A New Perspective on Medieval and Early Modern Agriculture: Six Centuries of Norfolk Farming c.1250-c.1850

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I
INTRODUCTION

Since the late nineteenth century, ideas about the development of English agriculture from the sixteenth century onwards have been dominated by notions of an agricultural revolution. This was originally conceived as a phenomenon of the century after 1750, when English agriculture was transformed by rapid technological change made possible by the replacement of outmoded agrarian institutions. Subsequent contributions have challenged both the nature and the timing of this revolution, so that now there are also claims that an agricultural revolution took place between 1560 and 1673, as well as between 1650 and 1750. These revisions have encouraged a more gradualist interpretation of developments after 1750, which has been reinforced by recent estimates of agricultural output demonstrating that growth was more rapid in the first half of the eighteenth century than in the second. While there is no consensus over the timing and pace of an agricultural revolution, there is a fairly general agreement that English agriculture underwent a fundamental technological transformation between the mid-sixteenth and the mid-eighteenth century, brought about by the introduction of new fodder crops,

*Earlier versions of this paper were presented to seminars at The Queen's University of Belfast, Trinity College, Dublin, University of Alberta, Edmonton, University of British Columbia, Vancouver, University of Washington, Seattle, and the Centre of East Anglian Studies at the University of East Anglia, Norwich, as well as to the annual conference of the Economic History Society, Liverpool, 1990. We are grateful for the opportunities these presented to discuss both our evidence and ideas. The research from which this paper springs began in the early 1970s, when we were both postgraduate students in Cambridge. We have since both received personal research fellowships from the Economic and Social Research Council which greatly facilitated the lengthy tasks of data collection and analysis. Our debts to other scholars are too numerous to mention, but specific thanks are due to the staff of the Norfolk Record Office, to Jenitha Orr and Meemee Wong for research assistance, and to Anne Rook for drawing the diagrams.

which had a decisive impact on "productivity" in terms of grain yields per acre.[1]

The most significant consequence of this productivity improvement, especially in the century after 1750, is taken to have been the ability of British agriculture — albeit aided by increased food imports — to feed an ever-growing population. By 1850 an estimated 6.5 million extra mouths were being fed from home production compared with 1750.[2] Industrialization would have been impossible without this population growth, and without industrialization the economy would probably have remained relatively static, with economic growth the exception rather than the rule. But the transformation was more complex than this, for industrialization, by definition, entailed a progressive reduction in the proportion of the population employed in agriculture: an essential precondition for structural economic change was therefore a significant rise in the productivity of labour employed in agriculture.[3]

Thus the twin achievements of eighteenth- and nineteenth-century agriculture are seen as the ability to match population growth with rising agricultural production, and structural economic change with major gains in agricultural labour productivity. This appears all the more remarkable when set against the perceived experience of earlier centuries. Although one historian claims that the growing population of the sixteenth and early seventeenth centuries elicited a corresponding revolution in agricultural production, most others regard the cessation of population growth by the mid-seventeenth century as indicative of a failure of agricultural output to keep up with expanding demand. The verdict on thirteenth- and early fourteenth-century agriculture is even more unfavourable. Not only did agriculture fail to

[1] An example is in one of the most recent contributions: Gregory Clark, "Yields per Acre in English Agriculture, 1250-1860: Evidence from Labour Inputs", *Econ. Hist. Rev.*, 2nd ser., xliv (1991), p. 459, who argues that "the agricultural revolution thus pre-dates the industrial revolution", on the basis of the trend in wheat yields per acre.

[2] J. D. Chambers and G. E. Mingay, *The Agricultural Revolution, 1750-1880* (London, 1966), pp. 3-4; G. E. Mingay, "Dr Kerridge's 'Agricultural Revolution': A Comment", *Agric. Hist.*, xliii (1969), p. 497; R. B. Outhwaite, "Rural England, 1500-1750", *Histoire Sociale / Social History*, ii (1968), pp. 85-97.

[3] N. F. R. Crafts, "Income Elasticities of Demand and the Release of Labour by Agriculture during the British Industrial Revolution", *Jl. European Econ. Hist.*, ix (1980), p. 167; E. A. Wrigley, *Continuity, Chance and Change: The Character of the Industrial Revolution in England* (Cambridge, 1988), pp. 10-11.

meet the challenge of population growth, but attempts to expand the area under production in conditions of technological inertia are believed to have driven down the productivities of both land and labour, thus negating economic growth and precipitating a Malthusian crisis of major proportions. When plague struck in 1348-9 it therefore struck a population that was probably already in decline.[4]

According to this interpretation medieval agriculture failed because it destroyed the fragile ecological equilibrium on which the sustained production of crops and animals ultimately rested. Nor was this the first example of such a phenomenon. Archaeologists have speculated that attempts to raise agricultural production during the Romano-British period may likewise have led to a progressive loss of soil nitrogen, resulting in ecological stress and productivity decline on the lighter and poorer soils.[5] A double dilemma therefore confronted pre-industrial agriculture: how to raise both land and labour productivity under conditions of population growth; and how to raise agricultural output without jeopardizing the fertility of the soils on which it depended.

This article explores these themes over a period of six centuries for the county of Norfolk. More specifically it is concerned with three issues: the nature and extent of technological change in farming from the thirteenth to the nineteenth century; the provenance, character and timing of the agricultural revolution; and the relationship between population growth and agricultural productivity. In exploring these issues it makes two further contributions. First, it bridges the gaps that have developed in historical writing between the largely independent accounts of medieval and early modern agriculture and, to a lesser extent, between the literature on the early modern period and that on the eighteenth and nineteenth centuries. Secondly, the construction of these bridges breaks new methodological ground, through quantitative

[4] Richard M. Smith, "Demographic Developments in Rural England, 1300-48: A Survey", in Bruce M. S. Campbell (ed.), *Before the Black Death: Studies in the "Crisis" of the Early Fourteenth Century* (Manchester, 1991), pp. 25-78.

[5] S. Applebaum, "Roman Britain", in H. P. R. Finberg (ed.), *The Agrarian History of England and Wales*, i, *A.D. 43-1042* (Cambridge, 1972), pp. 246-7; Martin K. Jones, "Agricultural Productivity in the Pre-Documentary Past", in Bruce M. S. Campbell and Mark Overton (eds.), *Land, Labour and Livestock: Historical Studies in European Agricultural Productivity* (Manchester, 1991), pp. 86-93; Eric Klingelhöfer, *Settlement and Land Use in Micheldever Hundred, Hampshire, 700-1100* (*Trans. Amer. Philos. Soc.*, lxxxi pt. 3, Philadelphia, 1991), pp. 50-4, 73.

comparisons of agricultural statistics derived from manorial accounts, probate inventories and nineteenth-century agricultural surveys.

This reconstruction of farm enterprises for a single geographical area over such a long period of time gives a new perspective to ideas both of continuity and discontinuity in English agriculture. The major discontinuity in Norfolk's crop production came after 1740, during the era of the traditional agricultural revolution, when the proportions of land under various crops changed dramatically and crop yields rose to unprecedented heights. While there was a remarkable continuity in the mix of crops during the preceding five hundred years, there were more subtle discontinuities in the geography of crop (and livestock) production, as farmers increasingly adapted their husbandry systems to the demands of the market.

There was also considerable discontinuity in the pace of technological advance. The transformation of the eighteenth and nineteenth centuries had an even longer genesis than has been thought, since almost all the technological innovations that brought it about can be found as far back as the thirteenth century. But a thirteenth-century agricultural revolution did not materialize, and it was in the seventeenth century that developments in the livestock sector, especially the doubling of stocking densities, led to the integration of crop and livestock husbandry, paving the way for the breakthrough in crop yields during the eighteenth century. In contrast to the emphasis on arable farming found in writing on the subject, the livestock sector emerges as the more dynamic over the whole period of this study, since advances in livestock productivity far outweighed those for crops.

The eighteenth century also marks another break with a long-established pattern. Although crop yields fluctuated within the same broad limits between 1250 and 1700, this fluctuating pattern challenges the common assumption that, in pre-industrial England, when population grew, crop yields would fall. In the late thirteenth and early fourteenth centuries, and again in the late sixteenth and early seventeenth centuries, yields did not fall as population grew: on the contrary, they rose. Conversely, yields fell as the population fell in the late fourteenth and early fifteenth centuries and, again, in the late seventeenth century. Thereafter the relationship changed subtly: yields began to grow in the early eighteenth century, while population numbers remained static;

by the early nineteenth century, encouraged by renewed population growth, they had risen to unprecedented levels. This observation fuels the debate over the relationship between population growth and agricultural change in pre-industrial societies, directing attention to both the determinants of crop yields, and to the relationships between crop yields, agricultural productivity and agricultural output.

These findings are discussed in the concluding sections of the paper (VIII, IX and X). They emerge from the cumulative analysis of information on crop proportions, crop yields, livestock proportions and livestock densities, assembled in Sections IV, V, VI and VII, which is preceded by a brief discussion of accounts and inventories in Section III. To help set these results in a wider context, Section II of the paper presents a brief review of the historiography of English agriculture from the Middle Ages to the nineteenth century.

II

THE HISTORIOGRAPHY OF AGRICULTURAL CHANGE

The literature on medieval agriculture, as represented by the influential writings of M. M. Postan (deriving from those of Wilhelm Abel on the Continent), J. Z. Titow, David Grigg and Robert Brenner, is dominated by a concept of agrarian crisis.[6] This verdict derives from the fusion of two schools of thought: on the one hand, the emphasis of the English classical economists on the diminishing returns to labour and capital applied to land, and, on the other, the emphasis of Marxist historians on the exploitative nature of the socio-property relations embodied in

[6] Wilhelm Abel, *Agrarkrisen und Agrarkonjunktur in Mitteleuropa vom 13. bis zum 19. Jahrhundert*, 3rd edn. (Berlin, 1935); trans. Olive Ordish, as *Agricultural Fluctuations in Europe from the Thirteenth to the Twentieth Centuries* (London, 1980); Wilhelm Abel, *Die Wüstungen des ausgehenden Mittelalters*, 2nd edn. (Stuttgart, 1955); M. M. Postan, "Medieval Agrarian Society in Its Prime: England", in M. M. Postan (ed.), *The Cambridge Economic History of Europe*, i, *The Agrarian Life of the Middle Ages*, 2nd edn. (Cambridge, 1966), pp. 549-632; J. Z. Titow, *English Rural Society, 1200-1350* (London, 1969); D. L. Farmer, "Crop Yields, Prices and Wages in Medieval England", *Studies in Medieval and Renaissance Hist.*, vi (1983), pp. 117-55; David Grigg, *Population Growth and Agrarian Change: An Historical Perspective* (Cambridge, 1980), pp. 64-82; Robert Brenner, "Agrarian Class Structure and Economic Development in Pre-Industrial Europe", *Past and Present*, no. 70 (Feb. 1976), pp. 30-75, repr. in T. H. Aston and C. H. E. Philpin (eds.), *The Brenner Debate: Agrarian Class Structure and Economic Development in Pre-Industrial Europe* (Cambridge, 1985), pp. 10-63 (subsequent references are to this version).

feudalism.[7] Hence the assessment of seigneurial agriculture by Edward Miller and John Hatcher that "even highly organized and superficially efficient estates were failing in one quite basic requirement of good husbandry: the keeping of the land in good heart"; and Brenner's even more pessimistic assessment of peasant agriculture, asserting that "the surplus-extraction relations of serfdom tended to lead to the exhaustion of peasant production *per se*; in particular, the inability to invest in animals for ploughing and as a source of manure led to deterioration of the soil, which in turn led to the extension of cultivation to land formerly reserved for the support of animals. This meant the cultivation of worse soils and at the same time fewer animals — and thus in the end a vicious cycle of the destruction of the peasants' means of support. The crisis of productivity led to demographic crisis, pushing the population over the edge of subsistence".[8] Recent research has led to some qualification of these views, revealing medieval agriculture to have been more varied, dynamic and

[7] Yujiro Hayami and Vernon W. Ruttan, *Agricultural Development: An International Perspective* (Baltimore and London, 1971), pp. 28-34; M. M. Postan and John Hatcher, "Population and Class Relations in Feudal Society", *Past and Present*, no. 78 (Feb. 1978), pp. 24-37, repr. in Aston and Philpin (eds.), *Brenner Debate*, pp. 64-78 (subsequent references are to this version); David Grigg, *The Dynamics of Agricultural Change* (London, 1982), pp. 50-9; Mark Overton and Bruce M. S. Campbell, "Productivity Change in European Agricultural Development", in Campbell and Overton (eds.), *Land, Labour and Livestock*, pp. 29-35; Maurice Dobb, *Studies in the Development of Capitalism* (London, 1946); William Lazonick, "Karl Marx and Enclosures in England", *Rev. Radical Polit. Economics*, vi (1974), pp. 1-59; R. H. Hilton, "Introduction", in R. H. Hilton (ed.), *The Transition from Feudalism to Capitalism* (London, 1976), pp. 9-30; Brenner, "Agrarian Class Structure"; Robert Brenner, "The Agrarian Roots of European Capitalism", *Past and Present*, no. 97 (Nov. 1982), pp. 16-113, repr. in Aston and Philpin (eds.), *Brenner Debate*, pp. 213-327 (subsequent references are to this version); Michael Dunford and Diane Perrons, *The Arena of Capital* (London and Basingstoke, 1983), pp. 90-123; John E. Martin, *Feudalism to Capitalism: Peasant and Landlord in English Agrarian Development* (Atlantic Highlands, N.J., 1983); R. J. Holton, "Marxist Theories of Social Change and the Transition from Feudalism to Capitalism", *Theory and Society*, x (1981), pp. 833-67; R. J. Holton, *The Transition from Feudalism to Capitalism* (London, 1985). For the historiography of medieval soil exhaustion, see Nils Hybel, *Crisis or Change: The Concept of Crisis in the Light of Agrarian Structural Reorganization in Late Medieval England*, trans. James Manley (Aarhus, 1989).

[8] Edward Miller and John Hatcher, *Medieval England: Rural Society and Economic Change, 1086-1348* (London, 1978), p. 217; Brenner, "Agrarian Class Structure", p. 33. On the ecological shortcomings of medieval agriculture Brenner and Postan are united: "We might therefore expect that at times and in regions in which the animal population was reduced to the barest minimum the land was bound to suffer. Apparently it suffered in many parts of medieval England": Postan, "Medieval Agrarian Society", pp. 556-7; although in other crucial respects their interpretations of this period are fundamentally different: Aston and Philpin (eds.), *Brenner Debate*.

adaptable than has hitherto been appreciated.[9] Nevertheless stress continues to be laid on its technological backwardness and ecological excesses, and the possibility that agriculture's inadequacies contributed to a Malthusian positive check remains a matter of considerable debate.[10]

This predominantly negative assessment of thirteenth- and fourteenth-century agriculture finds some echo in the interpretation of the sixteenth century advanced by R. B. Outhwaite.[11] Using "productivity" as his yardstick of progress, he suggests that population pressure may well have prompted a Ricardian extension of cultivation onto "marginal" lands, with deleterious consequences for the efficiency of the agricultural sector. A similarly pessimistic picture is presented by both D. M. Palliser and Roger Schofield, who suggest that on this occasion a Malthusian crisis was only averted through the operation of preventive checks in the form of controls upon nuptiality and hence fertility.[12] Eric Kerridge, on the other hand, believes that agriculture experienced

[9] For a categorical statement of medieval agriculture's technological backwardness and inertia, see G. E. Fussell, "Social Change but Static Technology: Rural England in the Fourteenth Century", *History Studies*, i (1968), pp. 23-32. Recent revisions to this view include P. F. Brandon, "Demesne Arable Farming in Coastal Sussex during the Later Middle Ages", *Agric. Hist. Rev.*, xix (1971), pp. 113-34; Bruce M. S. Campbell, "Agricultural Progress in Medieval England: Some Evidence from Eastern Norfolk", *Econ. Hist. Rev.*, 2nd ser., xxxvi (1983), pp. 26-46; Mavis Mate, "Medieval Agrarian Practices: The Determining Factors?", *Agric. Hist. Rev.*, xxxiii (1985), pp. 22-31; Mark Bailey, *A Marginal Economy? East Anglian Breckland in the Later Middle Ages* (Cambridge, 1989); Kathleen Biddick, *The Other Economy: Pastoral Husbandry on a Medieval Estate* (Berkeley and Los Angeles, 1989); Christopher Thornton, "The Determinants of Land Productivity on the Bishop of Winchester's Demesne of Rimpton, 1208 to 1403", in Campbell and Overton (eds.), *Land, Labour and Livestock*, pp. 183-210. The most positive verdict on medieval agriculture to date is that given by H. E. Hallam in his *Rural England, 1066-1348* (London, 1981).

[10] For example, Christopher Dyer, *Standards of Living in the Later Middle Ages: Social Change in England, c.1200-1520* (Cambridge, 1989), pp. 40-1, 127-31. See also Bruce M. S. Campbell, "Ecology versus Economics in Late Thirteenth- and Early Fourteenth-Century English Agriculture", in Del Sweeney (ed.), *Agriculture in the Middle Ages: Reality and Image* (forthcoming, 1994). For an evaluation of the evidence bearing upon the operation of the Malthusian positive check in this period, see Smith, "Demographic Developments in Rural England", pp. 52-61.

[11] R. B. Outhwaite, "Progress and Backwardness in English Agriculture, 1500-1650", *Econ. Hist. Rev.*, 2nd ser., xxxix (1986), pp. 1-18.

[12] D. M. Palliser, "Tawney's Century: Brave New World or Malthusian Trap?", *Econ. Hist. Rev.*, 2nd ser., xxxv (1982), pp. 339-53; Roger Schofield, "The Impact of Scarcity and Plenty on Population Change in England, 1541-1871", *Jl. Interdisciplinary Hist.*, xiv (1983), pp. 265-91, repr. in Robert I. Rotberg and Theodore K. Rabb (eds.), *Hunger and History: The Impact of Changing Food Production and Consumption Patterns on Society* (Cambridge, 1985), pp. 67-94.

little difficulty in feeding a growing population. He characterizes the period 1560-1673 as a time of marked technological progress and productivity growth. For him "the agricultural revolution took place in England in the sixteenth and seventeenth centuries and not in the eighteenth and nineteenth".[13]

There is a similar lack of consensus over the fortunes of agriculture during the hundred years after 1650. Joan Thirsk, for instance, in one of the most careful recent assessments, characterizes the late seventeenth century as a period of "agricultural depression". While recognizing that sluggish prices stimulated ingenuity and diversification, she believes that dramatic increases in agricultural production did not come until the "agricultural revolution" which took place after 1750.[14] Other interpretations of the period are much more optimistic. For example, E. L. Jones and A. H. John both argue for a sustained rise in agricultural output after 1650 as the consequence of crop innovations and a rise in land productivity.[15] In Jones's view, between 1650 and

[13] Eric Kerridge, *The Agricultural Revolution* (London, 1967), pp. 13, 328. Kerridge's arguments are accepted by Brenner, who likewise believes that early modern England witnessed an "agricultural revolution": Brenner, "Agrarian Roots of European Capitalism", p. 308.

[14] Joan Thirsk, "Seventeenth-Century Agriculture and Social Change", in Joan Thirsk (ed.), *Land, Church and People: Essays Presented to Professor H. P. R. Finberg (Agric. Hist. Rev.*, xviii, supp., 1970), pp. 148-77, repr. in Joan Thirsk, *The Rural Economy of England* (London, 1984), pp. 183-216; Joan Thirsk (ed.), *The Agrarian History of England and Wales*, v, *1640-1750* (Cambridge, 1985), ii, *Agrarian Change*, pp. xix-xxxi; Joan Thirsk, *England's Agricultural Regions and Agrarian History* (Basingstoke, 1987); Joan Thirsk (ed.), *The Agrarian History of England and Wales*, iv, *1500-1640* (Cambridge, 1967).

[15] E. L. Jones's writing on this subject is mostly contained in his *Agriculture and the Industrial Revolution* (Oxford, 1974), but see also E. L. Jones, "English and European Agricultural Development", in R. M. Hartwell (ed.), *The Industrial Revolution* (Oxford, 1970), pp. 42-76; E. L. Jones, "Agriculture, 1700-80", in Roderick Floud and Donald McCloskey (eds.), *The Economic History of Britain since 1700*, 2 vols. (Cambridge, 1981), i, pp. 66-86. A. H. John's contributions include "The Course of Agricultural Change, 1660-1760", in L. S. Pressnell (ed.), *Studies in the Industrial Revolution Presented to T. S. Ashton* (London, 1960), pp. 125-55, repr. in W. E. Minchinton (ed.), *Essays in Agrarian History*, 2 vols. (Newton Abbot, 1967), i, pp. 223-53; A. H. John, "Agricultural Productivity and Economic Growth in England, 1700-1760", *Jl. Econ. Hist.*, xxv (1965), pp. 19-34, repr. in E. L. Jones (ed.), *Agriculture and Economic Growth in England, 1650-1815* (London, 1967), pp. 172-93; A. H. John, "Aspects of Economic Growth in the First Half of the Eighteenth Century", *Economica*, new ser., no. 28 (1961), pp. 176-90, repr. in both W. E. Minchinton (ed.), *The Growth of English Overseas Trade in the Sixteenth and Seventeenth Centuries* (London, 1969), pp. 165-83, and E. M. Carus-Wilson (ed.), *Essays in Economic History*, ii (London, 1962), pp. 360-73.

1750, "English agriculture underwent a transformation in its techniques out of all proportion to the rather limited widening of its market".[16] A recent review considers there is a "widespread historiographic impression that England had an agricultural revolution *circa* 1650 to 1750"; a verdict which has found support in the work of Robert C. Allen.[17]

These views have influenced opinion about the succeeding hundred years, the era of the traditional agricultural revolution.[18] The latter is now seen as a much more gradual phenomenon with, it is acknowledged, long antecedents. The retreat from the belief in a revolution during these centuries has recently become more pronounced, so that G. E. Mingay considers "in many ways the hundred years that ended in 1850 may be seen as a base, or rather a preparation, a limited but essential preparation, for the greater changes yet to come", and although the achievements of the hundred years after 1750 were remarkable, "it could hardly be said that they amounted to an agricultural revolution".[19] In this case the verdict on the period 1750-1850 is as much influenced by comparisons with subsequent agricultural developments as with those that had gone before.

A different perspective is provided by the estimates of N. F. R. Crafts and others of the rate of growth of agricultural output during this key period.[20] These indicate that growth rates accelerated during the first half of the eighteenth century, slackened somewhat during the following half-century, but rose

[16] Jones, *Agriculture and the Industrial Revolution*, p. 67.

[17] Immanuel Wallerstein, *The Modern World-System*, ii, *Mercantilism and the Consolidation of the European World-Economy* (London, 1980), p. 263; Robert C. Allen, "The Two English Agricultural Revolutions, 1459-1850", in Campbell and Overton (eds.), *Land, Labour and Livestock*, pp. 236-54; J. Yelling, "Agriculture, 1500-1730", in R. A. Dodgshon and R. A. Butlin (eds.), *An Historical Geography of England and Wales*, 2nd edn. (London, 1990), pp. 181-98.

[18] For the use of the term "agricultural revolution", see Mark Overton, "Agricultural Revolution? Development of the Agrarian Economy in Early Modern England", in Alan R. H. Baker and Derek Gregory (eds.), *Explorations in Historical Geography: Interpretative Essays* (Cambridge, 1984), pp. 118-39; Mark Overton, "Agricultural Revolution? England, 1540-1850", in Anne Digby and Charles Feinstein (eds.), *New Directions in Economic and Social History* (London and Basingstoke, 1989), pp. 9-21; J. V. Beckett, *The Agricultural Revolution* (Oxford, 1990).

[19] G. E. Mingay (ed.), *The Agrarian History of England and Wales*, vi, *1750-1850* (Cambridge, 1989), pp. 953, 971.

[20] N. F. R. Crafts, "British Economic Growth, 1700-1831: A Review of the Evidence", *Econ. Hist. Rev.*, 2nd ser., xxxvi (1983), pp. 83-4; R. V. Jackson, "Growth and Deceleration in English Agriculture, 1660-1790", *Econ. Hist. Rev.*, 2nd ser., xxxviii (1985), pp. 333-51.

dramatically in the first half of the nineteenth century, reaching a rate of over 1 per cent per annum. Unfortunately these calculations are not based on the direct evidence of physical output, but are derived from demand equations using evidence from prices and wages, together with assumptions about demand elasticities. New evidence of growth rates based on contemporary estimates of the output of agricultural products show a different trend: growth is more rapid in the fifty years after 1750 than the fifty years before and culminated in a rate of growth in the first half of the nineteenth century of just over 0.8 per cent per annum. More significantly, this new evidence suggests that by 1700 agricultural output, land productivity *and* labour productivity were all rising together, and that from the mid-century, perhaps for the first time in English history, they were rising in conjunction with population growth.[21]

The most marked dichotomy in the historiography of this six-hundred-year period is between interpretations of the medieval and early modern periods. Between them lie the fifteenth and early sixteenth centuries; a murky, ill-documented and under-researched period notable for three main developments. First, a swing from arable to pasture and retreat from marginal land as the infamous sheep ate up men.[22] Secondly, structural change in the size and layout of the fields and farms which formed the units of production.[23] Thirdly, tenurial change, associated with the break-up of demesnes and growth of leasehold and copyhold at

[21] The estimates are in Mark Overton, "Land and Labour Productivity in English Agriculture, 1650-1850", in Peter Mathias and John A. Davis (eds.), *The Nature of Industrialization*, v, *Agriculture and Industrialization* (Oxford, forthcoming), which also reviews other estimates of output and productivity.

[22] For evidence of this land-use shift, see Bruce M. S. Campbell, "People and Land in the Middle Ages, 1066-1500", in Dodgshon and Butlin (eds.), *Historical Geography of England and Wales*, pp. 105-11; Bruce M. S. Campbell, "Land, Labour, Livestock and Productivity Trends in English Seignorial Agriculture, 1208-1450", in Campbell and Overton (eds.), *Land, Labour and Livestock*, pp. 153-9. Settlement retreat is discussed in Maurice Beresford and John G. Hurst (eds.), *Deserted Medieval Villages* (London, 1971), pp. 3-75; A. R. H. Baker, "Changes in the Later Middle Ages", in H. C. Darby (ed.), *A New Historical Geography of England* (Cambridge, 1973), pp. 207-17.

[23] Dyer, *Standards of Living in the Later Middle Ages*, pp. 141-3. For case-studies of structural change, see Bruce M. S. Campbell, "The Extent and Layout of Commonfields in Eastern Norfolk", *Norfolk Archaeology*, xxxviii (1981), pp. 5-32; Marjorie Keniston McIntosh, *Autonomy and Community: The Royal Manor of Havering, 1200-1500* (Cambridge, 1986), pp. 116-26.

the expense of the old servile tenures.[24] Brenner and other Marxist historians interpret these developments as the rise of capitalist production relations, which they regard as a necessary prerequisite for the emergence of the new technology of the "agricultural revolution".[25] But they are not alone in attributing significant productivity gains to the dismantling of feudal institutions.[26]

A further documentary discontinuity separates those who would attribute these revolutionary changes to the seventeenth and early eighteenth centuries from those who date them to the late eighteenth and early nineteenth centuries. Once more, the intervening years witnessed important institutional and structural changes — with further tenurial restructuring, renewed interest by landlords in estate management, and the spread of enclosure — which had further important consequences for land and labour productivity and the nature of farm enterprises.[27] For those who would plump for an "agricultural revolution" after 1750 these developments provide some of the essential preconditions.

Differences of interpretation are, of course, the very grist to the mill of history, but it is important to distinguish between those which derive from alternative interpretations of the evid-

[24] J. Ambrose Raftis, *Tenure and Mobility: Studies in the Social History of the Medieval English Village* (Toronto, 1964); R. H. Hilton, *The Decline of Serfdom in Medieval England* (Studies in Econ. Hist., London, 1969); Margaret Spufford, *A Cambridgeshire Community: Chippenham from Settlement to Enclosure* (Dept. of English Local Hist., Occasional Paper, no. 20, Leicester, 1965), pp. 31-8; McIntosh, *Autonomy and Community*, pp. 116-26.

[25] Brenner, "Agrarian Roots of European Capitalism"; Martin, *Feudalism to Capitalism*; Dunford and Perrons, *Arena of Capital*, pp. 102-20.

[26] G. D. Snooks, *Economic Growth during the Last Millenium: A Quantitative Perspective for the British Industrial Revolution* (Australian National Univ., Working Papers in Econ. Hist., no. 140, Canberra, 1990), pp. 30-3.

[27] These are discussed in Chambers and Mingay, *Agricultural Revolution*; M. E. Turner, *English Parliamentary Enclosure: Its Historical Geography and Economic History* (Folkestone, 1980); J. R. Wordie, "Rent Movements and the English Tenant Farmer, 1700-1839", in Paul Uselding (ed.), *Research in Economic History: An Annual Compilation of Research*, vi (Greenwich, Conn., 1981), pp. 193-43; J. R. Wordie, "The Chronology of English Enclosure, 1500-1914", *Econ. Hist. Rev.*, 2nd ser., xxxvi (1983), pp. 483-505; J. R. Wordie, *Estate Management in Eighteenth-Century England* (London, 1982); G. E. Mingay, "The Size of Farms in the Eighteenth Century", *Econ. Hist. Rev.*, 2nd ser., xiv (1962), pp. 469-88; G. E. Mingay, *Enclosure and the Small Farmer in the Age of the Industrial Revolution* (London, 1968); G. E. Mingay, *English Landed Society in the Eighteenth Century* (London, 1963); J. V. Beckett, "Landownership and Estate Management", in Mingay (ed.), *Agrarian History of England and Wales*, vi, pp. 545-640.

ence and those which arise from the way in which that evidence has been assembled. Broad temporal, spatial and sectoral comparisons require data that have been systematically gathered and consistently analysed. If the criteria for comparison are quantitative, it is important that, when possible, they are measured, and measured according to a common methodology.[28] This is especially difficult when comparing periods with dissimilar historical sources, yet it is only recently that quantitative measures of agricultural production have been produced from single sources.[29] If a broader and internally more consistent picture of the evolution of English agriculture is to emerge, it is therefore essential that the construction of these measures is taken further and the traditional periodization of the past is transcended. As a step in that direction, this article presents a comparison of evidence from medieval account rolls, early modern probate inventories and nineteenth-century agricultural statistics, in order to cast new light on medieval and early modern farming.

[28] This is a recurring criticism by reviewers of the Cambridge *Agrarian Histories of England and Wales*, for example, Bruce M. S. Campbell, "Laying Foundations: The Agrarian History of England and Wales, 1042-1350", *Agric. Hist. Rev.*, xxxvii (1989), pp. 190-1; Kathleen A. Biddick, "Malthus in a Straitjacket? Analyzing Agrarian Change in Medieval England", *Jl. Interdisciplinary Hist.*, xx (1990), pp. 624-7; Mark Overton, "Depression or Revolution? English Agriculture, 1640-1750", *Jl. Brit. Studies*, xxv (1986), p. 350; H. J. Habakkuk, "The Agrarian History of England and Wales: Regional Farming Systems and Agrarian Change, 1640-1750", *Econ. Hist. Rev.*, 2nd ser., xl (1987), p. 285; E. A. Wrigley, "Early Modern Agriculture: A New Harvest Gathered In", *Agric. Hist. Rev.*, xxxv (1987), p. 69.

[29] For example, Bruce M. S. Campbell, "Towards an Agricultural Geography of Medieval England", *Agric. Hist. Rev.*, xxxvi (1988), pp. 24-39; Bruce M. S. Campbell and John P. Power, "Mapping the Agricultural Geography of Medieval England", *Jl. Hist. Geography*, xv (1989), pp. 24-39; J. A. Yelling, "Changes in Crop Production in East Worcestershire, 1540-1867", *Agric. Hist. Rev.*, xxi (1973), pp. 18-34; Mark Overton, "The Determinants of Crop Yields in Early Modern England", in Campbell and Overton (eds.), *Land, Labour and Livestock*, pp. 284-322; Paul Glennie, "Continuity and Change in Hertfordshire Agriculture, 1550-1700: I, Patterns of Agricultural Production", *Agric. Hist. Rev.*, xxxvi (1988), pp. 55-75; M. E. Turner, "Arable in England and Wales: Estimates from the 1801 Crop Return", *Jl. Hist. Geography*, vii (1981), pp. 291-302; Mark Overton, "Agriculture", in John Langton and R. J. Morris (eds.), *An Atlas of Industrializing Britain, 1780-1914* (London, 1986), pp. 34-53. The "Feeding the City" project at the Centre for Metropolitan History, Institute of Historical Research, London, has assembled a systematic database of agricultural and land-use information for ten counties around London in the period 1270-1339.

III

DEMESNE ACCOUNTS AND PROBATE INVENTORIES

Accounts furnish a plethora of detailed information about the demesne-farming activities of manorial lords and are most abundant for the period *c.* 1270-*c.* 1400. They follow a fairly standardized format and each normally records the activities of an entire farming year, from Michaelmas to Michaelmas, specifying the crops sown and harvested, together with livestock numbers at the start and end of the year. Accounts survive for all classes of estate, although large estates are better represented than small, and ecclesiastical better than lay.[30]

Inventories likewise survive in considerable numbers and are the principal source of information about farming practice between the mid-sixteenth and mid-eighteenth centuries.[31] They were drawn up as part of the probate procedure following the death of a farmer, and record the crops — both in the barn and in the field — and livestock on the farm. Each provides a snapshot view of a farm at a specific point in time and therefore provides less comprehensive information than do accounts. Indeed only those made during the months immediately preceding the harvest — in June and July — record all field crops. Moreover inventories do not follow a standard format, so the number that may be used to compile a particular statistic depends on the way in which the information is presented, with the result that different groups of inventories have to be used to measure different things. Each farm is usually recorded only once and some demographic bias can be expected in the data towards the farms of the

[30] For a discussion of manorial accounts, see P. D. A. Harvey, "Agricultural Treatises and Manorial Accounting in Medieval England", *Agric. Hist. Rev.*, xx (1972), pp. 170-82, and, especially, *Manorial Records of Cuxham, Oxfordshire, circa 1200-1359*, ed. P. D. A. Harvey (Oxfordshire Rec. Soc., l, and Roy. Comm. Hist. MSS., Jt. pubn., 23, Oxford, 1976), "Introduction".

[31] Mark Overton, *A Bibliography of British Probate Inventories* (Dept. of Geography, Univ. of Newcastle, Newcastle upon Tyne, 1983); Mark Overton, "English Probate Inventories and the Measurement of Agricultural Change", *A. A. G. Bijdragen*, xxiii (Wageningen, 1980), pp. 205-15; Mark Overton, "Probate Inventories and the Reconstruction of Agrarian Landscapes", in Michael Reed (ed.), *Discovering Past Landscapes* (London, 1984), pp. 167-94; Mark Overton, "Computer Analysis of an Inconsistent Data Source: The Case of Probate Inventories", *Jl. Hist. Geography*, iii (1977), pp. 317-26; Mark Overton, "Computer Standardization of Probate Inventories", in J.-P. Genet (ed.), *Standardisation et échange des bases de données historiques* (Paris, 1988), pp. 145-51; Mark Overton, "Computer Analysis of Probate Inventories: From Portable Micro to Mainframe", in Peter Denley and Deian Hopkin (eds.), *History and Computing* (Manchester, 1987), pp. 96-104.

old and infirm. Unlike the accounts, however, inventories relate to a very wide range of farm sizes, from the smallest to some of the largest, but with those of substantial yeomen predominating.

On the whole inventories are less reliable than the accounts, so the evaluation of their agricultural content gains much from a juxtaposition with medieval and nineteenth-century sources. National agricultural statistics were inaugurated in 1867, but local statistics survive for earlier dates and, while these are neither geographically comprehensive nor consistent, they cover many areas of the country. They include the 1801 crop return, the tithe files of *c.*1836 and county statistics for the 1830s and 1850s.[32]

The extent to which direct comparison is possible between these three principal groups of sources depends in part upon their respective patterns of survival. Manorial accounts provide representative coverage of only certain parts of central, southern and eastern England; probate inventories are also patchy in their coverage, as are the tithe files and crop returns.[33] A full reconstruction of agricultural trends over the six-hundred-year period, from the advent of manorial accounts in the mid-thirteenth century to the advent of official agricultural statistics in the latter part of the nineteenth century, will therefore only ever be possible for certain regions and counties.

One of those counties is Norfolk, long celebrated as one of the country's premier arable counties and the county most

[32] D. B. Grigg, "The Changing Agricultural Geography of England: A Commentary on the Sources Available for the Reconstruction of the Agricultural Geography of England, 1770-1850", *Trans. Inst. Brit. Geographers*, xli (1967), pp. 73-96; W. E. Minchinton, "Agricultural Returns and the Government during the Napoleonic Wars", *Agric. Hist. Rev.*, i (1953), pp. 29-43, repr. in Minchinton (ed.), *Essays in Agrarian History*, ii, pp. 103-20; Turner, "Arable in England and Wales"; M. Turner, "Agricultural Productivity in England in the Eighteenth Century: Evidence from Crop Yields", *Econ. Hist. Rev.*, 2nd ser., xxxv (1982), pp. 489-510; R. J. P. Kain and H. C. Prince, *The Tithe Surveys of England and Wales* (Cambridge, 1985); Roger J. P. Kain, *An Atlas and Index of the Tithe Files of Mid-Nineteenth-Century England and Wales* (Cambridge, 1986); Phillip Dodd, "The Agricultural Statistics for 1854: An Assessment of Their Value", *Agric. Hist. Rev.*, xxxv (1987), pp. 159-70.

[33] There is no national listing of accounts, although a summary register of manorial records may be consulted at the National Register of Archives, Quality Court, Chancery Lane, London. A handlist of grange accounts for ten counties around London — Essex, Middlesex, Hertfordshire, Bedfordshire, Buckinghamshire, Northamptonshire, Oxfordshire, Berkshire, Surrey and Kent — is being compiled by the "Feeding the City" project. For the spatial limitations to probate inventories as a source of yields, see Paul Glennie, "Measuring Crop Yields in Early Modern England", in Campbell and Overton (eds.), *Land, Labour and Livestock*, pp. 277-9; Turner, "Arable in England and Wales"; Kain, *Atlas and Index of the Tithe Files.*

closely associated with the genesis of the agricultural revolution. Norfolk is well served by extant accounts, inventories and tithe files. For the period between *c.*1250 and *c.*1450 there are approximately two thousand accounts representing in excess of two hundred different demesnes belonging to a wide range of different landlords, both lay and ecclesiastical.[34] Some three thousand farm inventories survive for the period 1584 to 1739.[35] Very few 1801 crop returns are extant for Norfolk, but the tithe files of the mid-1830s provide land-use and crop information for about two-thirds of tithe districts within the county. This series of sources is rounded off by a detailed set of agricultural statistics produced in 1854, based upon data from almost all the farms in the county.[36]

There are a number of methodological problems in deriving comparable measures from these sources.[37] The most important stem from the fact that accounts and inventories deal with units of different sizes, as shown in Table 1. Peasant farms are missing from the medieval material, whereas some of the very largest farms are missing from the early modern. This means that comparisons of absolute figures — crop acreages or livestock numbers — would be misleading, since they would reflect differences

[34] No attempt is made to list here all these accounts, which are drawn from the following archives: Public Record Office, London (hereafter P.R.O.); Norfolk Record Office, Norwich; North Yorkshire Record Office, Northallerton; Nottinghamshire Record Office, Nottingham; West Suffolk Record Office, Bury St Edmunds; Bodleian Library, Oxford; British Library, London (hereafter Brit. Lib.); Cambridge University Library; Canterbury Cathedral Library; Chicago University Library; Harvard Law Library, Cambridge, Mass.; John Rylands Library, Manchester; Lambeth Palace Library, London; Nottingham University Library; Eton College; Christ's College, Cambridge; King's College, Cambridge; Magdalen College, Oxford; St George's Chapel, Windsor; Elveden Hall, Suffolk; Holkham Hall, Norfolk; Raynham Hall, Norfolk; Pomeroy and Sons, Wymondham. We are grateful to the authorities concerned for access to these materials. A handlist of the individual accounts is available on request.

[35] The inventories used in this study are from the Norwich Consistory Court and are housed in the Norfolk Record Office. All available inventories were consulted with the exception of those for the period 1600-28. The numbers of inventories that can be used to calculate a particular measure varies because of the form in which information is presented. See Overton, "Measurement of Agricultural Change", p. 211.

[36] Turner, "Arable in England and Wales", p. 294; Kain, *Atlas and Index of the Tithe Files*, pp. 67-83; *Reports of Poor Law Inspectors on Agricultural Statistics (England), 1854*, Parliamentary Papers, 1854-5 (C. 1928), liii.

[37] For a fuller discussion of the methodological difficulties of combining information from accounts and inventories, see Mark Overton and Bruce M. S. Campbell, "Norfolk Livestock Farming, 1250-1740: A Comparative Study of Manorial Accounts and Probate Inventories", *Jl. Hist. Geography*, xviii (1992), pp. 377-96.

TABLE 1

NORFOLK: FREQUENCY DISTRIBUTIONS OF TOTAL SOWN ACREAGE[+] OF DEMESNES AND FARMS REPRESENTED BY ACCOUNTS AND INVENTORIES*

Sown acreage	1250-1349 N	%	1350-1449 N	%	1584-1640 N	%	1660-1739 N	%	1854 %
20–< 50	11	8.8	9	8.5	54	74.0	56	49.6	—
50–<100	29	23.2	32	30.2	12	16.4	43	38.1	—
100–<150	30	24.0	34	32.1	4	5.5	7	6.2	—
150–<200	26	20.8	16	15.1	3	4.1	1	0.9	—
200–<250	15	12.0	8	7.6	0	0.0	4	3.5	—
250–<300	4	3.2	1	0.9	0	0.0	1	0.9	—
300–<350	3	2.4	4	3.8	0	0.0	0	0.0	—
350–<400	5	4.0	2	1.9	0	0.0	0	0.0	—
400+	2	1.6	0	0.0	0	0.0	1	0.9	—
All	125	100.0	106	100.0	73	100.0	113	100.0	—
Mean all farms (acres)	152.5		132.7		27.0		41.4		49.1
Mean farms >20 acres	152.5		132.7		48.5		68.4		—

*Sources: 1250-1449, from manorial accounts: for location, see n. 34; 1584-1739, from probate inventories made June–July: for location, see n. 35.

[+] Cereals, together with peas, beans, vetches, buckwheat, turnips and clover. The sown acreage excludes pasture, meadow and fallow.

in farm sizes much more than differences in farming practice. Instead, comparisons must be based on relative measures, in the form of ratios and proportions. Since these may be calculated in a variety of ways, care must be taken to ensure an absolutely consistent methodology. To control for differences in farming patterns between large and small farmers, inventories have only been used for farms of at least twenty sown acres, equivalent to the smallest medieval demesne for which accounts are available. Since the spatial coverage of the data is irregular, aggregate county means are regionally weighted.[38] It is these aggregate means that provide the basis for comparison with the tithe files and the 1854 statistics, neither of which provides data at the level of individual farms. The former refer to "tithe districts", which are roughly equivalent to a parish and, although the latter are aggregations of returns from individual farms, the data are only available for nineteen poor-law unions.

[38] The county means are derived from four regional sub-means.

TABLE 2

NORFOLK: CROP COMBINATIONS 1250-1854*

	1250-1349	1350-1449	1584-1640	1660-1739	*c.* 1836	1854
% Grain acreage						
Wheat	18.8	17.5	28.7	19.8	48.4	49.0
Rye	13.1	6.9	16.4	11.4	—	1.0
Maslin	0.9	0.9	0.6	1.5	—	—
Barley	48.0	56.3	44.0	54.4	45.9	42.0
Oats	18.6	17.5	10.3	12.9	5.8	8.0
Dredge	0.6	1.0	0.0	0.0	—	—
% Sown acreage						
Grain	86.5	86.8	86.9	83.4	48.8	52.1
Legumes	13.5	13.2	9.0	13.7	26.9	24.4
Fodder[a]	13.5	13.2	12.7	16.6	51.2	46.5
Turnips[b]	0.0	0.0	0.1	7.2	24.3	22.1
Buckwheat	0.0	0.0	1.0	1.6	—	—
Clover	0.0	0.0	0.0	2.3	25.0[c]	21.4
Hemp, flax and hops	0.0	0.0	0.27	0.05	—	0.03
% Legume acreage						
Vetches	3.1	9.7	22.1	9.9	—	1.7
Clover	0.0	0.0	0.0	13.1	92.9	87.7
Bare fallow as % arable acreage	—	—	—	—	2.1	1.3
Grass[d] as % grass and arable	—	—	—	—	—	24.5

*Sources: 1250-1449, from manorial accounts: for location, see n. 34; 1584-1739, from probate inventories made in June–July with 20 or more sown acres: for location, see n. 35; *c.* 1836, Roger J. P. Kain, *An Atlas and Index of the Tithe Files of Mid-Nineteenth Century England and Wales* (Cambridge, 1986), p. 72; 1854, *Reports of Poor Law Inspectors on Agricultural Statistics (England), 1854*, Parliamentary Papers, 1854-5 (C. 1928), liii.

[a]Legumes, roots and buckwheat (excludes potatoes and carrots).

[b]Mean turnip acreage from August–December inventories as per cent of mean sown acreage June and July inventories.

[c]"Seeds".

[d]Meadow, permanent and rough pasture (excluding clover).

IV

CROP PROPORTIONS

The least problematic comparisons can be made between the proportions of the sown or grain acreage devoted to different crops. (See Table 2.) All four sources can be used for these indices, but only the accounts and inventories provide evidence of the proportion of farms on which the crops were grown. (See Table 3.) At an aggregate level, Tables 2 and 3 reveal that patterns of cropping in Norfolk were remarkably stable during the five

TABLE 3

NORFOLK: PERCENTAGES OF FARMS GROWING PARTICULAR CROPS 1250-1739*

	1250-1349	1350-1449	1584-1640	1660-1739
Wheat	96.8	88.8	87.5	89.9
Rye	79.8	54.2	64.6	60.3
Maslin	23.2	20.6	11.8	12.0
Barley	100.0	100.0	91.9	94.1
Oats	100.0	98.1	54.7	63.4
Dredge	12.8	16.8	0.0	0.0
Legumes	96.8	99.1	75.5	79.1
Vetches	5.2	26.0	50.9	44.1
Clover	0.0	0.0	0.0	15.9
Buckwheat	0.0	0.0	14.4	12.6
Turnips	0.0	0.0	0.2	44.7
Hemp, flax and hops	0.0	0.0	4.4	2.5

*Sources: 1250-1449, from manorial accounts: for location, see n. 34; 1584-1739, from probate inventories made in June and July with 20 or more sown acres, except turnips from June–December inventories: for location, see n. 35.

hundred years prior to 1740, in contrast to the far-reaching changes that evidently took place afterwards. Some new crops were introduced and some established crops rose or declined in relative importance but, on the whole, farmers in early modern Norfolk grew the same crops, in much the same proportions, as their medieval forebears. Nevertheless there were changes in both the geography of cereal cropping, and in the rotations of which these crops were a part.

Throughout this long period and, indeed, until well into the nineteenth century, Norfolk's dominant crop was barley. This was already the case in the mid-thirteenth century, when barley was still very much a minor crop in much of the rest of the country.[39] Throughout the Middle Ages Norfolk barley was traded up and down the east coast and across the North Sea.[40]

[39] On fifteen demesnes of St Benet's abbey in eastern Norfolk barley accounted for 64 per cent of the cereal acreage in 1238-46: Norfolk R.O., Diocesan Est/1 and 2/1; Church Comm. 101426 3/13. Within Norfolk as a whole, barley accounted for 51 per cent of the cereal acreage in 1250-99, as compared with a national average of 15 per cent. For the data on which the national mean is based, see Campbell and Power, "Mapping the Agricultural Geography of Medieval England", p. 25.

[40] For Norfolk's medieval grain trade, see E. M. Carus-Wilson, "The Medieval Trade of the Ports of the Wash", *Medieval Archaeology*, vi-vii (1962-3), p. 185; Vanessa Parker, *The Making of King's Lynn* (London, 1971), pp. 1-18; A. Saul, "Great Yarmouth in the Fourteenth Century: A Study in Trade, Politics and Society" (Univ. of Oxford D.Phil. thesis, 1975), pp. 226, 368-71, 374; Dorothy M. Owen (ed.), *The Making of King's Lynn* (Recs. Social and Econ. Hist., new ser., ix, London, 1984), pp. 42-8; R. H. Britnell, *Growth and Decline in Colchester, 1300-1525* (Cambridge,

(cont. on p. 56)

TABLE 4

NORFOLK: THE PRICES OF RYE, BARLEY AND OATS RELATIVE TO WHEAT*

	Wheat	Rye	Barley	Oats
1250-1299	1.00	0.65	0.72	0.40
1300-1349	1.00	0.67	0.74	0.49
1350-1399	1.00	0.68	0.55	0.36
1400-1499	1.00	0.58	0.53	0.38
1584-1640	1.00	0.73	0.59	0.37
1660-1735	1.00	0.61	0.53	0.35
c. 1836	1.00	0.62	0.57	0.40

*Sources: Medieval ratios calculated from London School of Economics, Beveridge Price Data, box G9. Early modern ratios calculated from prices given in probate inventories: for location, see n. 35.

This specialism persisted throughout the sixteenth, seventeenth and early eighteenth centuries, despite a general expansion of barley production in many other parts of the country and a corresponding decline in its price relative to other grains (Table 4).[41] By the 1730s over 80 per cent of all barley exported from England came from East Anglian ports.[42] For at least six hundred years barley was the preferred crop of most Norfolk farmers; its share of the county's grain area never fell below 40 per cent, and for significant periods exceeded 50 per cent. The concentration on barley was facilitated by intensive rotational systems, which relied upon half-year rather than full-year fallows and accordingly gave priority to spring-sown crops (virtually all the barley being spring- rather than winter-sown).[43] Indeed in

(n. 40 cont.)

1986), pp. 246-7; R. H. Britnell, "The Pastons and Their Norfolk", *Agric. Hist. Rev.*, xxxvi (1988), pp. 137-9; Campbell, "Ecology versus Economics". For Norfolk's contribution to London's grain supplies, see F. J. Fisher, "The Development of the London Food Market, 1540-1640", *Econ. Hist. Rev.*, v (1935), pp. 46-64, repr. in E. M. Carus-Wilson (ed.), *Essays in Economic History* (London, 1954), pp. 135-51; N. J. Williams, *The Maritime Trade of the East Anglian Ports, 1550-1590* (Oxford, 1988); Bruce M. S. Campbell *et al.*, *A Medieval Capital and Its Grain Supply: Agrarian Production and Distribution in the London Region, c.1300* (Hist. Geog. Research ser., no. 30, n. pl., 1993), pp. 47, 69-70, 181.

[41] Nationally, barley rose from an estimated 15 per cent to 27 per cent of the demesne cereal acreage between 1250-99 and 1400-49: the trend was especially pronounced in the eastern, midland and northern counties.

[42] David Ormrod, *English Grain Exports and the Structure of Agrarian Capitalism, 1700-1760* (Univ. of Hull, Occasional Papers in Econ. and Social Hist., no. 12, Hull, 1985), p. 38.

[43] These rotations are discussed in Bruce M. S. Campbell, "The Regional Uniqueness of English Field Systems? Some Evidence from Eastern Norfolk", *Agric. Hist. Rev.*, xxix (1981), pp. 16-28; Bruce M. S. Campbell, "Arable Productivity in

(cont. on p. 57)

the Middle Ages there were even some farms on which a state of barley monoculture effectively prevailed, in so far as its share of the grain area exceeded 70 or even 80 per cent of the total.[44] Intriguingly, barley attained its greatest pre-eminence during the demographic lulls of 1350-1499 and 1660-1735, when (as Table 4 shows) the price of barley relative to wheat was at its lowest level.

Wheat, the principal winter cereal, was the most highly priced crop of all and the leading commercial crop of much of the rest of south, central and eastern England, but it was of lesser importance in Norfolk.[45] Although consistently grown on nine out of ten Norfolk farms, its share of the grain area remained below a fifth of the total during 1250-1449 and 1660-1739. For a time, between 1584 and 1640, wheat expanded to occupy over a quarter of the grain acreage, but this gain was not sustained. By the nineteenth century, however, it occupied nearly half the cereal acreage and had supplanted barley as the county's leading cereal, suggesting a dramatic transformation from the early eighteenth century onwards.

Rye, the other principal winter-sown cereal, was grown on significantly fewer farms and was only dominant on Norfolk's lightest and least fertile soils, which were not suitable for wheat.[46] Over time its fortunes waxed and waned according to the extent to which these lighter soils were drawn into cultivation in response to the demand for land, and to the absolute and relative prices of grain. Prior to 1350 rye was commonly used as a cheap grain

(n. 43 cont.)
Medieval English Agriculture" (unpubd. 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.

[44] Demesnes devoting 70 per cent or more of their cereal acreage to barley included Ashby, Aylmerton, Burgh in Flegg, Costessey, Feltwell, Gimingham, Hanworth, Heigham by Norwich, Hemsby, Horning, Hoveton, Intwood, Keswick, Little Hautbois, Ludham, Martham, North Elmham, North Walsham, Ormesby, Reedham, Ringstead, Scottow and Sloley, while at Calthorpe, Flegg, Horsham, Thwaite and Tunstead this proportion exceeded 80 per cent. Four and a half centuries later the area immediately to the north of Aylsham and North Walsham was still sowing the county's largest acreages of barley: Kain, *Atlas and Index of the Tithe Files*, p. 76.

[45] Wheat accounted for an estimated 37 per cent of the national demesne cereal acreage in the period 1250-1349, as compared with only 18 per cent in Norfolk. It was especially prominent as a cereal in the two-field country of the north-east, the west midlands and south-west.

[46] Demesnes devoting 40 per cent or more of their cereal acreage to rye included East Wretham, Hargham, Hilgay, West Harling and West Tofts; all on the Breck edge. This compared with a county average of 13 per cent in the period 1250-1349 and 7 per cent in the period 1350-1449, and a national average of 6 per cent and 4 per cent respectively.

livery for farm servants, but thereafter its cultivation contracted as wage rates rose and dietary standards improved.[47] Changes in demand influenced its price relative to wheat, so that by the fifteenth century its relative share of the cereal acreage had contracted. By 1584-1640, however, with arable husbandry again in the ascendant and living standards once more declining, it had staged a comeback, only to lose ground again after 1660 as demographic pressure eased and dietary standards improved. Throughout these centuries there was a consistent background demand for rye-straw, which was especially valued for thatching because of its length. Significantly, by the mid-nineteenth century, with the improvement of much light land, a wider choice of crop breeds, and improved rural housing standards and diets, rye had contracted to only 1 per cent of the grain acreage.[48]

The fluctuating fortunes of rye — a bread grain — contrast with the dwindling importance of oats, which in Norfolk was primarily a fodder crop. There was a pronounced drop in the proportion of farms cultivating oats between the Middle Ages and early modern period, which was coupled with a contraction in its share of the total grain acreage. This trend is the more remarkable given a two- to threefold increase in the ratio of farm horses to sown acres over the same period. (See below, Table 6.) Evidently it was necessary to devote no more than one cereal acre in every five or six to the production of fodder, in order to satisfy the requirements of horse haulage and traction. Indeed the more oats were augmented with legumes, "horsemeat" (a legume-oats mixture), hay and grass, the smaller the share of the grain acreage it was necessary to devote to oats. Improved yields had the same effect, so that a two-and-a-half-fold increase in the ratio of workhorses to cereal acres between the Middle Ages and the mid-nineteenth century was matched by a trebling of oat yields. Over the same period the proportion of the grain acreage under oats contracted from 18 to 8 per cent of the total: the bare minimum necessary to service the needs of traction.

From as early as the mid-thirteenth century Norfolk was exceptional in the importance it attached to legumes as a source

[47] Christopher Dyer, "Changes in Diet in the Late Middle Ages: The Case of Harvest Workers", *Agric. Hist. Rev.*, xxxvi (1988), pp. 28-32.

[48] The decline in the consumption of rye bread is discussed in Sir William Ashley, "The Place of Rye in the History of English Food", *Econ. Jl.*, xxxi (1921), pp. 285-308, and in his *The Bread of Our Forefathers* (Oxford, 1928).

of human and animal food.[49] At this time several of the demesnes belonging to St Benet's abbey in eastern Norfolk were already devoting an eighth or more of their sown acreage to peas and beans.[50] By the early fourteenth century, when the intensive arable husbandry of this locality was at its most developed, this proportion had risen to a fifth or even a quarter on some demesnes.[51] Overall, legumes — principally peas, but also vetches and beans — occupied a remarkably consistent 13 per cent of the county's cropped acreage throughout the period 1250-1449. Subsequently their importance diminished somewhat, so that, by the late sixteenth and early seventeenth centuries, they occupied 9 per cent of the cropped area and were grown on three out of four farms. By 1660-1739, however, they had recovered to medieval levels of cultivation, partly due to the advent and gradual diffusion of clover.

Norfolk farmers pioneered the cultivation of clover in England and much has been made of the crop's revolutionary effects.[52] Nevertheless a comparison of inventories with the tithe files suggests that the principal benefits did not come until after 1740. Between 1660 and 1739 no more than 15 per cent of large farms grew clover and it accounted for only an eighth of the legume acreage, whereas by the 1830s clover comprised a quarter of the sown acreage and around 90 per cent of all legumes cultivated. In other words, beans, vetches and, above all, peas, long retained their medieval pre-eminence. Of these old-established crops, it is interesting to observe that vetches, introduced to Norfolk in the late thirteenth century, continued their diffusion — mainly

[49] Nationally, legumes accounted for an estimated 6 per cent of the demesne sown acreage in the period 1250-99, the proportion being lowest in the northern, midland and south-western counties.

[50] Norfolk R.O., Diocesan Est/1 and 2/1; Church Comm. 101426 3/13.

[51] During 1250-1349 demesnes on which legumes accounted for at least a fifth of the sown acreage included Alderford, Crownthorpe, Forncett, Guton in Brandiston, Hanworth, Hudeston, Hunstanton, Popinho, Scratby, Seething, Thornham and Tivetshall; at Bunwell, Flegg, Fordham, Lessingham, Loddon, Osmundiston, Sloley and Wiggenhall this proportion rose to a quarter.

[52] R. M. Garnier, "The Introduction of Forage Crops into Great Britain", *Jl. Roy. Agric. Soc. England*, 3rd ser., vii (1896), pp. 82-97; G. E. Fussell, "The Low Countries' Influence on English Farming", *Eng. Hist. Rev.*, lxxiv (1959), pp. 611-22; G. E. Fussell, "New Crops in Norfolk", *Amateur Historian*, iv (1958), pp. 1-8; G. E. Fussell, "'Norfolk Improvers': Their Farms and Methods", *Norfolk Archaeology*, xxxiii (1964), pp. 332-44; G. E. Fussell, "Adventures with Clover", *Agriculture*, lii (1955), pp. 342-5; Naomi Riches, *The Agricultural Revolution in Norfolk* (Chapel Hill, 1937).

at the expense of peas — so that by the late sixteenth century the proportion of farms growing them had doubled.[53]

In addition to vetches and clover, other new crops made their appearance. The first known reference to buckwheat in Norfolk occurs in 1480 at North Walsham, and by the late sixteenth century around 14 per cent of farmers were growing it, mostly in eastern Norfolk. It remained a specialism peculiar to this area, where it was probably used as a green manure in preparation for a wheat crop.[54] Turnips, in contrast, appeared in the 1580s in market gardens, moved to the fields on one or two farms by the 1630s, but spread rapidly to most parts of the county from the 1660s onwards. By the 1710s they were grown by over half of Norfolk's farmers, albeit still, for the most part, on a comparatively small scale.[55] Although some farmers were already cultivating quite large acreages at this time, within the county as a whole the crop only constituted about 7 per cent of the total sown acreage. On many farms, judging by the periods of the year at which turnips are mentioned in inventories, they were probably sown in August after the harvest as a catch crop for their green tops rather than for their roots.[56] As with clover, a comparison of the inventory data with the nineteenth-century cropping statistics makes it clear that turnips still had much ground left to conquer in the early eighteenth century. By the 1830s, however,

[53] Bruce M. S. Campbell, "The Diffusion of Vetches in Medieval England", *Econ. Hist. Rev.*, 2nd ser., xli (1988), pp. 193-208.

[54] In 1480 buckwheat is mentioned as part of the tithe received at North Walsham: Norfolk R.O., Diocesan Est/12. J[ohn] W[orlidge], *Systema Agriculturae*, 4th edn. (London, 1697), p. 41, describes its use as a green manure. He also considered (with several other contemporary writers) that the crop was grown on poor soils as a food for poultry. In Norfolk, however, it was largely confined to the fertile soils of the east and was grown by some of the most progressive farmers in the county, who were also introducing turnips and clover. Moreover the size of their poultry flocks (measured by value) does not seem to have differed from those of farmers not cultivating buckwheat with equivalent-sized holdings.

[55] Mark Overton, "The Diffusion of Agricultural Innovations in Early Modern England: Turnips and Clover in Norfolk and Suffolk, 1580-1740", *Trans. Inst. Brit. Geographers*, new ser., x (1985), pp. 205-21.

[56] As an integral part of the Norfolk four-course rotation turnips were supposed to be sown in March, whereas it is in the autumn that most are mentioned in inventories. Calculation of the proportion of the cropped acreage under turnips is complicated by the fact that they may not have been sown until other crops had been harvested. The figures from inventories in Table 1 are therefore derived by expressing the mean turnip acreage from inventories made from August to December as a percentage of the mean cropped acreage from June and July inventories for the same year.

the turnip acreage had risen to occupy nearly a quarter of the arable area.

On this evidence, therefore, patterns of cropping in Norfolk exhibited remarkable continuity up to the early eighteenth century but considerable change thereafter. Indeed the magnitude of the changes that occurred during the hundred years after 1740 were out of all proportion to those which had occurred during the preceding five hundred years. This stability in cropping is at odds with the view that the period from 1640-1750 witnessed a widespread diversification of arable husbandry through the cultivation of industrial crops, such as hops, hemp, flax, coleseed and dye plants.[57] These crops could be found on Norfolk farms, but systematic analysis of inventories indicates that fewer than 5 per cent of farmers represented in inventories (with more than twenty sown acres) were growing them. Nor were these industrial crops new to Norfolk agriculture in the seventeenth century. The commercial production of flax, hemp, coleseed, dye plants and teasels is documented as early as the late thirteenth and early fourteenth centuries, when the payment of tithes in flax and hemp suggests that these crops may have assumed particular prominence on peasant smallholdings.[58] They also continued, by and large, to be grown in the same parts of the county.

Nevertheless continuity in crops and crop proportions does not necessarily imply a continuity in methods of production. Husbandry techniques — the methods of ground preparation, fertilization, weeding, harvesting and rotational systems — are a subject on which the accounts cast much light and the inventories little. On the basis of the medieval evidence it would certainly be a mistake to regard any of these techniques as fixed or constant, for many were contingent upon the cost of labour and the price of grain.[59] In response to these influences, more intensive methods were adopted before 1310 but subsequently abandoned in the later fourteenth century. These changes in the intensity of cultivation took the form of modifications to both the length and nature of cropping sequences and to the frequency and duration of

[57] This is the argument of Joan Thirsk, in her editorial introduction to *Agrarian History of England and Wales*, v, *1640-1750*, i, *Regional Farming Systems*, pp. xxiv-xxvi.
[58] Campbell, "Agricultural Progress in Medieval England", p. 41.
[59] *Ibid.*, pp. 38-40.

fallows and, as such, were facilitated by the inherent flexibility of the county's field systems.[60]

Medieval rotations and fallowing practices may be reconstructed in graphic detail whenever consecutive accounts survive giving the names of field divisions within which the individual crops were sown. Reconstructions of cropping plans on a dozen demesnes scattered through the county confirm the extreme diversity of rotational and fallowing practices. There were demesnes on which convertible husbandry prevailed, with three or four years of crops followed by an equal or longer period during which the land lay unsown; demesnes on which land might be fallowed once every third, fourth or fifth year; and demesnes on which fallowing took place so infrequently as to constitute virtually continuous cropping.[61] Contrasting rotational systems sometimes co-existed on soils of different quality on the same demesne and the precise nature of cropping sequences usually varied a good deal from field to field and from year to year. The flexibility of rotations was, in fact, one reason why Norfolk subsequently proved so receptive to the introduction of new crops. At Hunstanton, for example, a crop-book of 1705-11 records 312 different cropping sequences on 493 separate plots of ground.[62] These too exemplify a variable and flexible system and reveal the incorporation of clover and ley grasses into an essentially medieval scheme of cropping. A more radical departure from medieval traditions can be found in the rotations recorded on three farms in west Norfolk between 1739 and 1751. These are some of the earliest examples of a Norfolk four-course rotation, in which wheat was succeeded by turnips, barley and

[60] M. R. Postgate, "Field Systems of East Anglia", in Alan R. H. Baker and Robin A. Butlin (eds.), *Studies of Field Systems in the British Isles* (Cambridge, 1973), pp. 303-5; J. Williamson, "Peasant Holdings in Medieval Norfolk: A Detailed Investigation into the Holdings of the Peasantry in Three Norfolk Villages in the Thirteenth Century" (Univ. of Reading Ph.D. thesis, 1976), pp. 272-306; Campbell, "Regional Uniqueness of English Field Systems?"; H. E. Hallam, "Farming Techniques: Eastern England", in H. E. Hallam (ed.), *Agrarian History of England and Wales*, ii, *1042-1350* (Cambridge, 1988), pp. 272-81; R. H. Britnell, "Eastern England", in Edward Miller (ed.), *Agrarian History of England and Wales*, iii, *1348-1500* (Cambridge, 1991), pp. 194-210.

[61] Rotations have been reconstructed for demesnes at Ashill, Bircham, Felbrigg, Keswick, Langham, Little Ellingham, Ormesby, Martham, Reedham, Sedgeford, Taverham, Thornage and Thorpe Abbotts in Norfolk, as well as Brandon, Redgrave and Rickinghall in north Suffolk.

[62] Norfolk R.O., L'Estrange Coll., BH/4.

clover.[63] Thereafter this sequence of cropping spread to the rest of the county, although strict adherence to the Norfolk four-course was rare. Clover leys often lasted several years; other crops such as oats and legumes were inserted into the rotation; and fallows were not entirely abandoned.[64] In direct contrast to medieval practice, however, it was a firm principle of these new rotations that the same land never bore grain crops in consecutive years.

Aside from the direct evidence of rotations, fundamental changes in both the nature of rotations and methods of husbandry can be inferred from shifts in the relative importance of winter and spring corn in particular regions of the county. (See Map.)[65] In the Middle Ages, winter corn dominated the south and west, whereas spring crops, with a particular emphasis on barley, occupied over 75 per cent of the cereal acreage on the fertile soils of eastern Norfolk. By the late sixteenth century, however, this pattern had been reversed. Winter corn (almost exclusively wheat) now dominated the cereal acreage in the east, while spring-sown crops gained steadily in relative importance on the light and relatively infertile soils of south-western Norfolk, as the cultivation of spring-sown barley expanded at the expense of winter-sown rye.[66] By the early seventeenth century, in direct

[63] "Management of Three Farms in the County of Norfolk", *Gentleman's Magazine*, xxii (1752), p. 501.

[64] Endless examples of rotations are given in William Marshall, *The Rural Economy of Norfolk*, 2 vols. (London, 1787); Arthur Young, *The Farmer's Tour through the East of England*, 4 vols. (London, 1771); Arthur Young, *General View of the Agriculture of the County of Norfolk* (London, 1804); Nathaniel Kent, *General View of the Agriculture of the County of Norfolk* (London, 1796). The four-course rotation was rare on the Coke estates of west Norfolk in the 1790s, but spread rapidly in the first two decades of the nineteenth century: R. A. C. Parker, *Coke of Norfolk: A Financial and Agricultural Study, 1707-1842* (Oxford, 1975), pp. 157-8.

[65] Discussion of the changing geography of crop and livestock production is based on systematic mapping of a wide range of variables from accounts and inventories. We hope to publish more of these maps in the future, but maps of livestock farming are to be found in Overton and Campbell, "Norfolk Livestock Farming", pp. 384, 390. Some early modern maps (calculated on a different basis) may be found in Mark Overton, *Agricultural Regions in Early Modern England: An Example from East Anglia* (Dept. of Geography, Univ. of Newcastle upon Tyne, Seminar Paper, no. 42, Newcastle upon Tyne, 1983). For the nineteenth century, see the maps in Kain, *Atlas and Index of the Tithe Files*; Susanna Wade Martins, *A Great Estate at Work: The Holkham Estate and Its Inhabitants in the Nineteenth Century* (Cambridge, 1980), pp. 20-4.

[66] Western and south-western demesnes on which barley registered a significant gain in its share of the cereal acreage included Ashill, Brandon, East Lexham, Feltwell, Great Cressingham and Heacham. See also Bailey, *Marginal Economy*, p. 237.

contrast to the situation three centuries earlier, it was west Norfolk that had become the stronghold of spring-cropping and commercial barley production.

Specialization in wheat by east Norfolk farmers was paralleled by a switch to pastoral husbandry on the heavy clay soils of central and south-eastern Norfolk. Direct evidence of the precise timing of the conversion of arable to pasture remains elusive but, by the time that inventories become available in the 1580s, it is plain that the change-over had in many cases already taken place.[67] The effect of subsequent price trends, especially after 1660, was merely to confirm this development, as is evident in the growing predominance of farms within these localities with livestock but either few, or no, crops. This parallels similar developments in many other parts of the country and in Norfolk, at least, is apparently without medieval precedent.[68] Further shifts in the geography of crop production took place between the eighteenth and nineteenth centuries. The differences between east and west became much less marked, as a greater proportion of wheat was grown in the west and a greater proportion of barley once more in the east.[69] Indeed the highest concentrations of barley production were to be found in the 1830s exactly where they had been in the Middle Ages.

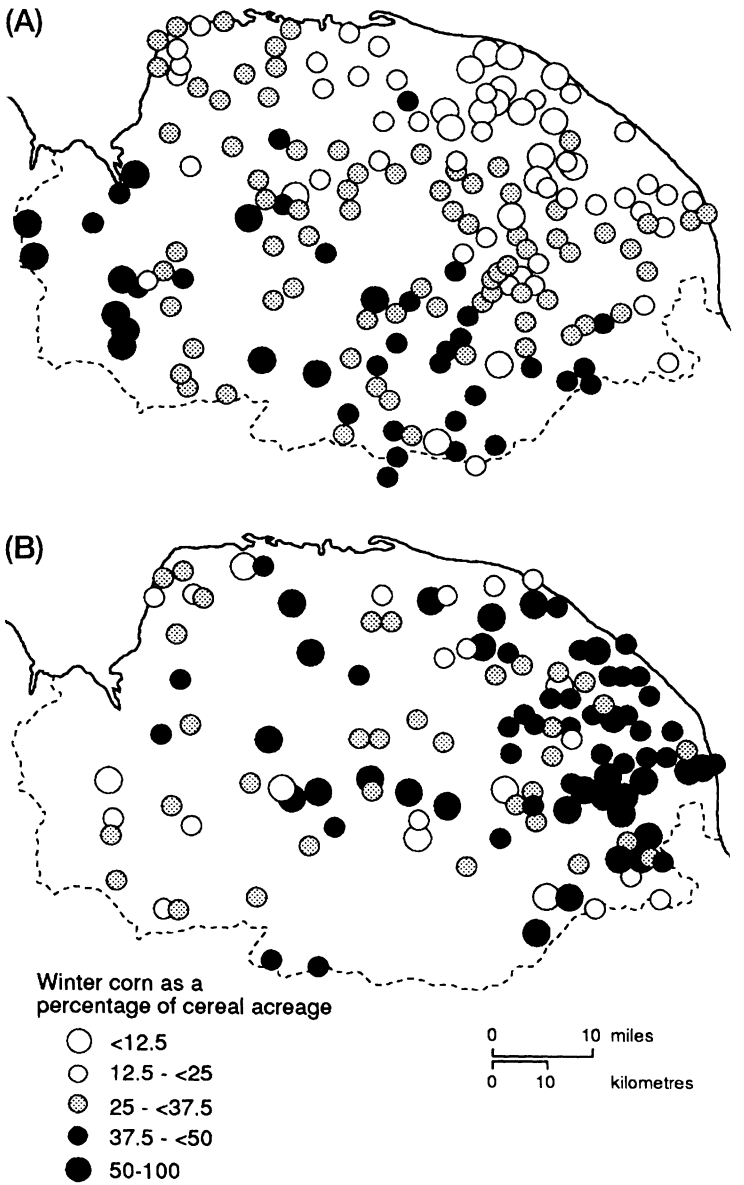
Since these spatial changes were associated with land of different qualities, other things being equal, they should have produced corresponding changes in crop yields. Heavy land which had yielded indifferently in the Middle Ages was taken out of cultivation; a greater proportion of the county's very best soils were

[67] Joan Thirsk, "The Farming Regions of England", in Thirsk (ed.), *Agrarian History of England and Wales*, iv, pp. 46-9; K. Skipper, "Wood-Pasture and Sheep-Corn: The Early Modern Regions of Norfolk Reconsidered" (Univ. of East Anglia M.A. thesis, 1989).

[68] Unless there were significant numbers of peasant producers who specialized almost exclusively in livestock. For examples of the emergence of specialist pastoral-farming regions during the fifteenth century, see Christopher Dyer, *Warwickshire Farming, 1349-c.1520: Preparations for Agricultural Revolution* (Dugdale Soc., Occasional Papers, no. 27, Oxford, 1981); Andrew Watkins, "Cattle Grazing in the Forest of Arden in the Later Middle Ages", *Agric. Hist. Rev.*, xxxvii (1989), pp. 12-25; H. S. A. Fox, "The Chronology of Enclosure and Economic Development in Medieval Devon", *Econ. Hist. Rev.*, 2nd ser., xxviii (1975), pp. 181-202. See also Harold Fox, "Peasant Farmers, Patterns of Settlement and *Pays*: Transformations in the Landscapes of Devon and Cornwall during the Later Middle Ages", in P. Higham (ed.), *Landscape and Townscape in the South-West* (Exeter, 1990), p. 64.

[69] Clare Sewell Read, "Recent Improvements in Norfolk Farming", *Jl. Roy. Agric. Soc. England*, xix (1858), p. 275.

MAP
WINTER-SOWN CEREALS AS A PERCENTAGE OF ALL CEREALS IN NORFOLK
(A) 1250-1449 AND (B) 1584-1739*



*Sources: See nn. 34-5.

devoted to wheat, and a greater proportion of its poor soils to barley.

V

CROP YIELDS

Crop yields per acre seem universally accepted by historians as the key index of agricultural progress and are often equated with "productivity". The word "productivity" has been described as "one of the most used, abused and misused words in our vocabulary", but it can be simply defined as the ratio of outputs to inputs.[70] In practice productivity indices vary, depending on the combinations of outputs and inputs that are considered and the units in which they are measured. The most important inputs, and therefore the most important productivities, are usually taken to be land and labour. Thus two of the most common measures of the agricultural productivity of a region are the output of agricultural products divided by the amount of land in agricultural production and by the number of workers employed in agriculture.[71] As yet, there are virtually no direct measures of labour productivity for English agriculture before the nineteenth century, although indirect measures, derived from estimates of the proportion of the work-force in agriculture and from wage rates, have been produced.[72] Fortunately the situation concerning land productivity is less bleak.

[70] V. H. Beynon and A. M. Houston, *Productivity: The Concept, Its Measurement and a Literature Review* (Nat. Econ. Development Office, London, 1969), p. 1. For further discussion of the issue of agricultural productivity in a historical context, see Overton and Campbell, "Productivity Change in Agricultural Development", pp. 7-17; Overton, "Land and Labour Productivity".

[71] Many economists favour a productivity measure, such as total-factor productivity, which embraces all of the separate factor productivities and relates output to a weighted combination of inputs. Difficulties in obtaining data for calculating total-factor productivity can be considerable, and it is impossible to derive a measure of total-factor productivity in English agriculture based on physical measures of inputs and outputs before the eighteenth century.

[72] E. A. Wrigley, "Urban Growth and Agricultural Change: England and the Continent in the Early Modern Period", *Jl. Interdisciplinary Hist.*, xv (1985), pp. 683-728, repr. in both Robert I. Rotberg and Theodore K. Rabb (eds.), *Population and Economy: From the Traditional to the Modern World* (Cambridge, 1986), pp. 123-68, and in E. A. Wrigley, *People, Cities and Wealth: The Transformation of Traditional Society* (Oxford, 1987), pp. 157-93; Mark Overton, "The Critical Century? The Agrarian History of England and Wales, 1750-1850", *Agric. Hist. Rev.*, xxxviii (1990), pp. 185-9; Gregory Clark, "Labour Productivity in English Agriculture, 1300-1860", in Campbell and Overton (eds.), *Land, Labour and Livestock*, pp. 211-35; Overton, "Land and Labour Productivity". Partial measures of labour

(cont. on p. 67)

Crop yields per sown acre can be directly calculated from manorial accounts and can be estimated indirectly from probate inventories. Before discussing the evidence from Norfolk, it is important to stress that yields per sown acre are only a partial measure of productivity: changes in yields per acre cannot be equated directly with changes in farm output or with changes in agricultural productivity as a whole.[73] Thus an increase in land productivity could arise at the cost of a decline in one or more of the other factor productivities, particularly the productivity of labour. Yield per sown acre is a restricted index of land productivity and is not the same as total agricultural output divided by the agricultural area. Obviously crop yields per acre take no account of livestock output, and cereal yields exclude the output of such farm products as fruit and vegetables, industrial crops, timber and turf. Yields per sown acre also fail to take account of the frequency with which the land is cropped. For example, high grain yields per acre on one farm might be associated with a long period of fallow, so that total grain output per acre of arable could be lower than for a comparable farm with lower yields but a shorter fallow.[74] It is also preferable to measure yields net of on-the-farm inputs such as seed and fodder, to get an indication of the grain available for consumption.[75] While this is possible for the Middle Ages, since accounts report the quantities of grain both sown and fed to livestock, it is not possible for the early modern period, when inventories are silent on both counts.[76]

Manorial accounts have long been used to produce crop yields per acre, but it is only comparatively recently that yields have been estimated from inventories.[77] Yields are not recorded dir-

(n. 72 cont.)

productivity are calculated from manorial accounts by Campbell for Martham ("Agricultural Progress in Medieval England", pp. 38-9) and Thornton for Rimpton ("Determinants of Land Productivity", pp. 204-7).

[73] For a discussion of this issue, see Overton and Campbell, "Productivity Change in Agricultural Development", pp. 7-17.

[74] As exemplified by the comparison of cereal productivity on the demesnes of Martham (Norfolk), Cuxham (Oxfordshire) and Rimpton (Somerset), in Thornton, "Determinants of Land Productivity", p. 192.

[75] B. H. Slicher van Bath, *The Agrarian History of Western Europe, A.D. 500-1850*, trans. Olive Ordish (London, 1963), pp. 18-23, 172-4, 177; E. A. Wrigley, "Some Reflections on Corn Yields and Prices in Pre-industrial Economies", in Wrigley, *People, Cities and Wealth*, pp. 92-130.

[76] Campbell, "Land, Labour, Livestock and Productivity Trends", pp. 170-2.

[77] Lord Beveridge, "The Yield and Price of Corn in the Middle Ages", *Econ. Hist.*, ii (1927), repr. in Carus-Wilson (ed.), *Essays in Economic History*, i, pp. 13-25; M. K.

(cont. on p. 68)

ectly in inventories, but can be inferred by comparing valuations of standing grain and harvested grain. The resulting estimates reflect the inventory appraisers' forecasts of yields and depend on assumptions about the precise ways in which they valued standing crops. Since the methodology is not straightforward, it has generated some debate, and the estimates shown in Table 5 and illustrated in the Graph are based on a refinement of Allen's modifications of the original method.[78] No attempt has been made to correct for distortions arising from the use of outsize customary acres and bushels. The scale of this distortion is likely to have diminished over time, as statute measures gained in currency, and by the eighteenth and nineteenth centuries (when the earliest reports on customary measures become available) the problem was no longer an important one in Norfolk.[79] Other potential

(n. 77 cont.)

Bennett, "British Wheat Yield per Acre for Seven Centuries", *Econ. Hist.*, iii (1935), pp. 12-29, repr. in Minchinton (ed.), *Essays in Agrarian History*, i, pp. 55-72; J. Z. Titow, *Winchester Yields: A Study in Medieval Agricultural Productivity* (Cambridge, 1972).

[78] Mark Overton, "Estimating Crop Yields from Probate Inventories: An Example from East Anglia, 1585-1735", *Jl. Econ. Hist.*, xxxix (1979), pp. 363-78; Mark Overton, "Agricultural Productivity in Eighteenth-Century England: Some Further Speculations", *Econ. Hist. Rev.*, 2nd ser., xxxvii (1984), p. 250, n. 37; Paul Glennie, "Continuity and Change in Hertfordshire Agriculture, 1550-1700: II, Trends in Crop Yields and Their Determinants", *Agric. Hist. Rev.*, xxxvi (1988), pp. 145-61. Robert C. Allen, "Inferring Yields from Probate Inventories", *Jl. Econ. Hist.*, xlviii (1988), pp. 117-25; Mark Overton, "Re-Estimating Crop Yields from Probate Inventories", *Jl. Econ. Hist.*, l (1990), pp. 931-5; Overton, "Determinants of Crop Yields", pp. 298-305; Glennie, "Measuring Crop Yields", pp. 255-83.

[79] During the Middle Ages statute perches are recorded at Hunstanton (Estfeld): Norfolk R.O., L'Estrange Coll. BG/2; Ketteringham: P.R.O., C134 F2(14); Marham: P.R.O., C134 F1(14); Quidenham: P.R.O., C133 F118(13); Saham: P.R.O., C134 F15(3); and Wymondham: P.R.O., C134 F2(16). Whereas non-statute perches were in use at Broome — 18½ ft.: P.R.O., C133 F114(7); Hudeston — 18½ ft.: P.R.O., C133 F118(8); Hunstanton (Westfeld) — 15½ ft.: Norfolk R.O., L'Estrange Coll. BG/2; Martham — 18½ ft.: Brit. Lib., Stowe MS. 936, fo. 37; Osmundiston — 16 ft.: Elveden Hall, Suffolk, Cornwallis (Bateman) MSS., box 47/2; Sedgeford — 17½ ft.: Williamson, "Peasant Holdings in Medieval Norfolk", p. 258; and Sheringham — 21½ ft.: P.R.O., C134 F8(20). On price evidence Lord Beveridge believed that Norwich cathedral priory changed from heaped to razed measures between 1344 and 1353: London School of Economics, Beveridge Price Data, box G9. The early modern and eighteenth-century evidence is largely negative since the standard authorities fail to mention Norfolk examples of non-statute acres, perches and bushels, although as late as 1800 such customary measures still prevailed in certain parts of the country: see Giles V. Harrison, "Agricultural Weights and Measures", in Thirsk (ed.), *Agrarian History of England and Wales*, v, ii, pp. 815-25; *A Return from Each Country in England and Wales, of The Different Measures ... under Which Wheat, Barley, Oats and Flour Are Sold*, Parliamentary Papers, 1854 (1761), lxv; Ronald Edward Zupko, *A Dictionary of English Weights and Measures: From Anglo-Saxon Times to the Nineteenth Century* (Madison, 1968).

sources of error are the magnitude of the allowance that should be made for the deduction of tithes, and differences in the farm sizes from which the estimates are derived. For the purpose of estimating gross yields there is no alternative but to assume that tithes represented a constant 10 per cent of the grain harvest, a degree of consistency which is unlikely to have applied in practice.[80] As far as the influence of farm size is concerned, medievalists tend to favour the view that yields recorded for seigneurial demesnes were superior to those obtained on peasant holdings in the same locality.[81] By the sixteenth and seventeenth centuries, however, no significant relationship is apparent between farm size and yields.[82]

Yields of individual cereal crops are given in Table 5 and shown in the Graph. As will be seen, there is a gap of 130 years between the 1450s, when the data from accounts effectively end, and the 1580s, when the inventory data begin. A gap of a further hundred years — broken only by the highly selective yield evidence assembled by Kent, Marshall and Young — occurs between the 1730s, when the inventory data peter out, and *c.*1836, when yield estimates are available from the tithe files.[83] For the mid-nineteenth century the report accompanying the agricultural statistics of 1854 includes some yield estimates, and shortly thereafter the results of several comprehensive surveys of yields are avail-

[80] Emmanuel Le Roy Ladurie and Joseph Goy, *Tithe and Agrarian History from the Fourteenth to the Nineteenth Centuries: An Essay in Comparative History*, trans. Susan Burke (Cambridge, 1982), pp. 24-60.

[81] Postan, "Medieval Agrarian Society", p. 602; Titow, *English Rural Society*, pp. 80-1; Dyer, *Standards of Living in the Later Middle Ages*, pp. 127-31. For a dissentient view, see Campbell, "Agricultural Progress in Medieval England", pp. 39-41.

[82] Overton, "Determinants of Crop Yields", p. 309-11, using evidence from Norfolk, Suffolk and Lincolnshire; Allen, "Two English Agricultural Revolutions", pp. 246-9, for Oxfordshire.

[83] Accounts for a handful of manors do continue into the second half of the fifteenth century but they are too few and unrepresentative to provide the basis for a reliable county estimate. Kain and Prince, *Tithe Surveys*; Kain, *Atlas and Index of the Tithe Files*: the only exception is the estimate produced by Arthur Young for a handful of farms in Norfolk: Arthur Young, *Farmer's Tour through the East of England*, iv, pp. 230-7. Robert C. Allen and Cormac Ó Gráda, "On the Road Again with Arthur Young: English, Irish and French Agriculture during the Industrial Revolution", *Jl. Econ. Hist.*, xlviii (1988), pp. 97-104, consider Young's yields to be representative although they do not compare them with either inventory or tithe evidence, or any other contemporary material. Cf. Eric Kerridge, "Arthur Young and William Marshall", *History Studies*, 1 (1968), pp. 43-65; G. E. Mingay, *Arthur Young and His Times* (London, 1975), pp. 15-16.

TABLE 5

NORFOLK: GROSS YIELDS 1250-1854*
(bushels per acre)

	Wheat	Rye	Barley	Oats	W.A.C.Y.[a]	Index[b]
1250-1274	13.2	8.8	15.7	13.5	9.3	100
1275-1299	14.9	10.3	15.8	13.8	10.3	111
1300-1324	14.9	10.0	16.1	13.3	11.0	118
1325-1349	15.6	10.5	17.2	15.0	11.9	127
1350-1374	11.4	8.9	15.3	11.9	8.6	92
1375-1399	12.9	10.1	17.3	14.0	9.7	104
1400-1424	12.7	9.9	14.9	13.9	8.0	86
1425-1449	10.7	12.0	15.4	14.5	8.9	96
1584-1599	11.7	11.9	11.7	15.4	8.2	85
1628-1640	17.3	11.6	11.9	18.4	9.4	98
1660-1679	12.8	14.1	13.9	13.1	8.2	85
1680-1709	14.7	9.0	15.3	20.0	8.5	89
1710-1739	16.9	14.4	22.0	26.4	12.9	134
1760s[c]	25.5	25.0	30.9	38.3	—	—
1790s[d]	24.0	—	—	—	—	—
c. 1800[e]	20.0	—	—	—	—	—
c. 1800[f]	24.0	—	36.0	40.0	—	—
1836[g]	23.3	—	32.0	36.3	20.7	216
1854[h]	30.0	—	38.0	46.0	25.5	266

*Sources: 1250-1449, from manorial accounts: for location, see n. 34; 1584-1739, from probate inventories made June–August with 20 or more sown acres, not weighted by harvest year: for location, see n. 35.

[a]Weighted Aggregate Cereal Yield. See n. 86.

[b]Index of W.A.C.Y. 1250-74 = 100.

[c]Calculated from Arthur Young, *The Farmer's Tour through the East of England*, 4 vols. (London, 1771), iv, pp. 230-7.

[d]Nathaniel Kent, *General View of the Agriculture of the County of Norfolk* (London, 1796), pp. 56, 59.

[e]William Marshall, *The Review and Abstract of the County Reports to the Board of Agriculture*, iii, *Eastern Department* (York, 1818), p. 349.

[f]Arthur Young, *General View of the Agriculture of the County of Norfolk* (London, 1804), pp. 251, 303, 306-8.

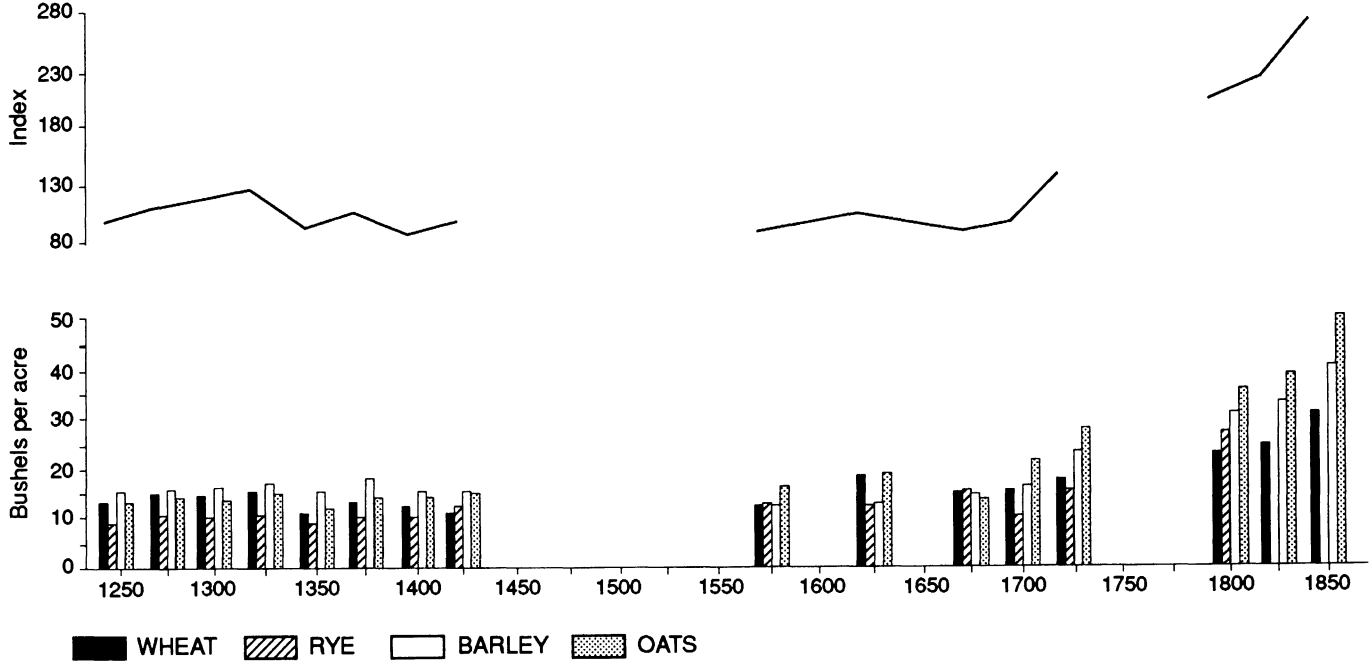
[g]Kain, *Atlas and Index of the Tithe Files*, p. 72.

[h]*Reports of Poor Law Inspectors on Agricultural Statistics (England), 1854.*

able.[84] Unfortunately differences in the relative values and extent of cultivation of the leading cereals limit the utility of individual yield figures as a measure of productivity change. As Patrick K. O'Brien and Gianni Toniolo have recently commented, "how much produce did a medieval peasant obtain from a 50-hectare

[84] *Reports of Poor Law Inspectors on Agricultural Statistics (England), 1854*, p. 39; P. G. Craigie, "Statistics of Agricultural Production", *Jl. Roy. Statistical Soc.*, xlvi (1883), pp. 1-47.

GRAPH
CEREAL YIELDS IN NORFOLK 1250-1854*



*Sources: See sources for Table 5.

plot of land compared with his modern successor cultivating the same plot is a question which can only be tackled by valuing the mix of crops harvested at prices prevailing in medieval and modern times".[85] Therefore Table 5 and the Graph also include an index of aggregate cereal yields, calculated by multiplying the yield figure for each crop by its price relative to wheat, and by the proportion of the cereal acreage it occupied.[86] This represents a single integrated measure of the mean volume of output per cereal acre over time.

How credible are the trends thus revealed? Wheat and barley were the two most widely grown and recorded crops, so their yields are the most securely documented. In the medieval period barley yields were consistently higher than wheat yields, although between 1584 and 1640 this relationship was reversed. This inversion reflects the fact that more of the wheat crop was being grown on the better soils of the east, and more of the barley on the poorer soils of the west and south-west. After 1660, with the resurgence of barley cultivation, the medieval relationship between wheat and barley yields was re-established and was still apparent in the 1830s. Throughout this long period the accounts, inventories and tithe files agree that wheat and barley gave the best yields on the county's most fertile and intensively cultivated soils, in the Fens and in eastern and northern Norfolk, and the worst yields on the light and infertile sands of the west and south-west.[87] In fact a wide yield differential existed between these two areas until well into the nineteenth century.[88] The only major

[85] Patrick K. O'Brien and Gianni Toniolo, "The Poverty of Italy and the Backwardness of Its Agriculture before 1914", in Campbell and Overton (eds.), *Land, Labour and Livestock*, p. 390.

[86] Symbolically, $Y = \Sigma\,(y_i \cdot p_i/p_w \cdot a_i/\Sigma a)$, where Y is weighted yield, y_i is the yield of crop i in bushels per acre, p_i is the price of the crop per bushel, p_w is the price of wheat per bushel, a_i is the acreage under crop i. For the derivation of this index, see Campbell, "Land, Labour, Livestock and Productivity Trends", pp. 165-74.

[87] The accounts also show that yields were least variable where they were at their highest and most variable where they were relatively low.

[88] In the period 1250-1349 weighted aggregate net cereal yields per acre ranged from a maximum of 12.12 bushels at Hemsby and 11.09 bushels at Martham, on the rich loam soils of the Flegg district of east Norfolk, to 4.46 at Gateley and 4.01 bushels at Wymondham, both on heavy soils in mid-Norfolk, and 3.31 bushels at Brandon and 3.32 bushels at East Wretham, on the light sandy soils of Breckland. At this date, therefore, there was a differential of three-and-a-half-fold between the highest- and lowest-yielding demesnes. The differential in cereal output per *arable* acre was, of course, even greater. For 1584-1640 wheat yields ranged from 4 to 24 bushels per acre, barley from 3 to 23. For 1660-1739 the corresponding figures were 3 to 32, and 6 to 36.

modification to this continuity in the geography of crop yields occurred on the heavy clay soils of south-eastern and central Norfolk: whereas in the Middle Ages these had yielded indifferently, by the 1830s their yields were well above average for the county.[89] This trend is already apparent from the inventory data and is testimony to the evolution of improved techniques for managing heavy land.

Compared with wheat and barley, the yield estimates for rye and oats — both minor crops — are more susceptible to error. Apart from the obvious problem of small sample sizes, there is the additional possibility that these crops were undervalued by inventory appraisers, since they were often produced for on-the-farm consumption and were not widely marketed. This may lead to some inflation of the yield estimates, as may the fact that no allowance has been made for the value of straw.[90] Hence, perhaps, the fact that in the sixteenth and seventeenth centuries oats and rye appear to have fared somewhat better relative to wheat and barley than they had done in the Middle Ages. On the other hand, the superior oat yields of the late seventeenth century are consistent with the crop's subsequent status as Norfolk's highest yielding cereal, which suggests that the apparent improvement in yields may indeed have been genuine. As such it can probably be related to husbandry changes which enhanced the status of oats within rotations and reduced the acreage on which they were grown.[91]

There are good reasons, therefore, for accepting as largely plausible the long-term trend of yields summarized in Table 5. The level, as opposed to the trend, of yields in the sixteenth and seventeenth centuries is most open to question, but it seems unlikely that the margin of error is more than 2 bushels per acre.[92] On this assumption, and in the light of existing literature

[89] For low yields on the heavy soils of south-east Norfolk in the Middle Ages, see Bruce M. S. Campbell, "Arable Productivity in Medieval England: Some Evidence from Norfolk", *Jl. Econ. Hist.*, xliii (1983), pp. 379-404.

[90] Glennie, "Measuring Crop Yields", pp. 265-6.

[91] During the Middle Ages oats were commonly sown at the runt end of rotations and therefore thickly. On many manors their yields improved after 1350 as rotations were shortened and fallows increased in frequency.

[92] The trend in wheat yields estimated from labour inputs "shows that there is little disagreement between the probate and labour input methods": Clark, "Yields per Acre in English Agriculture", p. 457.

on the course of crop productivity, three features stand out as of particular significance.

First, the Norfolk evidence reverses the prevailing assumptions about trends in medieval yields. There is no sign of a downward productivity trend as population pressure mounted within this most populous and intensively cultivated of medieval counties during the critical period between 1250 and 1349. On the contrary, yields tended to be higher before the Black Death, when arable husbandry was at fullest stretch and intensive methods were encouraged by high prices and low wages, rather than after, when the opposite conditions caused land to be withdrawn from cultivation and fallowing frequencies to rise.[93] Likewise yields rose between the periods 1584-99 and 1628-40 — when population was rising, grain prices were high and wage rates depressed — but then fell away between the periods 1628-40 and 1660-79, when population pressure slackened, prices stagnated and wages rose.

Secondly, contrary to the claims of Kerridge, Jones and, more recently, Allen and Yelling, in Norfolk at least, the breakthrough in grain productivity came in the eighteenth century and not in the seventeenth.[94] Wheat and barley yields remained at medieval levels until the first decades of the eighteenth century. Over the preceding five centuries wheat, rye, barley and oat yields were at their maxima during the first half of the fourteenth century. Thereafter, when yields peaked again in the 1630s, they were returning to an essentially medieval level and may well have been obtained by employing basically medieval methods of production.[95] Subsequently this ceiling was possibly breached by rye in the 1660s and oats in the 1680s, but not by barley and wheat (the two leading crops) until after 1710. It was only after 1710 that the mean yields of all four crops simultaneously bettered the earlier standard of productivity.[96] The weighted index of cereal

[93] Campbell, "Land, Labour, Livestock and Productivity Trends", pp. 144-9.

[94] Kerridge makes the extravagant claim that: "Inferior practices in the seventeenth century gave increases twice as great as the medieval standard of excellence, and the best, increases four times as great as the best medieval ones. At the end of the eighteenth century, yields were hardly more than in the early seventeenth. That is the measure of the advance that had been made by then": Kerridge, *Agricultural Revolution*, p. 329. See also Jones, "Agriculture and Economic Growth"; Allen, "Two English Agricultural Revolutions"; Yelling, "Agriculture, 1500-1730", pp. 193-5.

[95] Glennie, "Continuity and Change in Hertfordshire Agriculture: II", pp. 155-6.

[96] Much the same holds true of Hampshire, where yields estimated from inventories may be compared with those obtained on 24 demesnes of the bishops of Winchester:

(*cont. on p. 75*)

yields in the Graph lends dramatic emphasis to the fact that the turning-point came in the early eighteenth century: the index remains within the range 85-127 from 1250 until 1709 and only subsequently exhibits a decisive break with the past, rising marginally but decisively to 134, in 1710-39.

Thirdly, this yield rise, once initiated, evidently continued more or less unabated until the opening of the nineteenth century, when, according to the evidence assembled by Kent, Marshall and Young, wheat, barley and oat yields were 50-60 per cent higher than they had been in the 1730s. This steep rate of increase is without historical precedent; it also marks a break with the past in anticipating the renewed rise in population and associated changes in prices and wages.[97] Thereafter, for the next thirty or so years of the new century, the rate of increase slackened until a further upsurge in wheat yields — whose progress had hitherto lagged behind that of barley and oats — took place between the 1830s and the 1850s.[98] These trends seem to vindicate the view of an "agricultural revolution" (defined rather narrowly in terms of grain yields per acre) as an eighteenth-century phenomenon and also the arguments for a "second agricultural revolution" in the second quarter of the nineteenth century, since by the 1850s output per cereal acre was roughly twice what it had been in the 1730s and 1330s.[99]

At first sight, this Norfolk chronology of the growth in yields — and also, by implication, output — conflicts with estimates of agricultural output and productivity for England as a whole produced by Crafts and R. V. Jackson. The latter both consider that output and productivity were growing faster between 1700 and 1760 than they were between 1760 and 1800. Clark's recent estimates also suggest that the rate of growth in wheat yields was faster in the first half of the eighteenth century than it was in the second. Reconciling these various estimates is difficult, not only because they are calculated using different methods from different evidence but also, more importantly, because they measure

(n. 96 cont.)
Glennie, "Measuring Crop Yields", pp. 271-6; Titow, *Winchester Yields*; Overton and Campbell, "Productivity Change in European Agricultural Development", pp. 39-41.

[97] E. A. Wrigley and R. S. Schofield, *The Population History of England, 1541-1871: A Reconstruction* (Cambridge, 1989), pp. 402-12.

[98] Vindicating the opinion of Read, "Recent Improvements", pp. 274-5.

[99] F. M. L. Thompson, "The Second Agricultural Revolution, 1815-1880", *Econ. Hist. Rev.*, 2nd ser., xxi (1968), pp. 62-77.

different things. Cereal yield per sown acre is not the same as output, and is only a partial component of both land productivity and total factor productivity. In any case trends in Norfolk may have differed from those in other parts of England.[100]

VI

LIVESTOCK PROPORTIONS

Livestock occupy a subordinate position in most accounts of English agricultural development, despite their considerable contribution to the supply of food and industrial raw materials and their crucial role in the maintenance of arable husbandry through the provision of haulage, traction and manure. Yet livestock farming had greater potential for commercial development than did arable farming. Livestock farmers could respond more readily to the demands of distant markets because the costs of transporting their products were lower relative to those of arable farmers. Live animals could be walked to market; butter, cheese and wool were high in value relative to their bulk and hence better able to withstand the costs of overland carriage. Notwithstanding Norfolk's reputation as an arable producer, it is its livestock sector that emerges as consistently the more dynamic and, in certain respects, the more progressive branch of farming.[101]

The problems of comparing trends in livestock are much greater than those associated with crops and their yields, since stocking patterns varied considerably with farm size and category of farmer.[102] This is especially true of sheep. In the mid-nineteenth century the agricultural statistics — our most reliable source — demonstrate that sheep accounted for 33 per cent of

[100] For further discussion of estimates of output and productivity, see Overton, "Land and Labour Productivity"; for evidence of yields in other parts of England, see Overton and Campbell, "Productivity Change in Agricultural Development", pp. 38-41.

[101] Livestock are considered in Overton and Campbell, "Norfolk Livestock Farming".

[102] M. M. Postan, "Village Livestock in the Thirteenth Century", *Econ. Hist. Rev.*, 2nd ser., xv (1962), pp. 219-49, repr. in M. M. Postan, *Essays on Medieval Agriculture and General Problems of the Medieval Economy* (Cambridge, 1973), pp. 214-48; Kathleen Biddick, "Medieval English Peasants and Market Involvement", *Jl. Econ. Hist.*, xlv (1985), pp. 823-31; Robert C. Allen, *The "Capital Intensive Farmer" and the English Agricultural Revolution: A Reassessment* (Dept. of Economics, Univ. of British Columbia, Discussion Paper, no. 8711, Vancouver, 1987).

Norfolk livestock (Table 6).[103] In the Middle Ages, during the periods 1250-1349 and 1350-1449, the corresponding proportions were smaller, at 21 and 32 per cent respectively. These figures are almost certainly an understatement, both for the demesne sector and for agriculture as a whole. In the first place, they relate exclusively to demesne flocks, the largest of which were often managed on an inter-manorial basis and — increasingly during the fourteenth century — accounted for separately.[104] More seriously, it seems probable that at this time sheep were much more a peasant than a demesne animal. This is implicit in institutional arrangements which allowed lords to rely upon their tenants' sheep to dung their demesne lands.[105] It is also strongly suggested by Norfolk's massive contribution to the 1341-2 wool tax, which amounted to over an eighth of that collected from the country as a whole and two-and-a-half times that contributed by any other county.[106] This is a far greater contribution than might have been expected on the evidence of Norfolk's demesne flocks alone.

Whereas before 1350 seigneurial foldcourse owners had been more interested in their grain harvest than their wool clip and were content to exploit their tenants' animals for manuring the arable, from the mid-1370s this pattern began to change. As grain prices fell and labour costs rose, many landlords leased out their demesnes but retained their flocks in hand and exploited and extended their foldcourse rights, in order to expand their own sheep numbers at the expense of those of their tenants.[107] The attraction lay in sheep farming's lower costs of production and its capacity to produce meat, milk and wool at a time of uncertain

[103] Total livestock units are calculated as follows: (horses x 1.0) + (oxen x 1.2) + (adult cattle [cows + bulls] x 1.2) + (immature cattle x 0.8) + (sheep x 0.1) + (swine x 0.1). The weightings are based on feed requirements: for their derivation, see Campbell, "Land, Labour, Livestock and Productivity Trends", pp. 156-7.

[104] Norwich cathedral priory adopted central sheep accounting in 1392, after which sheep are rarely recorded in the accounts of individual manors: Norfolk R.O., L'Estrange Coll. IB 3/4. For other examples of central sheep accounting, see F. M. Page, "'Bidentes Hoylandie': A Medieval Sheep Farm", *Econ. Hist.*, i (1929), pp. 603-5; R. A. L. Smith, "The Estates of Pershore Abbey" (Univ. of London M.A. thesis, 1939), pp. 215-16; R. H. Hilton, "Winchcombe Abbey and the Manor of Sherbourne", *Univ. Birmingham Hist. Jl.*, ii (1949-50), pp. 50-2.

[105] Williamson, "Peasant Holdings in Medieval Norfolk", pp. 272-301; Campbell, "Regional Uniqueness of English Field Systems?", pp. 17-25; Postgate, "Field Systems of East Anglia"; Mark Bailey, "Sand into Gold: The Foldcourse System in West Suffolk, 1200-1600", *Agric. Hist. Rev.*, xxxviii (1990), pp. 40-57.

[106] M. Ormrod, "The Crown and the English Economy, 1290-1348", in Campbell (ed.), *Before the Black Death*, pp. 178-9.

[107] Bailey, "Sand into Gold", pp. 43-51.

markets.[108] This trend is apparent in the greatly expanded importance of sheep as a demesne animal after 1350 and a corresponding expansion in the mean size of demesne flocks. For instance, sheep numbers increased fourfold on the estates of the prior of Norwich between 1300 and 1500.[109] By the first half of the sixteenth century the county's greatest flockmasters were managing flocks of a thousand or more animals and the latent conflict of interests between foldcourse owners and their tenants was a mounting source of rural tension.[110] Such was the scale of this seigneurial expropriation of folding rights that by the close of the sixteenth century comparatively few sheep remained in the hands of tenant farmers. Instead, the majority of recorded sheep were concentrated in the hands of a few substantial flockmasters, mostly scattered through the west and south-west of the county.[111]

By the sixteenth and seventeenth centuries, therefore, the ownership pattern of the thirteenth century had been inverted. Sheep were now disproportionately a landlord animal, as is apparent in the highly skewed distribution of flock sizes recorded in the inventories.[112] In fact many of the largest flocks of all would have been owned by flockmasters whose inventories would not have been presented to the Consistory Court at Norwich, but are more likely to have had their probate dealt with by the Prerogative Court at Canterbury. Unfortunately none of these inventories are available for the period before 1660 and, for consistency, none of those that survive after 1660 have been included in the statistics presented here. As a result sheep are seriously underestimated in the livestock statistics for 1584-1640 and 1660-1739 summarized in Table 6.[113] Between 60 and 70 per cent of accounts record

[108] Mavis Mate, "Pastoral Farming in South-East England in the Fifteenth Century", *Econ. Hist. Rev.*, 2nd ser., xl (1987), pp. 523-36.

[109] Norfolk R.O., L'Estrange Coll. IB 4/4; DCN 62, 64.

[110] K. J. Allison, "Flock Management in the Sixteenth and Seventeenth Centuries", *Econ. Hist. Rev.*, 2nd ser., xi (1958), pp. 98-112; Diarmaid MacCulloch, "Kett's Rebellion in Context", *Past and Present*, no. 84 (Aug. 1979), pp. 51-3.

[111] Some of the county's greatest flockmasters managed as many as 15,000 animals: Allison, "Flock Management", pp. 99-101; A. Simpson, *The Wealth of the Gentry, 1540-1660: East Anglian Studies* (Cambridge, 1963), pp. 179-216.

[112] In the period covered by the inventories used here 70 per cent of farmers had no sheep recorded. Of those who did, the mean flock size was 86 animals, the median 30, the minimum 2, and the maximum 1,737.

[113] B. A. Holderness, "East Anglia and the Fens: Norfolk, Suffolk, Cambridgeshire, Ely, Huntingdonshire, Essex and the Lincolnshire Fens", in Thirsk (ed.), *Agrarian History of England and Wales*, v, i, p. 228, also points to the underenumeration of sheep in inventories.

TABLE 6

NORFOLK: LIVESTOCK STATISTICS 1250-1854*

	1250-1349	1350-1449	1584-1640	1660-1739	1854
% Livestock units[a]					
Cattle (excl. oxen)	45.9	43.8	[52.9][b]	[58.3]	40.3
Cattle	58.5	48.8	[53.4]	[58.3]	40.3
Horses	17.0	15.0	[36.2]	[27.2]	22.6
Oxen	12.7	5.0	[0.5]	[0.0]	0.0
Sheep	21.1	32.6	[4.9]	[10.9]	33.2
Swine	3.4	3.8	[5.5]	[3.8]	3.9
Livestock ratios[c]					
Immature : adult cattle[d]	0.82	0.52	0.84	1.79	—
Immature : adult cattle[e]	0.72	0.47	0.78	1.63	—
Sheep : cattle[e]	4.59	7.87	[0.74]	[5.47]	8.42
Oxen : horses[e]	0.66	0.37	0.05	0.00	0.00
Beasts per 100 cereal acres					
Livestock[d]	35.0	40.7	[76.9]	[76.7]	—
Livestock[e]	32.1	36.2	[50.9]	[69.7]	60.7
Cattle (excl. oxen)[e]	14.7	16.3	41.4	37.2	23.9
Cattle[e]	18.7	18.2	41.4	37.2	23.9
Horses[e]	5.4	5.3	16.8	12.5	13.7
Oxen[e]	4.1	2.2	0.0	0.0	0.0
Sheep[e]	68.7	113.7	[17.6]	[205.2]	201.4
Swine[e]	10.9	13.6	22.3	18.0	23.9
Draught beasts per 100 sown acres[e]	8.1	6.3	14.4	10.6	10.7

*Sources: 1250-1449, from manorial accounts: for location, see n. 34; 1584-1739, from probate inventories made June–July with 20 or more sown acres: for location, see n. 35; 1854, *Reports of Poor Law Inspectors on Agricultural Statistics (England), 1854.*

[a]See n. 103.

[b]Figures in square brackets involve sheep numbers which are subject to error.

[c]All farms with a minimum cattle herd size of 10.

[d]Means of ratios calculated for each farm or demesne.

[e]Aggregate mean: mean number of first animal type for the whole county divided by the mean number of the second animal type or by the mean crop acreage for the county.

sheep in the Middle Ages, but a mere 30 per cent of farm inventories include them. In Lincolnshire and Kent, where the Norfolk institution of the foldcourse did not exist, the proportion of inventories mentioning sheep is around 70 per cent.[114] It is certainly difficult to believe that the stocking density of sheep in 1584-1640 was inferior to that of 1350-1449, and it seems plausible to suppose that their share of livestock units throughout the early modern period was in the range 20-30 per cent, rather than the 5-11 per cent actually recorded for the farms with extant inventories. If this was indeed the case, it follows that the relative importance of all other categories of livestock is overstated, although not their stocking densities.

Data for other classes of livestock are more reliable. Allowing for the underestimation of sheep, swine, for instance, stand out as comprising a consistent 3-5 per cent of total livestock units throughout the period 1250-1854. Draught animals — horses and oxen — also comprised a fairly consistent 20-30 per cent of livestock units, although the number of horses in the early modern period may be slightly exaggerated by the inclusion of horses used for non-agricultural purposes. Horses were replacing oxen for draught as early as the late twelfth century and this process made steady progress throughout the Middle Ages, the first two-horse and one-man teams appearing on light-land demesnes towards the end of the fourteenth century.[115] A few oxen remained in Norfolk right down to the nineteenth century, but they had been virtually eliminated by the 1630s. The final stronghold of draught-oxen in Norfolk was the Fens but, after drainage in the seventeenth century, the Fens were to be an area of horse-power as well as horse-breeding.

Given Norfolk's naturally strong land-use bias towards arable, it was a remarkable achievement that non-working animals formed such a comparatively large proportion of livestock units from so early a date. This testifies to the intensity and effectiveness of the mixed-farming system that was already firmly in place in the thirteenth century and upon which subsequent centuries were to improve. This system gave priority to the more

[114] C. W. Chalklin, *Seventeenth Century Kent* (London, 1965), p. 100; Joan Thirsk, *English Peasant Farming: The Agrarian History of Lincolnshire from Tudor to Recent Times* (London 1957), pp. 34, 72, 87, 106.

[115] Campbell, "Towards an Agricultural Geography", pp. 91-4; John Langdon, *Horses, Oxen and Technological Innovation: The Use of Draught Animals in English Farming from 1066-1500* (Cambridge, 1986), pp. 50-1.

productive classes of livestock — horses rather than oxen for draught, cattle rather than sheep, adults rather than immatures — and sustained them on a mixture of temporary and permanent pasturage, managed grassland, hay and fodder crops of various types.[116] Notwithstanding the county's reputation for sheep farming, the distinctive institutions with which sheep farming was associated and the fact that there were certain types of land on which sheep alone would thrive, it was cattle that — with the possible exception of the fifteenth and early sixteenth centuries — constituted the core of Norfolk's intensive pastoral regime over this six-hundred-year period.

Cattle accounted for 40 per cent of livestock units in the mid-nineteenth century and, allowing for the underenumeration of sheep, accounted for a similar proportion throughout the Middle Ages. It is improbable that they accounted for less between 1584 and 1739, and after 1660 may well have accounted for significantly more. Throughout the Middle Ages, and until well into the seventeenth century, the low ratio of immature cattle to adults indicates that herds were geared towards dairying, with the breeding of replacement oxen and milking cattle a secondary consideration.[117] This made sound economic sense in a husbandry system that aimed at maximizing output per unit area of land, since cattle-based dairying is more productive of human food per unit area than most other forms of pastoral activity.[118] During the Middle Ages cattle assumed greatest prominence where integrated mixed-farming systems were most fully developed, notably on the fertile soils of central and eastern Norfolk, within ready access of the Norwich market and the textile-producing villages to the north.

By the early modern period cattle husbandry had undergone a spatial reorganization.[119] First, as noted earlier, increasing numbers of farmers on the heavy clay soils of south-central and south-

[116] Bruce M. S. Campbell, "Intensive Pastoral Husbandry in Medieval England: A Norfolk Perspective", in Edwin B. Dewindt (ed.), *The Salt of Common Life: Individuality and Choice in the Medieval Town, Countryside and Church. Essays Presented to J. Ambrose Raftis on the Occasion of His 70th Birthday* (Michigan, 1994).

[117] Bruce M. S. Campbell, "Commercial Dairy Production on Medieval English Demesnes: The Case of Norfolk", in Annie Grant (ed.), *Animals and Their Products in Trade and Exchange* (*Anthropozoologica*, xvi, *numéro spécial*, 4, Paris, 1992), pp. 107-18.

[118] I. G. Simmons, *The Ecology of Natural Resources* (London, 1974), pp. 201-6.

[119] Maps illustrating this reorganization are in Overton and Campbell, "Norfolk Livestock Farming", pp. 384, 390.

eastern Norfolk abandoned the unrewarding task of trying to cultivate their stiff and intractable soils and turned almost exclusively to pastoral husbandry.[120] Secondly, a proportion of these farmers, no doubt with an eye to the changing demands of the Norwich and, possibly, the metropolitan markets, concentrated their efforts not on dairying but on meat production. Many of the animals in question were not bred in the county but were brought in from outside, and there are enough references to Scottish, northern and Welsh steers to demonstrate that Norfolk graziers — especially in the Waveney valley — had become part of an inter-regional livestock trade that entailed the movement of stock over considerable distances. A century later, Kent reckoned that one-half of Norfolk cattle were driven from Scotland, a quarter from Wales and Ireland, while the remaining quarter were home-bred.[121] Henceforth, until the ploughing-up campaign of the Napoleonic Wars, southern and central Norfolk was to be a predominantly pastoral farming region which satisfied its grain requirements by drawing upon the surrounding arable districts. Thirdly, the mixed farmers on the fertile soils of the east of the county also began to fatten bullocks as an important adjunct to cereal farming.[122]

The emergence of bullock-fattening as an independent specialism in its own right shows up in the presence of herds with a demographic structure strongly biased towards immatures, especially after 1660 when the ratio of immature to adult cattle doubled. (See Table 6.) This, in turn, implies a higher turnover of animals, as they were finished more rapidly, generating a demand for young stock from breeding areas. Fattening was essentially a supply response to the significant changes in market demand from the late seventeenth century, and it was with the object of increasing fodder supplies that many Norfolk farmers adopted the cultivation of ley grasses, expanded their barley

[120] Shin-Ichi Yonekawa, "Champion and Woodland Norfolk: The Development of Regional Differences", *Jl. European Econ. Hist.*, vi (1977), pp. 163-76; Thirsk (ed.), *Agrarian History of England and Wales*, iv, pp. 46-7.

[121] Kent, *General View*, p. 101. For an example of this trade, see D. M. Woodward, "Cattle Droving in the Seventeenth Century: A Yorkshire Example", in W. H. Chaloner and Barrie M. Ratcliffe (eds.), *Trade and Transport: Essays in Economic History in Honour of T. S. Willan* (Manchester, 1977), pp. 35-57.

[122] Kent, *General View*, p. 33; Marshall, *Rural Economy of Norfolk*, i, p. 125; Holderness, "East Anglia and the Fens", pp. 234-6; Wade Martins, *Great Estate at Work*, p. 24.

acreage and experimented with new crops.[123] This revitalized mixed-farming systems and promoted a significant increase in cattle numbers on arable farms. Nowhere were these developments more pronounced than in eastern Norfolk, which regained its fourteenth-century prominence as an important cattle producer, albeit with bullock-fattening rather than dairying its principal goal.

VII

STOCKING DENSITIES

More striking than any of these changes in the composition and ownership of flocks and herds was an apparent doubling in the stocking densities of virtually all classes of livestock between the Middle Ages and the early modern period. This is significant because it implies dramatic increases in both the output and the productivity of the livestock sector. The ratio of draught animals — horses and oxen — to sown acres also more than doubled and was of considerable significance, since it represented a gain in the amount of working capital per cultivated acre and presumably led to increases in labour productivity.[124] The magnitude of the differences in stocking densities is so great that it raises questions about the reliability of the comparison between accounts and inventories. This is a complicated problem, since the underenumeration of sheep, the inclusion of non-agricultural horses, the development of farms exclusively devoted to livestock and the introduction of new crops into the sown acreage, all need to be taken into account when interpreting changes in stocking densities. How these densities are measured is also important. Stocking densities can be expressed as a ratio of livestock units to either the cereal acreage or the sown acreage, with average ratios for the county being calculated either as the mean of farm densities or from the aggregate totals of acres and animals. These issues are considered elsewhere, with the conclusion that the

[123] Mark Overton, "An Agricultural Revolution, 1650-1750", in Mark Overton *et al.*, *Agricultural History: Papers Presented to the Economic History Society Conference* (Canterbury, 1983), pp. 9-13; Overton, *Agricultural Regions in Early Modern England*; Overton, "Diffusion of Agricultural Innovations"; Overton, "Determinants of Crop Yields". See Thirsk, "Seventeenth-Century Agriculture and Social Change", for other responses to low cereal prices.

[124] E. A. Wrigley, "Energy Availability and Agricultural Productivity", in Campbell and Overton (eds.), *Land, Labour and Livestock*, pp. 323-39.

aggregate ratio of livestock units to cereal acres is the most robust measure.[125]

The most serious problem, given that the average size of farm represented by accounts is significantly larger than that recorded by inventories, is that stocking densities varied with farm size. Nevertheless the evidence from inventories shows that stocking densities only varied inversely with farm size up to a maximum of about fifty acres. Above this size no particular relationship is apparent. Yet, on farms of more than fifty acres, mean stocking densities roughly doubled between 1259-1450 and 1660-1740, from 35.9 to 62.5. Moreover for farms over twenty acres (employed in Table 6) the greatest rise in stocking densities took place between the late sixteenth century and the mid-seventeenth century (a comparison between inventories), rather than between the Middle Ages and the late sixteenth century (a comparison between accounts and inventories).[126] Thus the dramatic differences in stocking densities are not easily dismissed as merely the result of distortions arising from the different sources employed in the comparison.

The strength of the inverse relationship between stocking density and sown area revealed by the inventory data raises intriguing questions about the nature of the equivalent relationship in the Middle Ages.[127] At present it is widely believed, on little direct evidence, that in the thirteenth and fourteenth centuries stocking densities on peasants' holdings were inferior to those on demesnes, on the grounds that lords had greater command over capital and enjoyed privileged access to pastoral resources.[128] Moreover royal purveyancing and high levels of feudal rent, including customary dues such as heriot and obituary, struck directly at the peasants' ability to build up flocks and herds.[129] If

[125] Overton and Campbell, "Norfolk Livestock Farming".

[126] Means of total livestock units per 100 cereal acres were 37.6 for 1425-49, 38.3 for 1584-99, and 62.4 for 1628-40: Overton and Campbell, "Norfolk Livestock Farming". Between 1584 and 1739, 22 inventoried farms with at least fifty cropped acres have been identified in parishes for which there are also documented demesnes. A comparison of these two closely comparable sets of farms reveals 6 with stocking densities at or below the medieval average and 16 with densities above. Overall, stocking densities on the inventoried farms were 80 per cent higher than on the corresponding demesnes. This disparity is already apparent before 1640 and becomes more pronounced thereafter.

[127] Allen, "Two English Agricultural Revolutions", p. 253, raises the same point.

[128] Postan, "Medieval Agrarian Society", p. 554; Postan, "Village Livestock in the Thirteenth Century".

[129] J. R. Maddicott, *The English Peasantry and the Demands of the Crown, 1294-1341* (Past and Present Supplement, i, Oxford, 1975), repr. in T. H. Aston (ed.), *Landlords,*

(cont. on p. 85)

this was indeed the case, then one of the most striking differences between medieval agriculture and that of later centuries was the comparatively undeveloped scale of the peasants' pastoral sector. The transformation of their relative poverty in livestock during the fourteenth century, into the wealth that is so apparent at the close of the late sixteenth century, also implies a major process of capital accumulation within the peasant sector during the intervening period.[130] Such a process would certainly accord with the views of those who argue that it was the decline of feudal socio-property relations that provided the scope for capital accumulation and the fuller development of productive forces, but it remains to be demonstrated that this was in fact the case. Certainly a fuller investigation of medieval peasant livestock needs to be placed high on any future research agenda.

While livestock densities provide some impression of manure potential and of the relative importance of the cereal and pastoral sectors (on the assumption that legumes and other fodder crops were essentially pastoral products) it provides no true measure of whether changes in stocking densities were the consequence of a genuine improvement in the ratio of livestock to the total area of farmland (as opposed to the cereal or sown acreage) or merely of a relative shift in the ratio of cereal to pastoral land use. To establish this would require information on the areas under ley grasses, fallows and the various forms of permanent pasture, which neither accounts nor inventories provide. To calculate stocking densities in terms of the total farm area — the ideal — is therefore out of the question.[131]

There can be no doubt that the cereal and sown acreages varied as a proportion of the total farmed area. In the 1830s, after

(n. 129 cont.)
Peasants and Politics in Medieval England (Cambridge, 1987), pp. 285-359; A. R. H. Baker, "Evidence in the *Nonarum Inquisitiones* of Contracting Arable Lands in England during the Early Fourteenth Century", *Econ. Hist. Rev.*, 2nd ser., xix (1966), pp. 518-32.

[130] Sidney Pollard and David W. Crossley, *The Wealth of Britain, 1085-1966* (London, 1968), p. 65; R. H. Hilton, "A Crisis of Feudalism", *Past and Present*, no. 80 (Aug. 1978), pp. 15-16, repr. in Aston and Philpin (eds.), *Brenner Debate*, p. 133; Dyer, *Warwickshire Farming*, pp. 30-2; Dyer, *Standards of Living in the Later Middle Ages*, pp. 144-5; McIntosh, *Autonomy and Community*, pp. 226-7.

[131] For other ways of calculating the balance between crops and stock, see J. A. Yelling, "Probate Inventories and the Geography of Livestock Farming: A Study of East Worcestershire, 1540-1750", *Trans. Inst. Brit. Geographers*, li (1970), pp. 111-26.

centuries of reclamation, the cereal and sown acreages accounted for an estimated 38 and 77 per cent of the total land area respectively, with the remainder made up of fallows (2 per cent), grassland (21 per cent), commons (11 per cent) and woodland (4 per cent).[132] Prior to the widespread adoption of the Norfolk four-course rotation (which reduced the grain acreage to half the arable acreage), the grain acreage probably accounted for a larger proportion of a smaller arable area in both the medieval and early modern periods. At its medieval peak, *c.*1300, the cereal acreage may have matched or even exceeded that of the 1830s. Certainly, on the evidence of both manorial accounts and inquisitions *post mortem* (which record land use on the estates of lay tenants-in-chief of the crown), fallows and grassland held in severalty were both at a minimum *c.*1300 and the average ratio of arable to grassland (measured by area) was 5.0 to 1.0 (or 3.7 to 1.0 if measured by value).[133] The corresponding ratio in 1836 was 5.9 to 1.0, or 3.9 to 1.0 if commons are included.[134]

After 1350 the arable and cereal acreages contracted and the areas of temporary and permanent pasture expanded, which, other things being equal, should have produced an improvement in stocking densities.[135] Such a trend is indeed recorded by the accounts, but the gain was a modest 13 per cent and was not sustained after 1375, which implies that it may be understated (due to the under-recording of sheep) and that the peasant sector was the principal beneficiary through the leasing of demesne herds, herbage and rights of pasturage, of which there is considerable evidence.[136] After 1450 there are signs that the arable acreage continued to decline and the proportion of pasture to increase, for the ensuing hundred years was the peak period of settlement contraction and abandonment in the county.[137] It was this period

[132] Kain, *Atlas and Index of the Tithe Files*, p. 72.

[133] For a detailed presentation of the inquisitions *post mortem* data, see Bruce M. S. Campbell, "Medieval Land Use and Land Values", in Peter Wade-Martins (ed.), *An Historical Atlas of Norfolk* (Norwich, 1993), pp. 48-9.

[134] Calculated from Kain, *Atlas and Index of the Tithe Files*, p. 72.

[135] Campbell, "Land, Labour, Livestock and Productivity Trends".

[136] For the farm of demesne dairies and their herds, see Campbell, "Commercial Dairy Production on Medieval English Demesnes".

[137] K. J. Allison, "The Lost Villages of Norfolk", *Norfolk Archaeology*, xxxi (1957), pp. 116-62; P. Wade-Martins, "The Development of the Landscape and Human Settlement in West Norfolk from 350-1650 A.D., with Particular Reference to the Launditch Hundred" (Univ. of Leicester Ph.D. thesis, 1971); David Dymond, *The Norfolk Landscape* (London, 1985), pp. 135-46.

which saw the beginnings of piecemeal enclosure and important changes in the foldcourse as an institution. It is probable that increasing proportions of the county's heavy land were laid down to grass, in the face of high wage rates and low grain prices.[138] By 1600 it seems likely that there was a higher ratio of grassland to arable than in 1300, partly because there were now significant numbers of specialist pasture farms with little or no arable at all, but also because mixed farms maintained higher grassland ratios.

The trend towards a higher ratio of livestock to cereal acres that is apparent before 1640 becomes even more pronounced after 1660. On this occasion, however, rising livestock numbers appear to have been accompanied by a significant growth in both the arable and cereal acreages. The mean sown acreage recorded in inventories increased from fifty-five acres in the first half of the seventeenth century to eighty-five acres by the second half. It could be that the sample of inventories is biased in the latter period towards larger farmers, that average farm size was increasing, that the arable acreage was extending at the expense of pasture, or that all three of these factors were responsible for the increasing acreages. Of these possibilities, the extension of arable at the expense of pasture is most likely, since there is no reason to suppose any significant change in the types of farm represented by inventories during the course of the late seventeenth century and, while farm size could have been increasing, it is unlikely to have risen by over 50 per cent. Yet as arable was encroaching on pasture, livestock densities were simultaneously increasing, which can only imply a growing reliance upon fodder crops as part of an arable rotation. As fodder cropping grew in significance, so arable and pastoral husbandry became more closely integrated and mixed-farming systems rose in intensity, a development reinforced by a higher turnover of animals as greater emphasis was placed upon the rearing and fattening of younger beasts. At the same time, it seems almost certain, although our data reveal little direct evidence of it, that livestock productivity, as manifest by higher carcass weights and greater milk and wool yields, also rose significantly.[139] By 1700 Norfolk's cereal acreage was probably

[138] Campbell, "Extent and Layout"; D. P. Dymond, "The Parish of Walsham-le-Willows: Two Elizabethan Surveys and Their Medieval Background", *Proc. Suffolk Inst. Archaeology*, xxxiii (1974), pp. 195-211.

[139] Annie Grant, "Animal Resources", pp. 149-87, in Grenville Astill and Annie Grant (eds.), *The Countryside of Medieval England* (Oxford, 1988); P. L. Armitage, "A Preliminary Description of British Cattle from the Late Twelfth to the Early

(cont. on p. 88)

much the same as in 1300, but there were perhaps twice as many livestock and those livestock were undoubtedly more productive. Thereafter, especially with the revival of grain prices after 1740, stocking densities fell back somewhat, but by 1854 they remained well above those of the Middle Ages; a tribute to the boost provided to pastoral as well as to arable productivity by wider adoption of the Norfolk four-course rotation.[140]

VIII

TECHNOLOGICAL EVOLUTION AND AGRICULTURAL REVOLUTION

Taken together, this new evidence of crop proportions, crop yields, livestock proportions and stocking densities demands several important revisions to existing ideas of the nature and course of agrarian change between the thirteenth and the nineteenth centuries. Before reviewing these, however, it is necessary to reiterate that the data from accounts and inventories give only a limited picture of the fortunes of farm enterprises on only certain categories of farm. Some new pieces are added to the puzzle and the guesses about some of the others are better informed, but limitations of the historical record make it impossible for the complete picture to be reconstructed. Peasant farming in the Middle Ages and the activities of the great gentlemen flockmasters of the sixteenth and seventeenth centuries remain serious lacunae. Information is also lacking on the actual volume of crop and livestock output, the size of the cultivated area, and the relative importance of arable and pasture. Nor is material available on the changing magnitude of farming inputs, which makes it impossible to calculate fluctuations in the profitability of farming, or to measure agricultural productivity other than in terms of crop yields per acre.

The evidence from manorial accounts and probate inventories suggests that agricultural technology was far from static during this long period. Medieval and early modern farmers exhibited

(n. 139 cont.)
Sixteenth Century", *The Ark*, vii (1980), pp. 405-13; Clark, "Labour Productivity in English Agriculture", pp. 214-19.

[140] In east Worcestershire, the only area for which broadly comparable data are available, stocking densities fell continuously from the mid-sixteenth to the mid-eighteenth centuries as farmers increasingly specialized in wheat. This response indicates the development of an extensive farming system in contrast to the development of intensive systems in Norfolk. Yelling, "Probate Inventories and the Geography of Livestock Farming".

considerable ingenuity, adaptability and innovation in their husbandry practices. Indeed they had to, if yields were not to fall. Reserves of soil nitrogen had been continually depleted for millennia and, in a sense, farmers had to run in order to stand still by finding new ways of replacing the nitrogen taken out by crops. Legumes were particularly important in this respect, because they are able to convert atmospheric nitrogen into soil nitrogen which can be taken up by subsequent cereal crops. Contrary to the impression given by some historians, animal (or human) manure did not add new nitrogen to the soil: it was merely a means of recycling nitrogen that had been removed by harvested crops.[141]

Although there are abundant examples of the careful use of manures in the Middle Ages (including the application of night-soil from Norwich), there was no overall correlation between crop yields and stocking densities.[142] This is because crop and livestock production varied in the extent to which they were integrated and therefore in the rate at which nitrogen was recycled and restored to the soils from which it had been removed. Historians are right to have diagnosed medieval agriculture as characterized by relatively low stocking densities compared with later periods, but they have misarticulated the relationship between the arable and pastoral sectors and, in particular, the extent to which the productivity of the former was a function of the size of the latter.[143] High stocking densities, and hence a high manure potential, were no guarantee of high yields if arable and pastoral husbandry were managed as largely separate enterprises.[144] It is an obvious point, but growing crops could not benefit from manure which remained locked within the pastoral sector or was applied in such a way as to be dissipated through

[141] Robert S. Shiel, "Improving Soil Fertility in the Pre-Fertiliser Era", in Campbell and Overton (eds.), *Land, Labour and Livestock*, pp. 51-77.

[142] For the medieval use of "urban manure" — possibly night-soils — see Campbell, "Agricultural Progress in Medieval England", p. 34. See also Young, *Farmer's Tour through the East of England*, ii, p. 66, on the same in the eighteenth century.

[143] Biddick, *Other Economy*, p. 65.

[144] Kathleen Biddick, "Agrarian Productivity on the Estates of the Bishopric of Winchester in the Early Thirteenth Century: A Managerial Perspective", in Campbell and Overton (eds.), *Land, Labour and Livestock*, p. 115. A correlation of the weighted aggregate net yield per acre against the number of livestock units per 100 cereal acres for Norfolk, for the period 1250-1449, gives a correlation coefficient of +0.037. Indeed at Felbrigg, between 1401 and 1420, a correlation of the weighted aggregate yield per seed and per acre against the number of livestock units per 100 cereal acres, using five-year means, gives correlation coefficients of -0.71 and -0.57 respectively: Norfolk R.O., WKC 2/130-1/398x6. Yet see Titow, *Winchester Yields*, pp. 30-1.

leaching and oxidization. Where manure supplies were scarce, much could be gained by minimizing waste and ensuring their systematic and well-timed application to the soil. In these respects, some farmers with low stocking densities were much more assiduous than those with high ones, as is implicit in the fact that significantly higher stocking densities in the late sixteenth and early seventeenth centuries failed to elicit yields per acre that were superior to those of the Middle Ages.

It is in fact Norfolk's stocking densities rather than its crop yields that, on the evidence presented here, most distinguishes early modern from medieval agriculture. Whereas the best medieval yields were not significantly bettered until well into the eighteenth century, seventeenth-century stocking densities were roughly twice those of the fourteenth century.[145] In this sense, at least, Kerridge is correct in identifying a "revolution" in early modern farming. A switch of emphasis towards livestock farming was already under way in the late fourteenth century and continued through the fifteenth into the early sixteenth century. Unfortunately the latter stages of this movement cannot be documented until inventories become available in the late sixteenth century, when particularly significant gains appear to have been registered by the smallholdings of the peasantry. At first, increased livestock were accommodated on land withdrawn from arable cultivation and converted to pasture, with some heavyland farmers abandoning cultivation altogether. But fodder cropping and an expansion of temporary pasturage must also have played an increasing part, for stocking densities continued to rise on mixed farms until well into the seventeenth century, as pasture reverted once again to arable. Thus more livestock may well have been supported by a reduced acreage of pasture. This suggests that the output of forage and fodder per acre must have risen above medieval levels although this cannot be demonstrated explicitly from the evidence.

One way in which fodder and forage supplies could have been increased was by blurring the distinction between permanent pasture and permanent arable, through wider adoption of the ley

[145] The chronology of crop yields in Norfolk accords reasonably well with that established, by Guy Bois, Joseph Goy, Emmanuel Le Roy Ladurie, Hugues Neveux, Herman van der Wee and others, for parts of northern France and the Low Countries from tithe and other related data: Campbell, "Land, Labour, Livestock and Productivity Trends", pp. 178-82.

husbandry which had been practised in some parts of Norfolk since at least the fourteenth century.[146] At the same time, the productivity of ley husbandry could have been upgraded by the substitution of sown for self-seeded grasses.[147] Kerridge argues strongly for this development but inventories are problematic in their treatment of meadow and pasture because only those crops grown with the "industry and manurance of man" were meant to be included.[148] Thus they excluded natural grass or pasture, but might have included sown grass leys since these involved expenditure of capital and labour. As the seventeenth century advanced, inventory appraisers increasingly recorded sown grass, which points to the progressive expansion and improvement of ley husbandry. These methods undoubtedly helped to further the development of integrated mixed-farming systems and to restore yields to something approaching their early fourteenth-century peak, but it was not until after 1700 that yields were raised to significantly higher levels.

It seems probable that after 1650, unlike the period after 1350, the arable acreage did not fall. Contrary to the assumption of both Jones and John, the terms of trade moved only slightly in favour of livestock at the expense of crops, and this could have been more than offset by government inducements to maintain arable cultivation, together with the development of both new markets and new ways of marketing grain.[149] As a result the arable acreage may actually have expanded. Such a development would have squeezed supplies of permanent pasture yet further, thus providing farmers with a greater incentive to devote an

[146] Convertible husbandry systems, with three or four years of crops followed by three or four years when the land reverted to grass, were in operation on the de Clare demesne at Great Bircham between 1341 and 1349, and on the de Felbrigg demesne at Felbrigg between 1400 and 1408: P.R.O., SC 6/930/17-23; Norfolk R.O., WKC 2/130/398x6. Eric Stone drew attention to the probable existence of such a system in "The Estates of Norwich Cathedral Priory, 1100-1300" (Univ. of Oxford D.Phil. thesis, 1956), p. 347.

[147] Carolina Lane, "The Development of Pastures and Meadows during the Sixteenth and Seventeenth Centuries", *Agric. Hist. Rev.*, xxviii (1980), pp. 18-30.

[148] Overton, "Reconstruction of Agrarian Landscapes", pp. 169-70.

[149] Jones, *Agriculture and the Industrial Revolution*, p. 72; John, "Agricultural Productivity and Economic Growth", pp. 19-25; M. W. Flinn, "Agricultural Productivity and Economic Growth: A Comment", *Jl. Econ. Hist.*, xxvi (1966), pp. 93-8; Overton, "Agricultural Revolution, 1650-1750", pp. 6-7; Patrick O'Brien, "Agriculture and the Home Market for English Industry, 1660-1820", *Eng. Hist. Rev.*, c (1985), pp. 773-800; but see also the comments of Glennie, "Continuity and Change in Hertfordshire Agriculture: II", pp. 157-8.

increased proportion of their sown acreage to fodder production. They did this through the widespread adoption of clover and especially turnips. These crops prompted the further integration of livestock and crops since they were grown as part of an arable rotation, and, whether by accident or design, the increased cultivation of clover added new supplies of nitrogen to the soil.[150] Significantly it is from this date that a clear correlation emerges between stocking densities and crop yields on individual farms, indicative of the wider diffusion of genuinely integrated mixed-farming systems.[151]

The focus of livestock husbandry was also changing. Norfolk had long been precocious in its high ratio of non-draught to draught animals, a development facilitated by its equally precocious preference for horses for draught work. Within the non-draught sector, cattle assumed prominence and, from at least the mid-thirteenth century, herds exhibited a strong demographic bias towards mature females, indicative of a specialist interest in dairying. From the mid-seventeenth century, however, this bias began to tilt in the opposite direction, as immature cattle were increasingly favoured over adults and meat production took precedence over dairying. This marks an important new departure. Stock had for long been bought in from breeders in Scotland, Wales and the north of England, to be fattened over the summer on pasture farms in the marshes and river valleys. But after 1660 this practice spread to a second group of farms in the arable areas of eastern Norfolk, where bullocks were fattened on turnips and clover and probably also on barley.[152]

By 1700 east Norfolk farmers were moving towards the system of farming that was to have dramatic effects for the whole county a century later. Although they had some of the best land, they strove to maintain and increase soil fertility and were uniquely receptive to new technology. East Norfolk farmers were the first to grow buckwheat and, from the mid-seventeenth century, were the first to grow clover. Turnips were also grown here at an early

[150] The role of legumes in fixing nitrogen from the air was not properly understood until the late nineteenth century (Shiel, "Improving Soil Fertility", p. 54), but seventeenth-century farmers were well aware that clover was the "mother of corn": Walter Blith, *The English Improver Improved* (London, 1652), pp. 184-5; Worlidge, *Systema Agriculturae*, p. 26.

[151] Overton, "Determinants of Crop Yields", p. 312; Allen, "Two English Agricultural Revolutions", p. 253.

[152] Holderness, "East Anglia and the Fens", pp. 234-6.

date. These farmers continued to obtain the highest cereal yields, as their forebears had done in the Middle Ages. Indeed these east Norfolk farmers had been in the vanguard of progressive farming since at least the thirteenth century, when a similarly intensive and integrated mixed-farming system had developed. At that time, however, partly because of the environmental limitations of the technology involved and partly for institutional and economic reasons, it failed to develop or spread to much of the rest of the county.[153]

The story was very different in the eighteenth century. The evidence from inventories vindicates the view of both Kent and Marshall that the traditional "agricultural revolution" started in east Norfolk.[154] Here, by the 1730s, a few farmers were achieving yields which were unprecedented by the standards of the previous five centuries.[155] These pushed up mean yields for the county as a whole which, for the first time, broke away from medieval levels. Furthermore, this occurred without the stimulus of falling wages, rising prices and vigorously expanding demand. Indeed trends in agricultural wages convey a strong impression that labour productivity was also rising. By the mid-eighteenth century rising exports demonstrate that English agriculture was clearly producing a surplus, and a significant proportion of that surplus was being exported from Norfolk.[156]

Between 1740 and 1800, under the stimulus of renewed population growth and rising demand, the new husbandry of the east spread to much of the rest of the county, where clover, and more especially turnips, could help reclaim light land for cereal production, in conjunction with other improvements such as the addition

[153] As M. M. Postan has observed: "The real problem of medieval technology is not why new technological knowledge was not forthcoming, but why the methods, or even the implements, known to medieval men were not employed, or not employed earlier or more widely than they in fact were": M. M. Postan, *The Medieval Economy and Society* (London, 1972), p. 42. For a discussion of the constraints upon agricultural progress at this time, see Campbell, "People and Land", pp. 81-100; Campbell, "Ecology versus Economics".

[154] Marshall, *Rural Economy of Norfolk*, i, p. 125; Kent, *General View*, p. 33.

[155] A good example is provided by a farm at Billockby. In 1728 it grew wheat, barley and oats, together with buckwheat, clover and turnips, and was fattening Scottish cattle. Wheat yields — at 26 bushels per acre — and barley yields — at 33 bushels — were just at the medieval maxima for this part of the county. Norfolk R.O., INV 78/30.

[156] Ormrod, *English Grain Exports*; Nathaniel Kent, "Exported Produce of Norfolk", *Annals of Agriculture*, xxii (1794), pp. 34-41.

of massive quantities of marl and lime to the soil.[157] As a result, by the 1830s, high grain yields could be found in many parts of the county and the cultivation of turnips and clover had become so widespread that they constituted a quarter each of the total sown acreage. More significant than the rise in yields, however, was the extension of the arable acreage which these crops permitted, for this probably made a proportionately greater contribution to the rise in total grain output.[158] As a contemporary commentator observed: "we sow on these improved farms five times as many acres of wheat, twice as many of barley; of the former we grow three times as much on an acre, of the latter twice as much as formerly".[159] Associated with these developments was a greatly expanded volume of fodder: while cattle were the beneficiary of this in much of the east of the county, sheep remained the dominant animal in the west.[160] In fact it was the growth in fodder supplies that enabled the expansion in arable acreage to take place without much sacrifice in stocking densities, which implies that absolute numbers of cattle and especially sheep were also increasing. These gains in pastoral production reinforced the powerful upward trend in agricultural output as a whole. If the existence of such a trend in physical output is considered to represent the essence of an "agricultural revolution", there are certainly grounds for reinstating the late eighteenth and early nineteenth centuries as the principal revolutionary era.

By the 1830s the full potential of legume-based intensive husbandry seems to have been reached. Indeed if the comparison between the contemporary estimates around 1800 and the evidence of the tithe commissioners is valid, then yields had risen little over the first three decades of the nineteenth century. Between the 1830s and 1850s, however, yields of wheat jumped again. It is possible that by this time nitrogen was no longer the "limiting factor" in crop growth, so further applications of nitro-

[157] Hugh C. Prince, "The Changing Rural Landscape, 1750-1850", pp. 7-83, in Mingay (ed.), *Agrarian History of England and Wales*, vi, p.46; Hugh C. Prince, "The Origins of Pits and Depressions in Norfolk", *Geography*, xlix (1964), pp. 15-32; Marshall, *Rural Economy of Norfolk*, i, p. 259, ii, p. 364; Parker, *Coke of Norfolk*, p. 156.

[158] For England as a whole it has been estimated that between 1750 and 1800 the cultivated area grew by 0.42 per cent per annum, total agricultural output by 0.44-0.81 per cent, and total land productivity by 0.12-0.38 per cent: Overton, "Land and Labour Productivity".

[159] "Management of Three Farms in the County of Norfolk", p. 502.

[160] Wade Martins, *Great Estate at Work*, p. 24.

gen may have had little effect on yields. The element most likely to have been deficient was phosphorous, and this mid-nineteenth-century rise in yields coincides with the importation of large quantities of phosphate fertilizer from overseas, dubbed by F. M. L. Thompson a "second agricultural revolution". There is much contemporary Norfolk evidence of the intensive application of imported phosphate fertilizers and also of imported feedstuffs such as cattle-cake.[161] Thereafter yields rose little until the second half of the twentieth century, when artificial fertilizers, pesticides and herbicides were to revolutionize the physical output of farming once again.[162]

This long-term perspective demonstrates that most of the components of the technological package embodied in the Norfolk four-course rotation — the use of legumes, a reduction of fallows, manure-intensive husbandry, and the integration and mutual development of arable and pastoral husbandry — had been in place since the Middle Ages. Turnips were added as a fodder crop from at least the 1630s, and clover was being sown for fodder in the 1660s. It was the wider cultivation of the latter which from the mid-eighteenth century greatly enhanced the supply of nitrogen to the soil.[163] In the following century, nitrogen — in the form of feedstuffs and fertilizers — together with other plant nutrients, were imported from abroad, and in the twentieth century the chemical industry has produced vast quantities of nitrogen from the air using energy from fossil fuels.[164]

IX

POPULATION GROWTH AND AGRICULTURAL CHANGE

The evidence of changes in yields reverses the commonly accepted view of the relationship between the direction of population change and the trend of crop yields. Until the early eighteenth

[161] Thompson, "Second Agricultural Revolution"; Wade Martins, *Great Estate at Work*, p. 16; N. Bacon, *Report on the Agriculture of Norfolk* (London, 1844), p. 111; Read, "Recent Improvements", pp. 276-80, 287-8; Parker, *Coke of Norfolk*, pp. 158-61; B. Almack, "On the Agriculture of Norfolk", *Jl. Roy. Agric. Soc. England*, v (1842), pp. 307-57.

[162] F. R. Harper, "Crop Production in England and Wales, 1950-1980", *Jl. Roy. Agric. Soc. England*, cxlii (1981), pp. 42-54.

[163] G. P. H. Chorley, "The Agricultural Revolution in Northern Europe, 1750-1880: Nitrogen, Legumes and Crop Productivity", *Econ. Hist. Rev.*, 2nd ser., xxxiv (1981), pp. 71-93.

[164] Shiel, "Improving Soil Fertility", pp. 58-61, 67.

century the trends in yields suggest a Boserupian rather than a Malthusian response to the stimulus of population increase, in so far as population growth, accompanied by falling real wages and rising grain prices, was associated with rising not falling yields.[165] Conversely, yields fell when, after 1350, and again after 1650, population growth eased, wage rates rose and grain prices fell.[166] The decline in yields was greater in the fourteenth century, as was the decline in population, than it was after 1650.[167]

Historians have tended to follow Ricardo in arguing that extending the arable acreage involves the cultivation of land of poorer quality, which will in turn give poorer yields per acre and lower mean yields overall. Although neither accounts nor inventories can reveal the process directly, it is clear that mean yields tended to be at a maximum when the arable acreage was also at a maximum — as in the early fourteenth and early seventeenth centuries — rather than vice versa. In the short-term, provided the extension to the arable acreage involves ploughing out permanent pasture, cereal crops cultivated on the new arable will benefit from the reserves of nitrogen stored in the pasture land. This nitrogen boost can give yields on the new arable that are potentially twice those on old-established arable but, after twenty years or so, yields will fall back as the nitrogen is used up.[168] Thus, as Christopher Thornton has shown for the Winchester demesne of Rimpton in Somerset, some of the yield increases in the thirteenth century could have been due to this short-term

[165] Grigg, *Dynamics of Agricultural Change*, pp. 21-43; Postan and Hatcher, "Population and Class Relations", pp. 69-70; Ester Boserup, *The Conditions of Agricultural Growth: The Economics of Agrarian Change under Population Pressure* (London, 1965); Ester Boserup, *Population and Technology* (Oxford, 1981); E. A. Wrigley, "Malthus's Model of a Pre-Industrial Economy", in Michael Turner (ed.), *Malthus and His Time* (New York, 1986), pp. 3-18; E. A. Wrigley, "The Classical Economists and the Industrial Revolution", in Wrigley, *People, Cities and Wealth*, pp. 21-45.

[166] E. H. Phelps Brown and Sheila V. Hopkins, "Seven Centuries of Building Wages", *Economica*, new ser., no. 22 (1955), pp. 195-206; E. H. Phelps Brown and Sheila V. Hopkins, "Seven Centuries of the Prices of Consumables Compared with Builders' Wage-Rates", *Economica*, new ser., no. 23 (1956), pp. 296-314, both repr. in Carus-Wilson (ed.), *Essays in Economic History*, ii, pp. 168-96, and in Henry Phelps Brown and Sheila V. Hopkins, *A Perspective on Wages and Prices* (London, 1981), pp. 1-59.

[167] John Hatcher, *Plague, Population and the English Economy, 1348-1530* (London and Basingstoke, 1977); Wrigley and Schofield, *Population History of England*, pp. 207-15.

[168] Shiel, "Improving Soil Fertility", pp. 72-3; Overton, "Determinants of Crop Yields", pp. 293-4.

bonus. Once arable land reverts to pasture it takes about a hundred years for the reserves of soil nitrogen to regenerate. By the late sixteenth century, therefore, a re-extension of the arable acreage could again have led to short-term yield increases.[169]

Even in the longer-term, when reserves of nitrogen in former pasture land have been depleted, the Ricardian assumption only holds in the absence of technological change and if all other inputs per acre (including the rotational system and the frequency with which land is sown) remain constant. It has been demonstrated that considerable technological progress was achieved in the Middle Ages, and there is abundant evidence for the Middle Ages that other inputs were increased considerably. Such a process of intensification is directly observable before 1315 in medieval accounts, which record reductions in fallow, the substitution of higher- for lower-value crops, high seeding rates, intensive manuring and the lavish use of labour to prepare the soil and weed and harvest the crop.[170] Inventories do not contain such information, but it would seem likely that similar processes were at work in the late sixteenth and early seventeenth centuries, given that yields, cultivated acreage and wage trends were moving in the same directions as they had done before 1315. This evidence accords with Boserup's argument that yields will rise under conditions of population pressure, through an intensification of production which can serve to drive down labour productivity.[171]

Although in Norfolk mean yields rose in response to pressure of population in both the thirteenth and sixteenth centuries, the evidence of prices suggests that nationally agricultural output was failing to keep pace with growing demand.[172] Compared with the increase in demand (population almost doubled between 1541 and 1656 from around 2.7 million to 5.3 million and the magnitude of the increase was roughly the same during the century before 1300), the rise in yields was comparatively modest.

This indicates the danger of taking yields per sown acre as the sole guide to agricultural productivity. The overall productivity of agriculture, taking all factor inputs into account, may not have been rising, and indeed was probably falling during these periods,

[169] Thornton, "Determinants of Land Productivity", pp. 196-8, employs this argument in his study of Rimpton.
[170] Campbell, "Agricultural Progress in Medieval England", pp. 26-46.
[171] Boserup, *Population and Technology*.
[172] Pollard and Crossley, *Wealth of Britain*, p. 95.

since the improved returns to land may have been offset by falling returns to labour and capital, especially if higher yields were achieved through the intensification of labour inputs. If total agricultural productivity (calculated as the ratio of total outputs to total inputs) was indeed falling, then the agricultural sector would have been responsible for driving down living standards in such a way as to induce Malthusian-like demographic responses. Likewise, although yields dropped in subsequent periods, if the contraction in output was proportionately less than the reduction in inputs, overall agricultural productivity could well have been rising, as labour and capital were deployed with greater efficiency. This is more likely to have happened during the drop in yields from 1650 to 1700 than it was from 1350 to 1450 since, on the evidence of stocking densities, livestock output was probably significantly higher in the late seventeenth than it had been in the late fourteenth century. Under these circumstances, higher per capita output and incomes in agriculture would have relaxed the pressures for Malthusian preventive curbs to fertility, paving the way in due course for renewed population growth.

The adjectives "Malthusian" and "Boserupian" tend to be used rather loosely by historians, the former to mean that limitations of agricultural supply impose a constraint on population growth, and the latter to mean that population pressure stimulates a rise in agricultural output through rising yields. The two views are frequently held as mutually exclusive interpretations of the relationship between population growth and agrarian change, and strictly speaking they are, since Boserup's prime assumption is that population growth is independent of food supply. But this is not to say that a Malthusian check to population growth is incompatible with rising yields under conditions of population pressure, for the experience of Norfolk appears to demonstrate just that.[173]

This discussion of the relationship between productivity and population growth has suggested that land and labour productivity were inversely related before the eighteenth century, since increases in grain yields were likely to have been at the expense of the productivity of labour, and vice versa. Yet from the eight-

[173] This argument is developed in an unpublished paper, Mark Overton and Bruce M. S. Campbell, "Population Change and Agricultural Productivity in England, 1250-1850".

eenth century both land and labour productivity were rising together.[174] While technological change explains some part of the eventual rise in crop yields, it does not, by and large, explain improvements in labour productivity. With the exception of an increase in the draught power available from livestock, there is no evidence of technical innovations which would have materially added to the efficiency of farm labour until the end of the eighteenth century.[175]

X

INSTITUTIONS AND MARKETS

In the absence of substantial food imports, it is of course rising labour productivity, rather than the productivity of land alone, that is a necessary pre-condition for an expansion in the proportion of the nation's workforce employed in the industrial and tertiary sectors of the economy.[176] On the basis of changes in the estimated proportion of the population resident in towns, E. A. Wrigley has inferred that labour productivity in English agriculture must have doubled between the early seventeenth and the early nineteenth centuries.[177] Clark, on the other hand, working from changes in real wage rates, considers the rise in agricultural labour productivity to have begun earlier and amounted to a quadrupling between *c.*1300 and *c.*1850.[178] Clearly much remains to be learnt about the timing and scale of this transformation. Placing the kinds of indices employed by Wrigley and Clark on a firmer empirical footing will help, but this needs to be coupled

[174] Overton, "Land and Labour Productivity".

[175] Wrigley, "Energy Availability", pp. 323-39. For the contribution of improved material technology to the productivity of agricultural labour after 1750, see E. J. T. Collins, "Labour Supply and Demand in European Agriculture, 1800-1880", in E. L. Jones and S. J. Woolf (eds.), *Agrarian Change and Economic Development: The Historical Problems* (London, 1969), pp. 61-94; E. J. T. Collins, "The Age of Machinery", in G. E. Mingay (ed.), *The Victorian Countryside*, 2 vols. (London, 1981), i, pp. 200-13; George Grantham, "The Growth of Labour Productivity in the Production of Wheat in the *cinq grosses fermes* of France, 1750-1929", in Campbell and Overton (eds.), *Land, Labour and Livestock*, pp. 340-63.

[176] Nicholas F. R. Crafts, "British Industrialization in Its International Context", *Jl. Interdisciplinary Hist.*, xix (1989), pp. 415-28; N. F. R. Crafts, "The New Economic History and the Industrial Revolution", in Peter Mathias and John A. Davis (eds.), *The Nature of Industrialization*, i, *The First Industrial Revolutions* (Oxford, 1989), pp. 25-43; Wrigley, *Continuity, Chance and Change*, pp. 10-11.

[177] Wrigley, "Urban Growth and Agricultural Change", p. 138; Overton, "Critical Century?", pp. 185-6.

[178] Clark, "Labour Productivity in English Agriculture", pp. 219-21.

with more explicit investigation of the employment of labour within agriculture using manorial accounts, farm accounts and the like.[179]

Nevertheless, although agricultural labour productivity was rising from at least the sixteenth century, it was not until the eighteenth century that this was matched by rising land productivity and expanding total output. Nor was it until the end of that century that the strong positive relationship between the rate of growth in population and the rate of growth in food prices, which had existed from the Middle Ages, was finally broken.[180] That it was, reflects the marriage of an effective technology to an appropriate farm structure, which together were capable of responding to rising demand by raising the productivity of land without sacrificing the productivity of labour. To understand how this marriage came about shifts attention from the forces of production to the relations of production. It was institutions and markets which provided the crucial link between land and labour productivity and, hence, the overall productivity of the agricultural sector.

Such key institutional and structural developments as the substitution of waged for servile labour, break-up and leasing-out of demesnes, engrossment of holdings, establishment of more competitive terms of tenure and transformation of property rights exercised a powerful indirect influence upon the course of agricultural productivity growth.[181] Thus the rise in labour productivity has been ascribed to a more efficient, motivated, better-fed and harder-working labour force, to the substitution of first animal and then mechanical power for human labour, to the elimination of peasant smallholdings and creation of a system of large capitalist farms, and to the replacement of open-field agriculture by farming in enclosed fields under private property rights.[182]

[179] For a pioneering attempt to measure labour productivity on an individual demesne, see Thornton, "Determinants of Land Productivity", pp. 201-7.

[180] Overton, "Land and Labour Productivity"; Overton and Campbell, "Productivity Change in European Agricultural Development", pp. 44-5; Wrigley and Schofield, *Population History of England*, pp. 402-12.

[181] See above, nn. 6, 27. See also Douglass C. North and Robert Paul Thomas, *The Rise of the Western World: A New Economic History* (Cambridge, 1973).

[182] Gregory Clark, "Productivity Growth without Technical Change in European Agriculture before 1850", *Jl. Econ. Hist.*, xlvii (1987), pp. 419-32; Clark, "Labour Productivity in English Agriculture"; Wrigley, "Energy Availability"; Patrick K. O'Brien and Caglar Keyder, *Economic Growth in Britain and France, 1780-1914: Two*

(cont. on p. 101)

Likewise gains in land productivity have been assumed to depend on these changes in property rights, together with a growth in the size of farms.[183] But the relationships between these structural changes and trends in productivity are far from resolved and demand more research. Judicious application of the comparative approach may also help in establishing the relative importance of the different variables.[184]

These institutional changes were in turn linked to changing market opportunities. Markets were the essential mediator in a commercialized economy between the supply of and demand for agricultural products, yet developments in their nature and operation remain insufficiently understood. Over time, changes occurred in the efficiency with which the market operated (thereby raising or lowering transactions costs), in the size and composition of demand, and in the degree to which farmers participated in the market both to obtain farm inputs and to dispose of their produce.[185] Many of these developments are

(n. 182 cont.)
Paths to the Twentieth Century (London, 1978); Robert C. Allen, "The Growth of Labor Productivity in Early Modern English Agriculture", *Explorations in Econ. Hist.*, xxv (1988), pp. 117-46; Allen, "Two English Agricultural Revolutions", pp. 236-54; Brenner, "Agrarian Roots of European Capitalism"; Dunford and Perrons, *Arena of Capital*, pp. 120-3.

[183] Ernle, *English Farming*, pp. 207-23; Michael Turner, "English Open Fields and Enclosures: Retardation or Productivity Improvements", *Jl. Econ. Hist.*, xlvi (1986), pp. 669-92; Allen and Ó Gráda, "On the Road Again"; J. P. Cooper, "In Search of Agrarian Capitalism", *Past and Present*, no. 80 (Aug. 1978), pp. 20-65, repr. in Aston and Philpin (eds.), *Brenner Debate*, pp. 138-91.

[184] See, for instance, Peter Solar and Martine Goossens, "Agricultural Productivity in Belgium and Ireland in the Early Nineteenth Century", in Campbell and Overton (eds.), *Land, Labour and Livestock*, pp. 364-84; Allen and Ó Gráda, "On the Road Again". For a pioneering attempt at a critical evaluation of the sources of labour productivity growth in French wheat production 1750-1929, see Grantham, "Growth of Labour Productivity".

[185] R. H. Britnell, *The Commercialisation of English Society, 1000-1500* (Cambridge, 1993). A recent review of market development is to be found in J. A. Chartres, "City and Towns: Farmers and Economic Change in the Eighteenth Century", *Hist. Research*, lxiv (1991), pp. 138-55. The relationship between marketing and agricultural development has attracted more attention in France than Britain: Abbott Payson Usher, *The History of the Grain Trade in France, 1400-1710* (Cambridge, Mass., 1913); George Grantham, "Jean Meuvret and the Subsistence Problem in Early Modern France", *Jl. Econ. Hist.*, xlix (1989), pp. 184-200; D. R. Weir, "Markets and Mortality in France, 1600-1789", in J. Walter and R. S. Schofield (eds.), *Famine, Disease and Social Order in Early Modern Society* (Cambridge, 1989). For an early but flawed analysis of the development of the corn market in England, see N. S. B. Gras, *The Evolution of the English Corn Market from the Twelfth to the Eighteenth Century* (Cambridge, Mass., 1910); a critique is by E. Kneisel, "The Evolution of the English Corn Market", *Jl. Econ. Hist.*, xiv (1954), pp. 46-52.

amenable to closer investigation. For instance, manorial accounts represent a particularly rich and detailed source for exploring the level of commercial involvement of the demesne sector at a relatively early date, and information on the payment of money rents and patterns of wealth recorded in surviving tax schedules can be used to make inferences about the corresponding commercial involvement of the peasantry.[186] Once commercialized, farmers were exposed to changes in the size and composition of demand, as populations expanded and contracted, living standards rose and fell, dietary preferences changed, and new configurations emerged in the social and geographical distribution of wealth. In this context, more systematic investigation of the social history of diet will do much to help make sense of changes in the composition of agricultural output.

Certainly, on the evidence of the changes in husbandry practice documented here, the market was structuring agricultural production in Norfolk from at least the thirteenth century. From the end of that century light-soil farmers in south-west Norfolk, with potentially lucrative trading contacts via the River Ouse and the port of King's Lynn, discovered that their best comparative advantage lay in commercial barley production and expanded its cultivation accordingly.[187] As barley became more generally cultivated, its price fell both absolutely and relatively to the point at which, in the fifteenth century, farmers on the better soils of east Norfolk were encouraged to shift from barley to wheat, a trend reinforced during the sixteenth century, as demand for bread-wheat grew from Norwich and London. At the same time a more clearly defined and buoyant demand for meat and dairy produce, especially from Norwich, coupled with more favourable terms of trade for pastoral produce, encouraged the emergence of specialist livestock farms on the heavy soils of the centre and south-east of the county.[188] Subsequently, in the late seventeenth and early eighteenth centuries, increasing demand for quality

[186] Bruce M. S. Campbell, "How Commercialised Was the Seigniorial Sector of English Agriculture, circa 1300? Some Evidence from the Hinterland of London", in R. H. Britnell and Bruce M. S. Campbell (eds.), *A Commercialising Society? England, 1000-1300* (Manchester, forthcoming); E. A. Kosminsky, *Studies in the Agrarian History of England in the Thirteenth Century*, ed. R. H. Hilton, trans. R. Kisch (Oxford, 1956), pp. 152-96; Biddick, "Medieval English Peasants and Market Involvement".

[187] Bailey, *Marginal Economy*, pp. 153-6; P.R.O., E101/574/25.

[188] J. L. Bolton, *The Medieval English Economy, 1150-1500* (London, 1980), pp. 254, 346, 349; Dyer, *Standards of Living in the Later Middle Ages*, pp. 199-202.

malt from brewers and distillers in London and the Low Counties, a government policy of subsidizing the export of malt, new methods of marketing grain, and the growing practice of using barley to fatten bullocks, induced a further expansion of barley production at a county level — the crop for which Norfolk possessed a particular comparative advantage.[189]

Integral to these developments were the changing provisioning requirements of cities such as Norwich and London. Much has been written about the stimulus provided by the presence of major cities to agricultural progress, but to date — notwithstanding the lead long ago provided by J. H. von Thünen — there has been little attempt to map the provisioning zones of individual cities in a specific way.[190] The matter is an important one for, as urban hinterlands expanded and contracted, so farmers altered the crops and livestock they produced and the intensity of their production. Processes of this kind partly underlay the changing patterns of production observed in Norfolk.

Although estimates of medieval urban populations are currently undergoing some revision — a population of *c.*25,000 has been suggested for Norwich *c.*1330, and between 80,000 and 100,000 for London *c.*1300 — it is beyond dispute that England was more urbanized in the seventeenth century than it had been in the thirteenth.[191] London was probably twice as large *c.*1600 than it had been *c.*1300 and its food-supply hinterland was correspond-

[189] Mark Overton, "Agricultural Change in Norfolk and Suffolk, 1580-1740" (Univ. of Cambridge Ph.D. thesis, 1981), pp. 257-9; Ormrod, *English Grain Exports*; J. A. Chartres, "The Marketing of Agricultural Produce", in Thirsk (ed.), *Agrarian History of England and Wales*, v, ii, pp. 406-502, repr. in J. A. Chartres (ed.), *Agricultural Markets and Trade, 1500-1750* (Cambridge, 1990), pp. 157-253; See Riches, *Agricultural Revolution*, p. 24, for Norfolk's market advantages.

[190] Notably E. A. Wrigley, "A Simple Model of London's Importance in Changing English Society and Economy, 1650-1750", *Past and Present*, no. 37 (July 1967), pp. 44-70, repr. in Wrigley, *People, Cities and Wealth*, pp. 133-56; Wrigley, "Urban Growth and Agricultural Change"; John Langton and Göran Hoppe, *Town and Country in the Development of Early Modern Western Europe* (Hist. Geography Research ser., no. 11, Norwich, 1983); George Grantham, "Agricultural Productivity and Urban Provisioning Zones before the Industrial Revolution", *Jl. Econ. Hist.* (forthcoming). On the work of J. H. von Thünen, see Peter Hall (ed.), *Von Thünen's Isolated State: An English Edition of "Der isolierte Staat"*, trans. Carla M. Wartenberg (Oxford, 1966); Michael Chisholm, *Rural Settlement and Land-Use: An Essay on Location* (London, 1962), pp. 20-32.

[191] Elizabeth Rutledge, "Immigration and Population Growth in Early Fourteenth-Century Norwich: Evidence from the Tithing Roll", *Urban History Yearbook, 1988*, pp. 15-30; Derek Keene, *Cheapside before the Great Fire* (London, 1985).

ingly wider, although its precise extent has yet to be charted.[192] This hinterland expanded dramatically in subsequent centuries as the metropolis grew inexorably larger, providing a major spatial and temporal dynamic to the process of agrarian change. Metropolitan growth also benefited the many smaller market centres within its hinterland which serviced the trade it generated. Within Norfolk and Suffolk, for instance, John Patten estimates that the urban population grew by 50 per cent between 1603 and the 1670s, in contrast to a rural population increase of only 11 per cent.[193] The commercial opportunities offered by these expanding urban populations transformed the economics of agricultural production in Norfolk.

Norfolk is not England, still less Britain, and much useful work remains to be done reconstructing developments in the rest of the country. Nevertheless, although the particular course of agricultural development outlined here may be unique to that county, it is likely that the general influences on that development operated on a national scale. In the Middle Ages Norfolk was already responding to the influence of concentrated urban demand, although within the country as a whole such market penetration remained partial.[194] Subsequently further market expansion, encouraged by the increase in urbanization, promoted wider and more intense regional specialization.[195] What in the Middle Ages

[192] Derek Keene, "Medieval London and Its Region", *London Jl.*, xiv (1989), pp. 99-111; James G. Galloway and Margaret Murphy, "Feeding the City: London and Its Agrarian Hinterland", *London Jl.*, xvi (1991), pp. 3-14; Bruce M. S. Campbell, James A. Galloway and Margaret Murphy, "Rural Land-Use in the Metropolitan Hinterland, 1270-1339: The Evidence of *Inquisitiones Post Mortem*", *Agric. Hist. Rev.*, xl (1992), pp. 1-22; Fisher, "London Food Market"; Wrigley, "Simple Model of London's Importance".

[193] John Patten, "Population Distribution in Norfolk and Suffolk during the Sixteenth and Seventeenth Centuries", *Trans. Inst. Brit. Geographers*, lxv (1975), p. 62.

[194] Campbell, "People and Land", pp. 81-92; Campbell, "Ecology versus Economics".

[195] For market development, see Alan Everitt, "The Marketing of Agricultural Produce, 1500-1640", in Thirsk (ed.), *Agrarian History of England and Wales*, iv, pp. 496-522, repr. in Chartres (ed.), *Agricultural Markets and Trade*, pp. 15-141; Chartres, "Marketing of Agricultural Produce"; Eric Kerridge, "Early Modern English Markets", in B. L. Anderson and A. J. H. Latham (eds.), *The Market in History* (Beckenham, 1986), pp. 121-53; Ann Kussmaul, *A General View of the Rural Economy of England, 1538-1840* (Cambridge, 1990), pp. 103-25. Examples of market-related agricultural specialization include: Yelling, "Changes in Crop Production in East Worcestershire"; John Broad, "Alternate Husbandry and Permanent Pasture in the Midlands, 1650-1800", *Agric. Hist. Rev.*, xxviii (1980), pp. 77-89; Peter Edwards, "The Development of Dairy Farming on the North Shropshire Plain in the

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had been a feature of only certain parts of the country had by the seventeenth century become much more general. As different regions became increasingly drawn into this burgeoning market nexus, so more farmers intensified, innovated, and thereby secured higher yields. The pattern has yet to be mapped out in detail, but already it is clear that this process emerges in Hertfordshire and also, possibly, in Oxfordshire — both better placed to take advantage of the London market — before it does in Norfolk.[196] Each of these counties responded in its own way to the demands of the market: none the less a particular combination of circumstances enabled Norfolk to be conspicuously successful and to give its name to the most productive system of nineteenth-century farming in England.

A time perspective of six centuries within a single geographical area inevitably places existing interpretations of agrarian change in a new light. In particular, the evidence presented here offers no support for those verdicts on medieval agriculture that emphasize its technological inertia and ecological shortcomings. On the contrary, land productivity on medieval demesnes set a standard that was not to be exceeded for four centuries. Nor can any evidence be found to substantiate some of the more extravagant claims for the progress of cereal productivity over the sixteenth and seventeenth centuries. In fact it is livestock rather than crops that emerges as the more dynamic sector in early modern Norfolk agriculture. Taking the six centuries as a whole, and notwithstanding the revisionism of recent decades, it is the period after 1740 that clearly emerges as having undergone the most rapid and profound transformation of technology and productivity. Although many areas of uncertainty remain, these conclusions vindicate the comparative approach adopted in this paper and invite wider application of that approach elsewhere.

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Seventeenth Century", *Midland Hist.*, iv (1978), pp. 175-89; Glennie, "Continuity and Change in Hertfordshire Agriculture: I"; see also Overton and Campbell, "Productivity Change in European Agricultural Development", pp. 41-2.

[196] Overton and Campbell, "Productivity Change in European Agricultural Development", pp. 40-1.