demesnes had *extensive mixed-farming* as their second choice. These supported far lower stocking densities, carried smaller flocks, kept modest cattle herds, and made the greatest relative use of horses. They also grew the least barley and legumes and most oats. Fourteen others bore their closest resemblance to *arable husbandry with swine*. These were the only demesnes on which swine were of any significance and were also those which grew legumes on the largest and oats on the smallest scale. Other second choices were *extensive arable husbandry* (six demesnes), *light-land intensive farming* (two demesnes), and *intensive mixed-farming* (one demesne). This wide diversity of second choices, wider than that of any other farming system, testifies both to the variety of cropping regimes with which *sheep-corn husbandry* was associated (it is this that the regional distribution of second choices largely reflects – Fig 10) and the range of stocking densities by which *sheep-corn* demesnes were characterized. What

endowed this farming system with the unity that enabled it to transcend this diversity were two overwhelming common denominators, namely retention of the ox as the predominant working animal and the domination of non-working animals by sheep.

Sheep-corn husbandry was already well established as a farming system before 1350, at which time stocking densities on sheep-corn demesnes were mostly lower and the emphasis upon sheep less overwhelming. After 1349 there was a real increase in both the sheep-farming component of this husbandry system and the number of sheep-corn demesnes (Figs 1 and 2). Geographically, it remained one of the more far-flung farming types, with core demesnes occurring in such widely separate locations as the East and West Ridings of Yorkshire, the Welsh border, the Sandlings of East Suffolk, east Kent, the Isle of Wight, and Somerset (Fig 2). But as *sheep-corn husbandry* became more common so it began to become the characteristic demesne-farming system of certain localities. This was most conspicuously the case in the downland and woodland country of southern England, especially in Hampshire and Wiltshire and adjoining portions of neighbouring counties.⁹³ Twelve of the 27 sampled Hampshire demesnes (many of them properties of the bishops of Winchester on which, as Martin Stephenson has shown, sheep numbers more than doubled between the beginning and end of the fourteenth century) practised some form of *sheep-corn husbandry*, as did five of the ten sampled Wiltshire demesnes, and four of the five sampled Dorset demesnes.⁹⁴ Moreover, the majority of the

⁹³ R. Scott, 'Medieval agriculture', in R. B. Pugh, ed., *Victoria History of the County of Wiltshire, IV*, 1959, pp. 19–21; J. N. Hare, 'Change and continuity in Wiltshire agriculture in the later Middle Ages', in W. Minchinton, ed., *Agricultural Improvement: Medieval and Modern*, Exeter Papers in Economic History, 14, 1981, pp. 4–9; *Ag Hist* III, pp. 144, 292–8.

⁹⁴ M. J. Stephenson, 'Wool yields in the medieval economy', *Econ Hist Rev*, 2nd series, XLI, 1988, pp. 368–91.

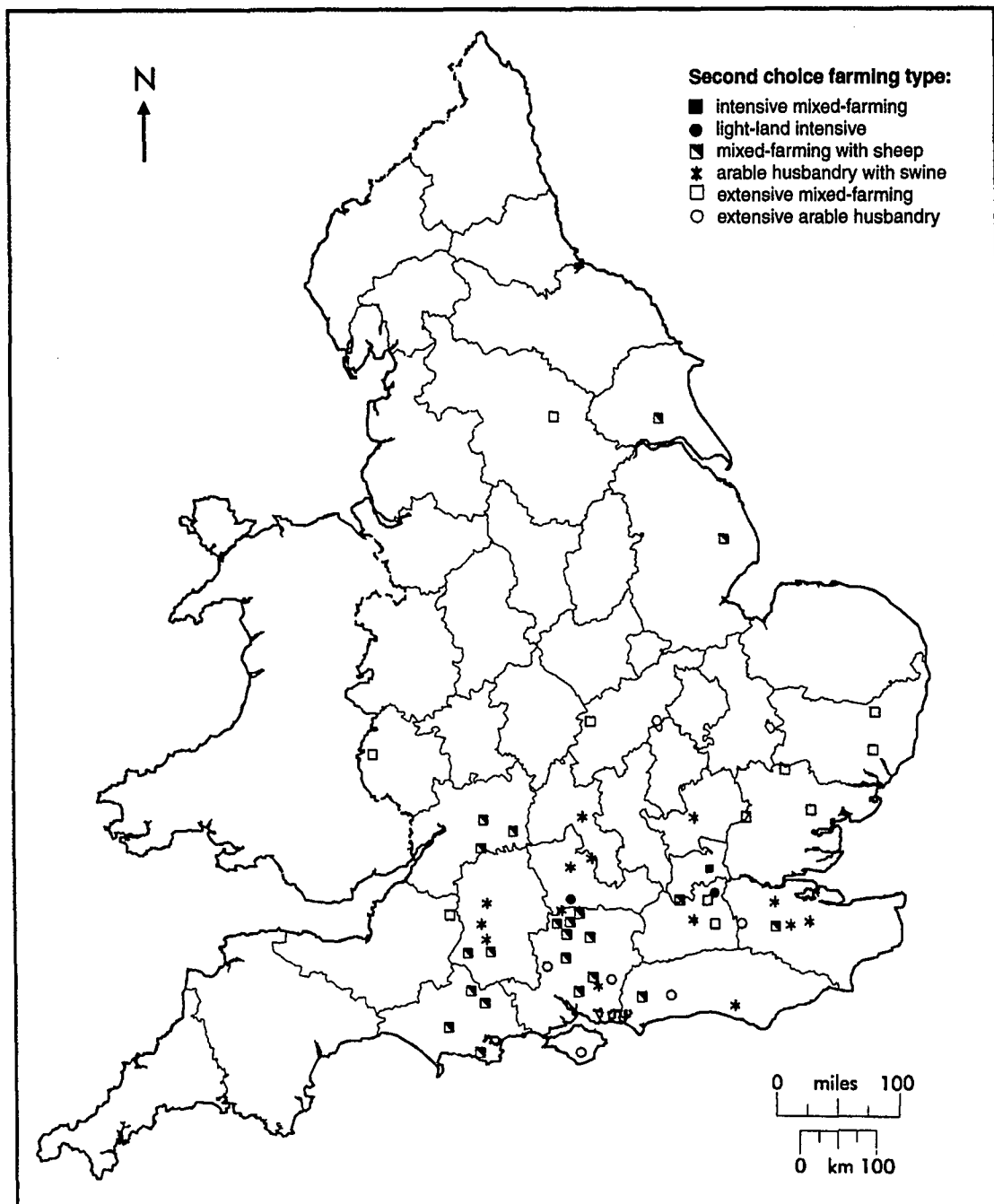


FIGURE 10

Sheep-corn husbandry demesnes, 1350-1449 (core and peripheral demesnes indicating second choice).

remaining sampled demesnes in these three counties practised *mixed-farming with sheep* (Fig 2). Other localities where *sheep-corn husbandry* was firmly established are the Gloucestershire Cotswolds and Sussex Downs.⁹⁵

Sheep-corn husbandry is also well represented among the Feeding the City II sample of demesnes, with no less than 29 examples (Table 5 and Fig 3). Thus, several demesnes in the Hertfordshire Chilterns appear to have developed this specialism, as did a group of demesnes in the Vale of the White Horse in north-west Berkshire and a scatter of demesnes on or accessible to the North Downs of Kent and Surrey.⁹⁶ In contrast, at Langenhoe and Southchurch (Essex) and Sharpness and Ham (Kent) *sheep-corn husbandry* appears to have been a response to the pastoral potential provided by extensive areas of coastal marsh. Most notable of all, however, is the concentration of sheep-corn demesnes near London; at Eltham a few miles to the south-west in Kent, at Wandsworth just across the Thames in northern Surrey, at Hyde immediately west of the city in Middlesex, and at a string of demesnes in the Colne and Thames valleys. There are intimations of this metropolitan grouping at the beginning of the fourteenth century but by the end of that century it had evidently become much more pronounced. Whether *sheep-corn husbandry* developed here as a response to the capital's demand for wool, for mutton, or for the grain produced from fields dunged by the flocks nevertheless awaits investigation.⁹⁷

Although an intrinsically extensive system of farming most typical of areas of comparatively low economic rent, the

presence of so many sheep-corn demesnes so close to London does demonstrate that it could and did develop in areas of strong commercial demand. Yet with certain exceptions the immediate hinterland of the capital had never been noted for the intensity and productivity of its demesne agriculture, mainly because of the unrewarding character of the soils with which, for the most part, cultivators had to contend.⁹⁸ Instead, it was at some distance from the city that medieval agriculture attained its greatest intensity, in north-eastern Kent, and above all in Norfolk and adjacent portions of the east midlands. At the end of the fourteenth century it was here that the most intensive farming systems were still to be found with the result that *sheep-corn husbandry* was conspicuous by its virtual absence. There is not a single core or peripheral sheep-corn demesne in Norfolk, Cambridgeshire, Huntingdonshire, or the Soke of Peterborough, and only two in Suffolk (Figs 2 and 10). Putting Norfolk under the microscope using the entire available sample of 106 documented demesnes identifies just five that practised *sheep-corn husbandry* (Fig 4).⁹⁹ Each was widely separate from the others and appears to have developed its sheep-corn regime in response to essentially local circumstances that were either or both environmental (the availability of fenland, marshland, or heathland pastures) and institutional (seignorial rights of foldcourse over the fallow arable and associated permanent pastures).¹⁰⁰ Rather than adopt *sheep-corn husbandry per se*, Norfolk demesnes tended to develop their sheep farming within the context provided by either *mixed-farming with sheep* (12 demesnes) or *light-land intensive farming* (20 demesnes). Apart from

⁹⁵ *Ag Hist III*, pp 264–5.

⁹⁶ *Ibid.*

⁹⁷ In the Dutch province of Drenthe, for instance, an expansion in arable production after 1650 was associated with declining numbers of cattle and rising numbers of sheep kept primarily for manuring: J Bieleman, 'Changing manuring techniques in open field farming in the Dutch province of Drenthe 1650–1850', in *I Jornadas Internacionales sobre Tecnología Agraria Tradicional*, Museo Nacional del Pueblo Español, Madrid, 1992, pp 251–6.

⁹⁸ *A Medieval Capital*, pp 138–40.

⁹⁹ Barton Bendish, Blickling, Burgh in Flegg, Burston, and Holkham.

¹⁰⁰ Campbell, 'Regional uniqueness'; Bailey, 'Sand into gold'; *Ag Hist III*, p 200; Campbell and Overton, 'A new perspective', pp 77–80; W Hassall and J Beuoy, eds, *Lordship and Landscape in Norfolk 1250–1350: The Early Records of Holkham*, 1993, pp 35–7, 52.

anything else the early replacement of the ox by the horse on the light soils of the county eliminated one of the most fundamental components of classic *sheep-corn husbandry*, which shows up better as the second-choice rather than first-choice farming type of a string of sheep-dominated mixed-farming demesnes on the light soils of the west of the county.

Cluster Six: 'extensive mixed-farming'

This is at once effectively the least well defined and most widely distributed farming type. Each of the three cluster techniques defines it differently, with the result that although K-means allocates 48 demesnes to this group, Ward's 71, and Normix 92, only 33 demesnes are common between them (Table 2). This core group is more than doubled in size by the addition of no less than 45 peripheral demesnes, thereby making *extensive mixed-farming* the single most common farming type (Table 3). The problem of definition derives in the main from the difficulty of distinguishing *extensive mixed-farming* from the other mixed-farming systems, particularly the *intensive mixed-farming* of Cluster One and *mixed-farming with sheep* of Cluster Three. This is highlighted by the fact that one or other of these alternative mixed-farming systems is the second-choice classification of all but three of these 78 demesnes (Fig 11). Moreover, the three exceptions are all peripheral demesnes (*sheep-corn husbandry* is the second choice of two, *extensive arable husbandry* the second choice of one). Numerically the pattern of second choices implies that *extensive mixed-farming* demesnes had most in common with *mixed-farming with sheep* but also a good deal in common with *intensive mixed-farming*. For this reason they show up in areas of both relatively intensive and extensive agriculture, in some of the economically most developed and economically most remote parts of the country, with the

result that *extensive mixed-farming* is the most truly 'national' of all the farming systems (Figs 2 and 11). Nevertheless, as the pattern of second choices makes plain, it was a national system with important regional variations.

Overall, the core demesnes most diagnostic of this farming type were characterized by higher than average stocking densities, significantly above those of *intensive mixed-farming* demesnes but below those of *mixed-farming with sheep* demesnes (Table 2). Working animals tended to comprise a higher proportion of livestock units than in either of these other two systems, with oxen mostly of far greater importance than horses (although this was subject to quite wide variation). Among non-working animals it was cattle that predominated, and demesnes of this type generally carried quite well developed cattle herds which served the dual functions of dairying and rearing replacement oxen. Sheep were often kept but very much took second place to cattle. On the arable front these demesnes were characterized by a more equal balance between the winter- and spring-sown grains than in any other farming system. Moreover, this was the system in which wheat and oats both respectively assumed their greatest relative importance. By comparison, rye, barley, and the various winter and spring mixtures were of little significance. Legumes, too, occupied a smaller than average share of the sown acreage. Such a combination of crops is strongly suggestive of a three-course system of rotation of a fairly unimproved and un-intensive nature.¹⁰¹ It is also consistent with the cultivation of medium to heavy

¹⁰¹ In Essex and Suffolk, for instance (the location of ten of the core demesnes), 'arable was usually fallowed one year in three in preparation for a winter-sown crop, to be followed the next year by a spring-sown crop': *Ag Hist III*, p 195. Three-course cropping also prevailed on the core demesne at Rimpton, Somerset: C C Thornton, 'The determinants of land productivity on the Bishop of Winchester's demesne of Rimpton, 1208 to 1403', in Campbell and Overton, *Land, Labour and Livestock*, pp 183-210. At Broadway, Worcs, however, two-course cropping appears to have been the norm: Gray, *English Field Systems*, p 503.

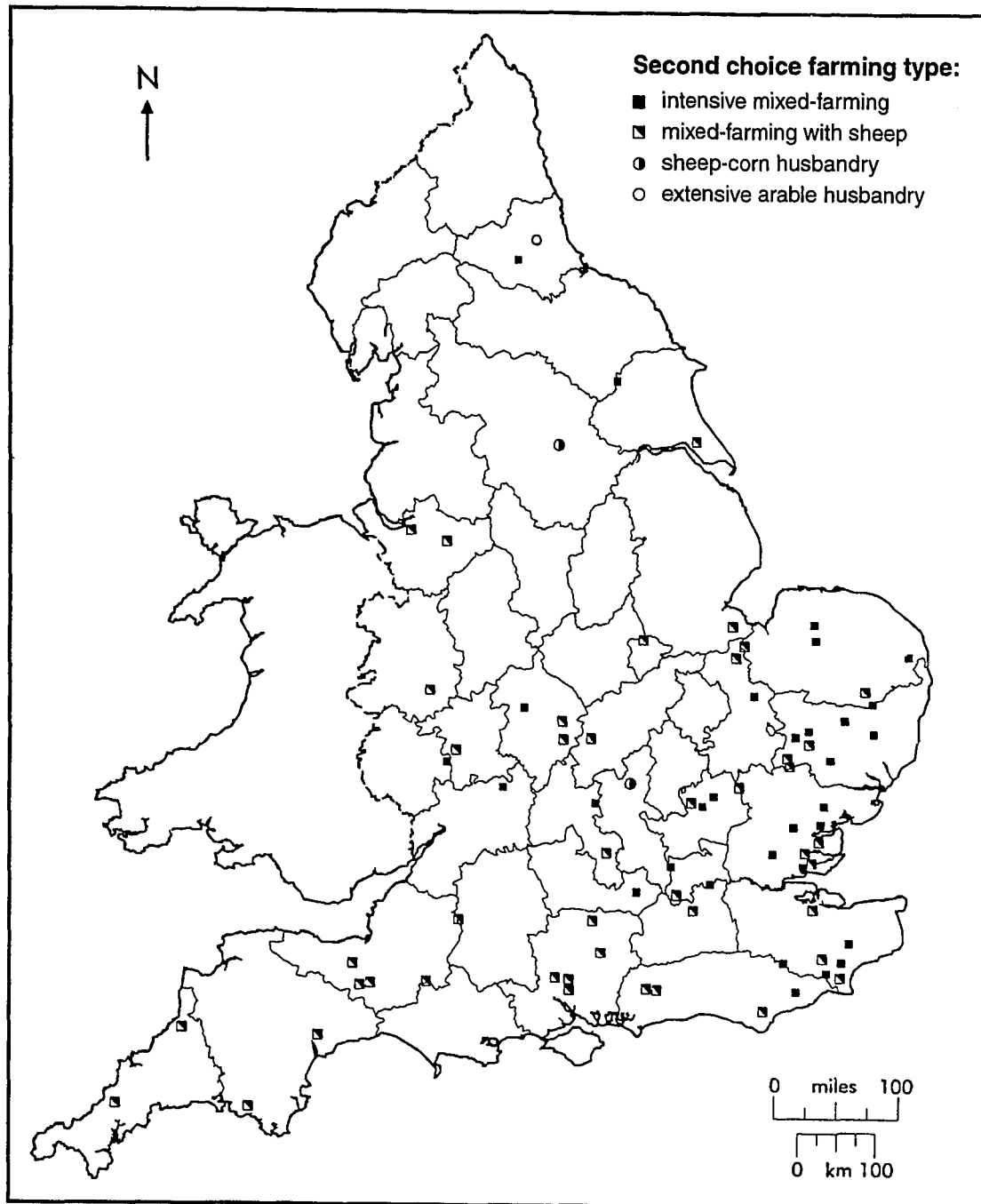


FIGURE II

Extensive mixed-farming demesnes, 1350-1449 (core and peripheral demesnes indicating second choice).

soils, an impression reinforced by the strong pastoral emphasis upon cattle.¹⁰² In many of these respects there is a strong affinity between this farming system and the *mixed-farming with cattle* of the pre-Black Death period whose association with the heavier lowland soils of counties such as Essex and Warwickshire was especially marked (Fig 1).¹⁰³

The arable component of *extensive mixed-farming* was in a very real sense its most consistent feature. Both the core and the peripheral demesnes, those whose second choice was *intensive mixed-farming* and those for which it was *mixed-farming with sheep*, sowed the same basic combination of crops. On all of them wheat and oats were the two leading crops, all maintained a fairly equal balance between the winter and spring grains, and none differed greatly in the share of the cropped acreage devoted to legumes. Those demesnes which departed furthest from this general pattern of cropping were those peripheral demesnes which most resembled *intensive mixed-farming*. The latter are the demesnes with the strongest bias towards spring grains and which grew legumes on the largest scale. Nevertheless, the winter grains still occupied at least a third of the sown acreage and legumes only an eighth. Differences of cropping regime between *extensive mixed-farming* demesnes were therefore remarkably slight. Of far greater moment were the differences which existed in the pastoral component of husbandry.

Extensive mixed-farming demesnes varied first and foremost in the relative size of their arable and pastoral sectors as measured by the ratio of livestock units to cropped

acres. Stocking densities were lowest of all, and the bias towards arable husbandry consequently greatest, on those peripheral demesnes with the closest resemblance to *intensive mixed-farming*. Conversely, they were highest on those peripheral demesnes whose closest affinity was with *mixed-farming with sheep*. On the former group of demesnes stocking densities were generally well below the national average, on the latter they were well above. Somewhat paradoxically, working animals – horses and oxen – accounted for a smaller share of total livestock units on demesnes with a second choice of *intensive mixed-farming* than on those with a second choice of *mixed-farming with sheep*, the reason being that horses made their greatest relative contribution to draught power on the former. The more intensive demesnes were also those with the most developed cattle herds, as manifest in a demographic structure strongly biased towards mature females and a far greater relative importance attached to cattle than other categories of animal. Where pastoral husbandry was more extensive, for instance, the specialist interest in cattle-based dairying was less developed and sheep comprised a larger share of livestock units. Even so, it was these more extensive forms of pastoral regime which were associated with the greatest numbers of livestock units.

The core demesnes whose traits most embody this husbandry system are geographically to be found in some of both the most and least economically developed parts of the country (Fig 2). Two-thirds were located in the counties of the south and east of England, with particularly notable concentrations in Essex (seven examples) and southern Kent/East Sussex (six examples). This south-eastern distribution of *extensive mixed-farming* demesnes is consistent with the distribution of demesnes practising *mixed-farming with cattle* in the period 1250–1349 and implies considerable continuity of farming system on

¹⁰² At Marley, Sussex, on heavy clay, cattle farming was Battle Abbey's prime concern, underpinned, apparently, by a system of convertible husbandry: E Searle, *Lordship and Community: Battle Abbey and its Banlieu, 1066–1538*, Toronto, 1974, pp 272–303. Pastoral farming also loomed large on the Romney Marsh manors of Appledore, Ebony, and Ruckinge, Kent, where oats were typically sown on reclaimed marshland: *Ag Hist III*, p 131; R A L Smith, *Canterbury Cathedral Priory: A Study in Monastic Administration*, 1943, pp 181–3, 188.

¹⁰³ Power and Campbell, 'Cluster analysis', pp 236–7, 24C–1.

many demesnes in this area (Fig 1).¹⁰⁴ Similar continuity appears to have prevailed in parts of the west midlands, for here too a loose concentration of *extensive mixed-farming* demesnes is present in an area where *mixed-farming with cattle* had been well represented in the earlier period. The spatial coverage of the sample is unfortunately thinner in the period 1350–1449, but five *extensive mixed-farming* demesnes do nevertheless show up at Mathon (Herefordshire), Knowle (Warwickshire), Broadway and Leigh (Worcestershire), and Cleobury Barnes (Shropshire), the first three more intensive than extensive in character. Elsewhere, *extensive mixed-farming* shows up on a loose scatter of demesnes in southern England – all of them more extensive than intensive in character – including three in south Somerset. The only two recorded Cheshire demesnes were also both of this type, as was Howsham in the East Riding of Yorkshire. Core demesnes of this type are, however, absent from Norfolk, the east midlands, and much of south central England.

Adding the peripheral demesnes greatly extends and amplifies this picture (Fig 11). Not only are the existing concentrations in the south-east and the west midlands, reinforced, but several further examples are added both in Somerset and in the north-east.¹⁰⁵ *Extensive mixed-farming* also shows up in areas where it is otherwise unrepresented by core demesnes, most notably in Devon and Cornwall (where there are four peripheral demesnes) and Norfolk (where there are six). The combined distribution of core and peripheral demesnes reveals a spatially significant pattern of second choices (Fig 11). In southern and south-western England, for example, *extensive mixed-farming* was most closely related to *mixed-farming with sheep*. East

Anglian examples of *extensive mixed-farming* demesnes, in contrast, mostly bore a closer resemblance to *intensive mixed-farming*. Exceptions to the latter rule are mostly explicable in terms of local circumstances. Wisbech, Gedney and West Walton in the East Anglian Fens, for instance, all have the more extensive *mixed-farming with sheep* as their second choice, a reflection, no doubt, of the opportunities for extensive pastoral husbandry offered by the abundance of marshland grazing which each enjoyed. A superabundance of pasture may explain why similarly extensive versions of *extensive mixed-farming* also prevailed at Burstwick in Holderness, adjacent to the Humberside marshes, at Eastwood, Lawling, and Milton in Essex, with access to coastal marshes, and at Appledore and Barksore in Kent, both strategically placed to take advantage of the lush alluvial grazings available in Romney Marsh.

Analysis of the Feeding the City II sample of demesnes brings the distribution of *extensive mixed-farming* demesnes within the south-east into sharper focus (Fig 3). Although represented in greater numbers than demesnes of any other farming type, the 37 examples of *extensive mixed-farming* – 30 per cent of the total – are geographically highly specific in their distribution. No less than 22 are concentrated in Essex (plus Sawbridgeworth just across the county boundary into Hertfordshire) and six in Kent. In Essex *extensive mixed-farming*, generally in its more intensive form, was plainly the dominant farming type, practised by three out of four documented demesnes. Examples occur throughout most parts of the county and are particularly well represented on the heavy boulder clay soils which dominate so much of its centre.¹⁰⁶ Here, if further proof were

¹⁰⁴ Power and Campbell, 'Cluster analysis', pp 236–7, 240–1; *Ag Hist III*, pp 195–6, 206–7, 282–3.

¹⁰⁵ Elvethall and Witton (Durham), Burstwick and Methley (East and West Ridings of Yorkshire).

¹⁰⁶ R. H. Britnell, 'Agriculture in a region of ancient enclosure, 1185–1500', *Nottingham Medieval Studies*, XXVII, 1983, pp 37–55. For a case study of one Essex manor see, R. H. Britnell, 'Agricultural technology and the margin of cultivation in the fourteenth century', *Econ Hist Rev*, 2nd series, XXX, 1977, pp 53–66.

wanted, is clear evidence of a direct association between *extensive mixed-farming* and heavy clay soils. It is this same association which accounts for the distribution of this farming type in Kent, where it is exclusively confined to the wealden clays of the southern half of the county and the immediate environs of Romney Marsh. Elsewhere, apart from three examples in the Colne valley, *extensive mixed-farming* is not a particularly common farming type.¹⁰⁷ Nor is it well represented in Norfolk, where the application of discriminant functions identifies only 13 of the 106 documented demesnes as belonging to this farming type (Fig 4). These demesnes are more scattered than concentrated in distribution but do display a general bias towards localities of heavier soil or extensive alluvial grazings which coincidentally also tended to be those localities where oxen remained of significance longest.¹⁰⁸

Cluster Seven: 'extensive arable farming'

By the end of the fourteenth century pastoral farming had grown in importance on most demesnes with the result that there were relatively few on which arable husbandry remained the almost exclusive focus of attention. Whereas before 1350 one in five of all sampled demesnes carried virtually no livestock other than essential working animals, after 1349 the equivalent proportion is only one in ten.¹⁰⁹ These are the most 'arable' of all demesnes and, as a farming type, are immediately recognizable. No other group of demesnes is more consistently identified by all three clustering methods. Ward's, K-means, and Normix all identify a common core of 27 demesnes, which only in the case of

Normix is enlarged by the inclusion of two others. The net result is a group of 28 demesnes with a core membership of 27 and a peripheral membership of one (Tables 2 and 3). This group is defined less by the combination of crops which it grew – which differed in no significant respect from the mean pattern prevailing in the country as a whole – than by the scale and composition of its pastoral sector. The latter was small and composed almost exclusively of working animals – horses and oxen (with, on average, twice as many of the latter as the former). Stocking densities, consequently, were the lowest of any farming type. Arable production may have been everything but with such a deficiency of livestock high levels of productivity were unattainable. Production was perforce extensive.

One reason why patterns of cropping on *extensive arable husbandry* demesnes approximated so closely to the national average is that like *sheep-corn* demesnes (the other farming type of which this is true) they occurred in a wide variety of farming contexts. The 28 demesnes in question were scattered through 17 different counties ranging from Durham in the north to Hampshire in the south, from Norfolk in the east to Somerset in the west (Figs 2 and 12). As with *arable husbandry with swine* the explanation for this wide dispersal lies partly with institutional factors.

Rather than manage their flocks and herds directly some landlords chose to lease them out and keep only their arable land in hand. Others organized their sheep flocks on an intermanorial basis and accounted for them separately. The result in both cases is that some or all of the non-working animals disappear from the manorial accounts. Twelve of Norfolk's 106 documented demesnes fall into the *extensive arable husbandry* category and most probably do so for this reason (Fig 4). So conspicuously different from other demesnes are they in this otherwise intensively farmed

¹⁰⁷ Denham and Iwer (Buckinghamshire) and Yeoveney (Middlesex).

¹⁰⁸ Especially Thorpe Abbots, Tivetshall, Topcroft, and Rickinghall (Suffolk) on the heavy soils of south-east Norfolk and north Suffolk, Kempstone and Mileham on the boulder-clay soils of mid-Norfolk, West Walton in the Fens and Boughton on the Fen edge, and Halvergate in the Broadland marshes.

¹⁰⁹ Power and Campbell, 'Cluster analysis', p 238.

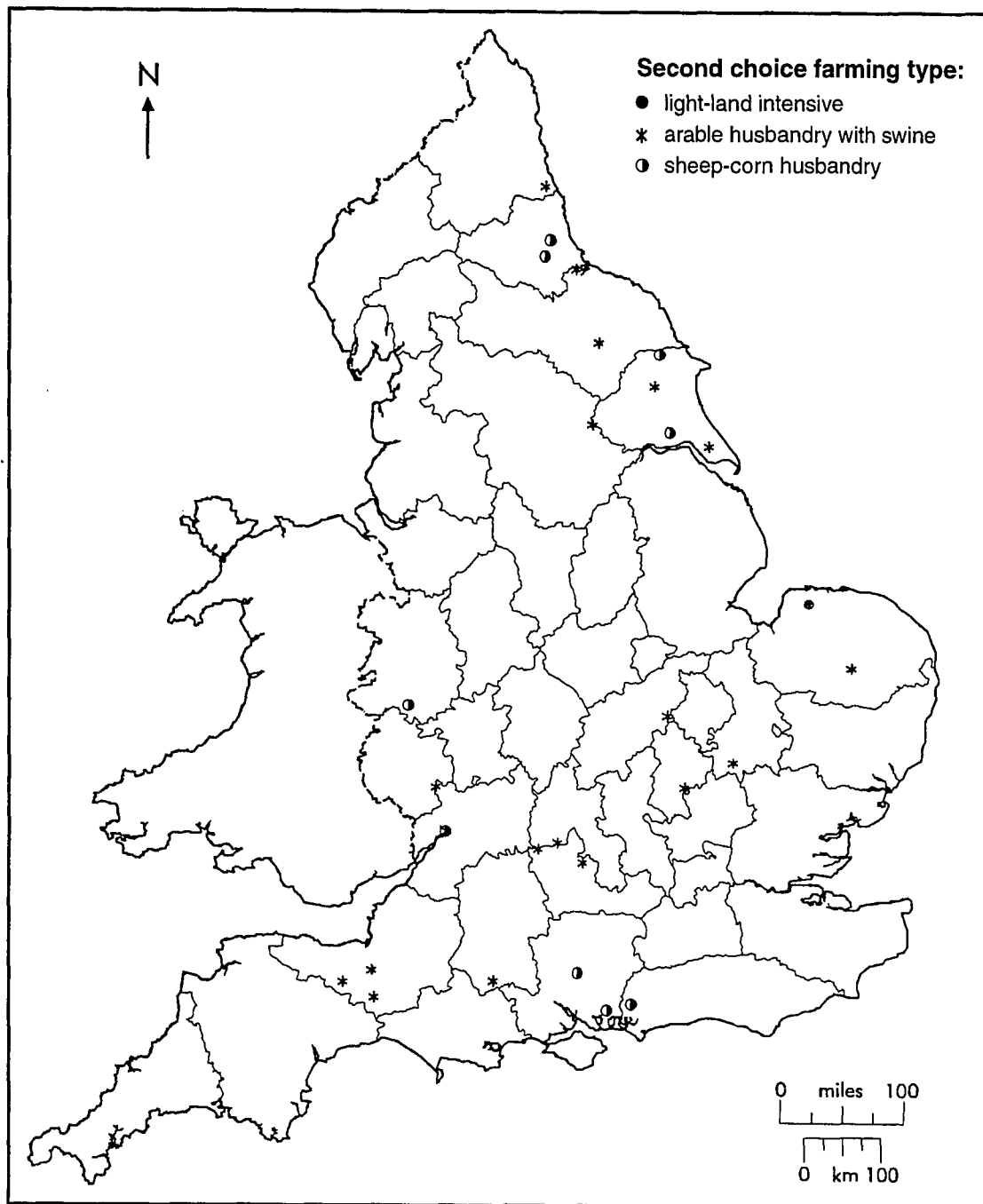


FIGURE 12

Extensive arable husbandry demesnes, 1350-1449 (core and peripheral demesnes indicating second choice).

county that they retain their distinctive identity even at a county level of analysis as the third of Norfolk's three basic farming types, the others being versions of *intensive*

mixed-farming and *light-land intensive* farming (Table 6, Fig 5). The same explanation probably applies to the six examples of this farming type within the Feeding the City

II sample of demesnes (Table 5, Fig 3). Nevertheless, in parts of the north-east of England *extensive arable husbandry* more probably represents a genuine economic preference.

Ten of the 28 *extensive arable-husbandry* demesnes are located in Durham and Yorkshire where they comprise just over half of all sampled demesnes (Fig 12). This is a significant concentration, the more so since an equivalent concentration of *extensive arable-husbandry* demesnes is apparent in this self-same part of the country in the period 1250-1349 (Fig 1). As before, a spatial division of production appears to have prevailed with pastoral production concentrated in the main on the uplands and upland margins, often on specialist vaccaries and bercaries, and lowland demesnes, particularly on the larger estates, only carrying enough animals to satisfy the draught requirements of the arable in which branch of production they in turn specialized.¹¹⁰ This was especially the case on estates which combined properties in both locations since replacement draught animals could simply be transferred in from the reservoir of animals maintained on the stock farms. Whereas demesnes elsewhere in England were becoming more mixed, many of those in the north-east maintained their traditional specialism in one or other branch of production with the result that the swing towards pastoralism is less apparent than might otherwise have been expected of an area naturally so well endowed with pastures. *Extensive arable-husbandry* demesnes at Stanton Lacy, Shropshire and Durneford, Herefordshire may possibly reflect a similar upland/lowland separation of pastoral and arable production in the counties of the Welsh border.¹¹¹

III

Of the seven basic demesne-farming systems that have been identified in the period 1350-1449 some were more distinctive and some more homogeneous than others.¹¹² Cluster analysis has particular utility here. Not only does it provide a statistical method of classifying farming systems based upon a consistent set of variables and contain a procedure for establishing the number of farming types present (thereby ensuring that classification reflects real similarities and dissimilarities within the data), but it can also be used to establish which farming systems are most alike or unlike each other.

Extensive arable husbandry and *sheep-corn husbandry* are the two farming systems most consistently defined by all three clustering methods. Significantly, the same two farming types are equally clearly defined in the period 1250-1349. After 1349 the K-means, Normix, and Ward's methods approach virtual unanimity in their identification of *extensive arable-husbandry* demesnes. So conspicuously different is this farming type that, as independent classification of the 106 Norfolk demesnes demonstrates, it shows up at a county as well as a national level of analysis. Whereas *extensive arable husbandry* is represented within the national sample by 27 core demesnes, *sheep-corn husbandry* is represented by 45. The larger number obviously provides greater scope for differences between the outcomes obtained from the three chosen clustering methods. Even so, there is a close correspondence between all three solutions. Nor are significant numbers of peripheral demesnes added to either farming category on the basis of their discriminant scores.

Each of these two farming systems is immediately and consistently defined because the demesnes that practised them

¹¹⁰ I S W Blanchard, 'Economic change in Derbyshire in the late Middle Ages, 1272-1540', unpublished PhD thesis, University of London, 1967, pp 168-74; *Ag Hist III*, pp 189-90.

¹¹¹ Davies, *Lordship and Society*, pp 112-17; *Ag Hist III*, pp 241-4.

¹¹² This analysis does not, of course, preclude the existence of other demesne-farming types not adequately represented in the available sample of accounts.

display certain features that are markedly atypical. With *extensive arable husbandry* this is its stunted pastoral sector composed almost exclusively of working animals; in the case of *sheep-corn husbandry* it is the predominance of oxen among working, and sheep among non-working animals. By comparison, the arable profiles of these two systems are far less distinctive and actually transcend differences in cropping regime, for geographically both systems occur in a variety of arable contexts; hence the wide range of alternative farming systems with which individual sheep-corn demesnes shared strong affinities. In contrast, *light-land intensive husbandry* was characterized by one of the most distinctive and environmentally specific of all arable regimes. No other system devoted so small an acreage to wheat and legumes and so large an acreage to rye. Yet (and contrary to the situation before 1350), this is the least consistently defined of all farming systems with only a relatively small core of demesnes common to all three cluster solutions. This is partly because of a high degree of variation in the precise form of husbandry practised by each constituent demesne but also because this farming system shared a number of features in common with several other farming systems (as witnessed by the fact that the 14 *light-land intensive* demesnes display three different second choices). Nevertheless, it is sufficiently distinctive to show up at a county as well as a national level of analysis and geographically displays a general association with a particular region and a specific association with a particular type of environment. There is therefore considerable merit distinguishing it as a separate system.

The remaining farming systems, embracing 70 per cent of all sampled demesnes, fall between these two extremes of definition. Apart from *arable husbandry with swine*, whose pastoral component was comparatively small, all these systems are

mixed-farming systems of one sort or another and all display strong affinities with each other. Distinguishing between the almost seamless gradation of mixed-farming types is the main challenge to the derivation of an effective classification of farming systems in this period. In fact, a stable cluster solution based on the first six principal component scores lumps all these demesnes into a single mixed-farming category.¹¹³ This is unhelpful. Genuine, if often subtle, differences did exist in the character, intensity, and distribution of mixed-farming systems and it is the task of any effective classification system to draw meaningful distinctions between them. That is why it was found more effective in this instance to base classification upon five rather than six principal component scores. Use of five rather than six component scores focuses upon broader differences which blur when the additional detail of the sixth component is included.

A striking feature of the three main mixed-farming systems identified here – *intensive mixed-farming*, *mixed-farming with sheep*, and *extensive mixed-farming* – is that although each shared certain features in common with the others, commonalties with other farming systems are far less marked. In fact, taking all three mixed-farming systems together, only 3 per cent of the 93 core demesnes and 6 per cent of the 187 core plus peripheral demesnes have a second choice other than one of these mixed-farming systems. *Intensive mixed-farming* stands out as the most clearly and consistently defined of the three systems, with the greatest correspondence in cluster membership between the three cluster solutions. Its intensive character endowed it with several extreme features – the scale of barley cultivation, specialist dairy function of its cattle herds, and majority reliance upon horse power – which help to differentiate it from the other mixed-farming

¹¹³ Above, p. 139.

systems. *Mixed-farming with sheep*, in contrast, exhibits fewer exceptional features, constitutes a system of middling intensity, and consequently is far less easily defined. All three clustering techniques identify substantial numbers of demesnes of this type, but the core of demesnes that is common between them is smaller than for any other mixed-farming type. Nor is *extensive mixed-farming* much better defined, for all the distinctiveness of its cropping regime and the large number of demesnes that practised some version of it. Difficult though it is to draw a line between these three mixed-farming systems, the result is nonetheless well worth the effort for these are among the most coherent of farming types in geographical distribution. Of no farming system is this truer than *intensive mixed-farming*, which is more closely associated with a single specific region than any other post-1349 farming type.

Those farming systems which, like *intensive mixed-farming*, were spatially most sharply focused are those which owed most to specific environmental and economic circumstances and which embodied regionally specific forms of technology (most notably a reliance upon horses rather than oxen for draught power, which, as Langdon has observed, was a major source of regional differentiation within medieval agriculture).¹¹⁴ But farm enterprise was a function of more than environmental, economic, and technological factors. What type of landlord, what size of estate, and the position of the individual demesne within the overall estate production system were also important considerations. Institutional factors such as these all exercised a far greater influence upon the pastoral than the arable sector. As analysis of the Feeding the City II sample of accounts demonstrates, conventual, collegiate, episcopal, lay, and royal estates differed in their capacities and willingness to invest in and

maintain flocks and herds.¹¹⁵ Perpetual institutions, such as convents and colleges, clearly enjoyed an edge over episcopal and lay estates which were vulnerable to asset stripping whenever the current incumbent died. Individual estate policy also exercised a bearing upon the choice of animals stocked and whether or not these were managed directly at demesne level, centralized and accounted for separately, or leased out. Those farming systems which exhibit the strongest imprint of the operation of these kinds of institutional factors – *arable husbandry with swine* and *extensive arable husbandry* – are also those which are geographically for the most part the least specific in distribution. As pastoral farming became more important so institutional factors became of correspondingly greater significance in determining the geographical distribution of farming types.

Under these circumstances it is hardly surprising that when farming systems are viewed collectively rather than individually the picture that emerges is more heterogeneous than homogeneous (Figs 2 and 3). Few types of farm enterprise were unique to a locality or region with the result that many demesnes remote from one another had more in common than those that were neighbouring. There is a lesson here for those who would seek to define and describe farming types in exclusively regional terms. Unfortunately, the national sample of demesnes is mostly too sparse in coverage to reveal local and regional configurations of farming types in sufficiently sharp focus (Fig 2). Only the Norfolk and portions of the Feeding the City II samples of demesnes are adequate for this purpose (Figs 3 and 4). From these it is clear that individual localities were sometimes dominated by particular farming types. On the boulder-clay plateau of central Essex, for instance, few demesnes deviated from some

¹¹⁴ Langdon, *Horses, Oxen and Technological Innovation*, pp 273–6.

¹¹⁵ Campbell, 'Measuring the commercialisation of seigneurial agriculture', pp 142–7.

version of *extensive mixed-farming*, and in eastern and northern Norfolk *intensive mixed-farming* was the preferred system of most demesnes. The latter example is particularly instructive for the Norfolk evidence is exceptionally full, allowing the agricultural geography of this one county to be seen more clearly than that of any other part of the country. During the period 1350–1449 a system of intensive mixed farming crystallized here on light to medium soils which was almost unique to this county. Forty-two of the 106 documented demesnes employed this system and 20 of the remainder, mostly on the county's lightest and poorest soils, followed a light-land alternative.¹¹⁶ Reclassifying Norfolk demesne-farming systems at county level elevates these two farming types to almost complete hegemony, with three out of four demesnes practising a version of *intensive mixed-farming* and one out of five a version of *light-land intensive farming*. Nevertheless, it is the national-level classification which is the more detailed and subtle and captures most fully the range of farm enterprise within the county. It serves to bring home the intrinsically heterogeneous character of late medieval farming systems, for examples of all seven national farming types occur within this one county, often as many as four or five of them within a few miles of each other. As Mark Overton found in the same county at the end of the sixteenth century '[farming] types do not form discrete regions so there is little point in drawing boundaries'.¹¹⁷ Paradoxically, therefore, although the form of mixed farming practised on most late fourteenth-century Norfolk demesnes stands out as the only

truly regional farming type, its distribution is more accurately represented by points than lines on the map. This bears out E L Jones' observation that 'lines drawn on the topographical map ... must arbitrarily bisect interesting zones of overlap and may distract attention from them'.¹¹⁸ Certain localities and regions, in fact, were distinguished more by the variety than the uniformity of farming systems that existed within them. This was conspicuously true of the Thames valley – one of the country's key economic arteries – and of Kent, a county which presented a range of environmental and economic opportunities (Fig 3).

Norfolk and the counties surrounding London together demonstrate that whereas the more extensive systems of husbandry might be found in almost any part of the country, even, on occasion, in areas of apparently high economic rent, the more intensive systems were much more circumscribed in distribution. Norfolk exhibited the full range of national farming types because it remained relatively populous and there were strong (if albeit waning) economic incentives to maintain more specialized and intensive forms of agriculture. The same, to a degree, was true of the immediate hinterland of London (whose reduced post-plague population nevertheless probably represented a greater share of the national total and continued to constitute a major focus of demand), where a correspondingly wide range of farming types may be identified. In economically less developed and commercialized parts of the country, however, a narrower range of farming types appears to have existed since the forces promoting economic differentiation were much weaker. In particular, the most intensive systems were either rare or absent.

¹¹⁶ Most of these demesnes also employed wheeled ploughs and sowed their seed relatively thickly.

¹¹⁷ M Overton, *Agricultural Regions in Early Modern England: An Example from East Anglia*, University of Newcastle upon Tyne, Department of Geography seminar paper, XLII, 1983, p 18.

¹¹⁸ E L Jones, 'The condition of English agriculture', p 616.

Compared with the situation before 1350 there was certainly a shift in the relative importance of these seven main farming systems. Demesnes practising *light-land intensive* and *extensive arable husbandry* both became relatively less common. *Intensive mixed-farming* lost ground and *arable husbandry with swine* merely maintained its minority status. The more extensive mixed-farming systems, however, became both more numerous and more mixed (insofar as their stocking densities tended to register the greatest increases). *Sheep-corn husbandry* – a particularly extensive system – gained most of all. Nowhere was the growth of mixed farming more pronounced than in central and southern England. It was here, therefore, in the half century or so immediately following the Black Death that farming systems changed most and the greatest gains in demesne stocking densities accrued.¹¹⁹ These areas stood in the vanguard of the shift from corn to horn – as they were to do again in comparable periods of agrarian change – for the simple reason that they were best placed environmentally and economically to switch resources from arable to pastoral production.¹²⁰ Above all this meant converting arable land to pasture. Further east, and especially on the lighter soils of East Anglia, the mixed-farming systems that had developed were traditionally both more intensive and more arable based, insofar as they were underpinned by fodder cropping and temporary grazing/folding on the arable.¹²¹ Demesne producers here lacked

an equivalent comparative advantage when it came to substituting more extensive and, consequently, more grass-based mixed-farming systems. They had prospered when the demand for grain was strong and now, as in all subsequent agricultural recessions, suffered as the terms of trade shifted in favour of low-cost pastoral producers.¹²² Demesne-farming systems in the west and north were similarly slow to change.¹²³ Here methods of pastoral farming had always been relatively extensive and an inherent land-use bias towards grass meant that good arable land remained at something of a premium. There was therefore no great incentive to alter the established balance of production.

IV

By the close of the fourteenth century, therefore, the country's agricultural geography had been subtly but profoundly transformed. Underpinning this transformation was a reconfiguration of economic rent, for it was upon this that the pattern and intensity of agricultural land use depended.¹²⁴ Economic rent is a function of land quality, of population density (and therefore the demand for land), and of distance from the market, and in all three respects the later fourteenth century witnessed important changes. Changing factor and commodity prices played to the comparative advantage of some regions more than others. Population densities fell but the rate of fall was spatially uneven due undoubtedly to local and regional differen-

¹¹⁹ Campbell, 'Land, labour, livestock and productivity trends', pp 158–9.

¹²⁰ For the expansion of grass at the expense of arable after 1349 in the midlands see, *Ag Hist III*, pp 78–80; C Dyer, *Wanwickshire Farming 1349–c 1520: Preparations for Agricultural Revolution*, Dugdale Society Occasional Papers, 27, 1981, pp 9–12. For the shifting frontier between corn and horn in the seventeenth century, see Kussmaul, 'Agrarian change in seventeenth-century England'.

¹²¹ The story on the heavy clay soils of East Anglia was rather different, although it was in the fifteenth century rather than the fourteenth that their conversion to grass made greatest progress. For a case study of land-use trends in Essex over this period see L R Poos, *A Rural Society after the Black Death: Essex 1350–1525*, 1991, pp 46–51.

¹²² Cf J D Chambers and G E Mingay, *The Agricultural Revolution 1750–1880*, 1966, p 181; P J Perry, 'Where was the "Great Agricultural Depression"? A geography of agricultural bankruptcy in late Victorian England and Wales', *AHR*, 20, 1972, pp 30–45.

¹²³ *Ag Hist III*, pp 45–8, 152–63.

¹²⁴ P Hall, ed, *Von Thünen's Isolated State: An English Edition of Der Isolierte Staat by Johann Heinrich von Thünen*, trans C M Wartenberg, 1966; M Chisholm, *Rural Settlement and Land-use: An Essay on Location*, 1962, pp 20–32; D Grigg, *The Dynamics of Agricultural Change: The Historical Experience*, 1982, pp 135–40; *A Medieval Capital*, pp 4–7.

tials in fertility and mortality and the redistribution of population by migration.¹²⁵ Towns for the most part contracted in size, the composition of urban demand for rural provisions altered, and the extent and orientation of their provisioning hinterlands were redrawn.¹²⁶

If the pattern of farming systems mapped here represents the response to these changes how should it be interpreted? It certainly represents a reversion to more land extensive and especially more pastoral forms of agriculture, and as such was consistent with prevailing economic trends. But as demesne managers increasingly counterbalanced grain production with animal husbandry were they also reverting to a form of agriculture in which estates on the one hand and localities and regions on the other were increasingly self-sufficient in what they produced? Certainly, as pressure eased off the land more localities and regions would have been able to meet their consumption requirements internally from within their own resources. Whereas c. 1300 it is possible to recognize the clear impact of growing centres of concentrated urban demand, both at home and overseas, upon the pattern of farming systems, by the end of the fourteenth century such centripetal influences had diminished in scale and their impact is far less self-evident.¹²⁷ The very fact that demesne agriculture became less differentiated suggests that incentives to specialize and intensify had weakened. The

new agricultural landscape that emerged therefore appears more Ricardian than Thünenesque, its configuration influenced more by land quality and local demand for the land and its products than by distance from major markets.¹²⁸ The latent patterns of specialization and intensification that may be detected at the climax of medieval economic expansion c. 1300 had mostly fallen into abeyance in an agrarian world seemingly reoriented along more local and regional lines. This, however, is almost certainly to underestimate the commercial potential of animals and animal products, both of which were capable of being marketed at a far greater range than grain.¹²⁹

If the orbit of grain markets became more circumscribed it does not necessarily follow that the same applied to the markets for live animals, for dairy products, hides, skins, and wool.¹³⁰ In fact, an active trade in live animals undoubtedly helped sustain the expansion of flocks and herds that was such a feature of this period. Most demesnes relied upon the market for replacement work horses, for the plough and especially for the cart, and the same often applied to oxen. The conduct of pastoral husbandry also regularly generated surplus animals for sale: redundant, decrepit, and sickly animals requiring replacement, surplus calves and lambs from specialist herds and flocks, animals purpose-bred for sale and others fattened for meat. On what scale that trade was conducted and over what distances remains to be established, but neither is likely to have

¹²⁵ The changing distribution of population is implicit in the changing distribution of taxable wealth: R. S. Schofield, 'The geographical distribution of wealth in England, 1334-1649', *Econ Hist Rev*, 2nd series, XVIII, 1965, pp. 483-510; H. C. Darby, R. E. Glasscock, J. Sheail, and G. R. Versey, 'The changing geographical distribution of wealth in England 1086-1334-1525', *J Hist Geog*, 5, 1979, pp. 257-61; A. Dyer, *Decline and Growth in English Towns, 1400-1640*, 1991, pp. 40-2.

¹²⁶ Dyer, *Decline and Growth in English Towns*, pp. 20-4; D. Keene, *Cheapside before the Great Fire*, 1985, pp. 19-20; Dyer, *Standards of Living*, pp. 199-202; Galloway et al., 'Changes in grain production and distribution', *Ag Hist III*, pp. 372-3.

¹²⁷ Power and Campbell, 'Cluster analysis', pp. 242; *A Medieval Capital*, pp. 172-83.

¹²⁸ For the difference between Ricardian and von Thünen economic rent see, Grigg, *The Dynamics of Agricultural Change*, pp. 50-1, 135-40.

¹²⁹ T. H. Lloyd, *The English Wool Trade in the Middle Ages*, 1977; D. L. Farmer, 'Marketing the produce of the countryside, 1200-1500', in *Ag Hist III*, pp. 377-408; Overton and Campbell, 'Norfolk livestock farming', pp. 377-8, 393-4.

¹³⁰ Lloyd, *The English Wool Trade*; M. Kowaleski, 'Town and country in late medieval England: the hide and leather trade', in P. J. Corfield and D. Keene, eds, *Work in Towns 850-1850*, Leicester, 1990, pp. 57-73.

been inconsiderable.¹³¹ Whether it was sufficient to maintain established levels of commercialization within the demesne sector is another matter.¹³² Nevertheless,

in the ongoing debate about the character and trend of the late medieval economy the classification of demesne-farming systems outlined here should provide an appropriate framework for a more critical evaluation of these and other issues.¹³³

¹³¹ Campbell, 'Measuring the commercialisation of seigneurial agriculture', pp 142-3, 148-9, 152-3, 163-74; I Blanchard, 'The Continental European cattle trade, 1400-1600', *Econ Hist Rev*, 2nd series, 39, 1986, pp 428-31; M K McIntosh, *Autonomy and Community: The Royal Manor of Havering, 1200-1500*, 1986, pp 141-3.

¹³² Campbell, 'A fair field', pp 68-9.

¹³³ For recent contrasting views of the period compare R H Britnell, *The Commercialisation of English Society 1000-1500*, 1993, pp 179-203; S R Epstein, 'Regional fairs, institutional innovation, and economic growth in late medieval Europe', *Econ Hist Rev*, 2nd series, XLVII, 1994, pp 441-58.