

Agricultural productivity in Woodland High Suffolk, 1600–1850

by Jonathan Theobald

Abstract

The recently published work by Turner, Beckett and Afton has highlighted the fact that historians interested in evaluating land productivity in early-modern England have far more than just probate inventories at their disposal. This paper utilizes complementary sources in order to counteract the obvious flaws and limitations of the inventory. From this the paper has been able to glean new livestock and grain yield data for Woodland High Suffolk and these are placed in the context of agrarian change in the district. Its conclusions as to if, when and how the district 'revolutionized' its means of producing food for the nation, lend support to the recent findings of historians such as Turner, Overton and Williamson.

Though recent work by Turner, Beckett and Afton has clearly shown the wide range of farm records available to the agrarian historian, there is little doubt that the probate inventory remains of central importance.¹ The lack of any similarly detailed series of records has meant that researchers interested in the material culture and farming of this period have been inexorably drawn to these documents. Although many approaches have been taken to the analytical study of inventories, those of particular interest to the purposes of this paper include the various case studies undertaken since 1970 whose principal aim was to determine trends in land productivity. These include the analyses of large samples of probate inventories for Worcestershire by Yelling, Norfolk by Overton, Oxfordshire by Allen and Hertfordshire by Glennie.² Each one of these exercises has had to devise or refine methods to overcome the shortcomings and flaws inherent in the inventory. Nevertheless, though these case studies have helped develop reliable techniques for calculating grain yield data from inventories, the study of livestock from these sources is still somewhat in its formative stages. Hence, there is no need to apologize for

¹ M. E. Turner, J. V. Beckett and B. Afton, *Farm production in England, 1700–1914* (2001).

² J. A. Yelling, 'Probate inventories and the geography of livestock farming: a study of East Worcestershire, 1540–1750', *Trans. Institute British Geographers* 51 (1970), pp. 111–26; M. Overton, 'Estimating crop yields from probate inventories: an example from East Anglia, 1585–1735', *JEH* 39 (1979), pp. 363–78; idem, 'Re-estimating crop yields from probate inventories', *JEH* 50 (1990), pp. 931–5; idem, 'The determinants of crop yields in early modern England', in B. M. S. Campbell and M. Overton (eds), *Land, labour and livestock: historical studies in*

European agricultural production (1991), pp. 284–322; M. Overton and B. M. S. Campbell, 'Norfolk livestock farming, 1250–1740: a comparative study of manorial accounts and probate inventories', *J. Hist. Geog.* 18 (1992), pp. 377–96; R. C. Allen, 'Inferring yields from probate inventories', *JEH* 48 (1988), pp. 117–25; P. Glennie, 'Continuity and change in Hertfordshire agriculture, 1550–1700, II, trends in crop yields and their determinants', *AgHR* 36 (1988), pp. 145–61; idem, 'Measuring crop yields in early modern England', in Campbell and Overton (eds), *Land, labour and livestock*, pp. 255–83.

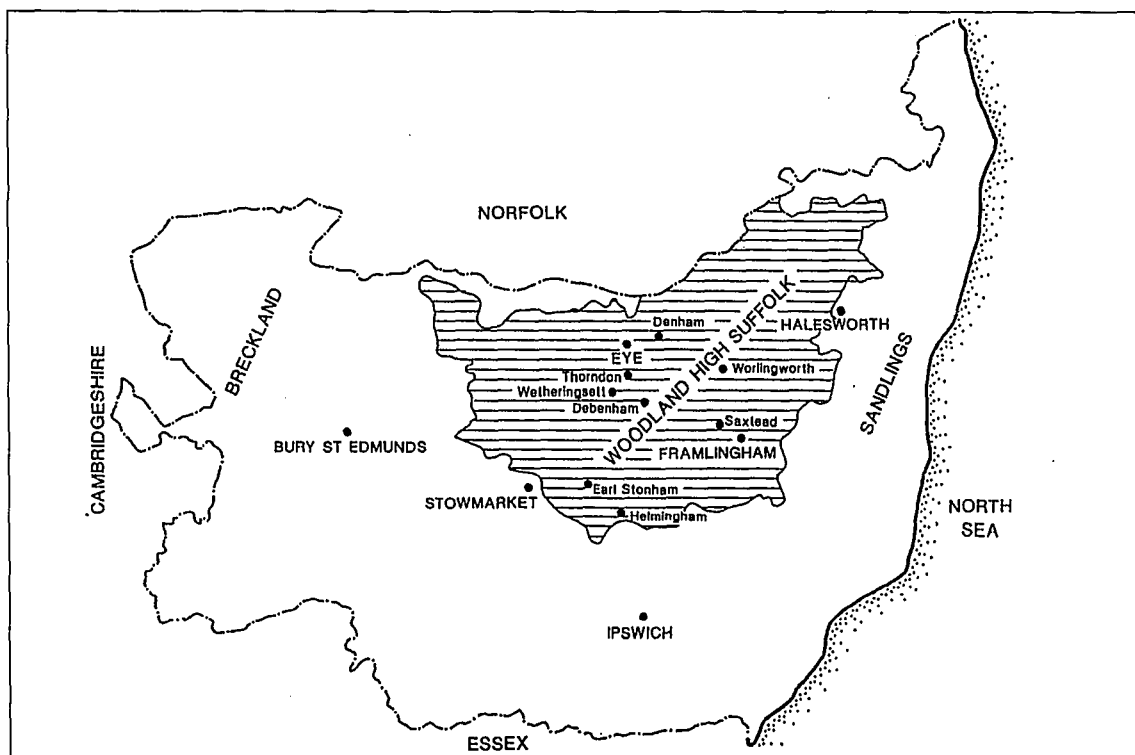


FIGURE 1. Woodland High Suffolk.

offering inventory-based figures for a new area. It is the aim of this paper both to advance the methodologies previously employed and to offer new empirical data from inventories for Woodland High Suffolk (Map 1). Data will be presented to illustrate trends in agricultural productivity both for the livestock and arable sectors in the region. This inventory data can be used to calculate overall increases in farm outputs once complementary information is provided concerning changes in farm production. Possible explanations for these productivity trends will be then be suggested. Finally, the paper intends to reflect on the present juncture reached in the historiographical debate concerning a 'revolution' in English agriculture, and evaluate what contribution the new figures can make to the argument. This paper's findings broadly support the conclusions stated in the last decade by Overton and Campbell, Williamson and Wade-Martins, and Turner, Beckett and Afton; that the 170 years after 1700 was the critical period of agricultural improvement and innovation.³

Woodland High Suffolk differs greatly from the areas covered in the case studies listed previously. They were, in the main, studies of whole counties, containing within them sharply contrasting agricultural regions. Woodland High Suffolk stands as a homogeneously distinct

³ B. M. S. Campbell and M. Overton, 'A new perspective on medieval and early modern agriculture: six centuries of Norfolk farming, c. 1250-c. 1850', *Past and Present* 141 (1993); S. Wade Martins and T. Williamson, *Roots of Change: farming and the landscape in East Anglia, c. 1700-1870* (Agricultural History Review, supplement ser. 2 1999), p. x; Turner, Beckett and Afton, *Farm Production*.

farming district. Yelling stressed the importance of defining such 'true' agricultural regions when working with inventories, but suggested that these districts could be located by synthesising data that was provisionally arranged into small sub-regions. These initial groupings had been generated in a purely non-critical, 'a priori' manner.⁴ The boundaries of Woodland High Suffolk, on the other hand, have been strictly defined by physical considerations. The terrain and soil within the region varies little throughout; the district, and the data extracted from it, therefore has geographical integrity.

Moreover, most earlier studies have discussed predominantly arable regions. Hertfordshire, north Oxfordshire, south Worcestershire and north-west Norfolk were sheep/corn arable districts, dominated by light soils and open fields. Only the clay vale of Oxfordshire, the north-east of Worcestershire and south-central Norfolk were early enclosed, heavy land districts, chiefly geared towards pastoral, dairying pursuits. The characteristics of Woodland High Suffolk are firstly that the soil found in the district is chiefly heavy and impermeable clay marl, with lighter gravelly soils only present on the valley sides and bottoms near rivers and streams, and secondly that the area is a high plateau, predominantly 50 metres above sea level. In Wade Martins and Williamson's *Roots of Change* the area constitutes a major part of their Central Claylands.⁵ The district was typical 'ancient' countryside, as defined by Rackham, largely enclosed by 1600, with farms and estates that were of a relatively modest size compared to other areas of East Anglia.⁶ In the seventeenth and eighteenth centuries the area was predominantly pastoral in nature. Dairying was the mainstay of the economy until the French Wars, when significant tracts of grassland were ploughed up; by 1850 farmers had only a limited amount of their land under pasture and meadow. This switch – inside a century – from dairying to a mainly arable system makes the region a particularly interesting choice to examine changes and improvements in farm production.

Whilst three repositories were utilized when collecting the inventory data included in this paper, the inevitable disadvantage of having a limited catchment as a study area was that the final sample size of usable inventories was modest. The size of sample used to calculate livestock proportions and densities was 61; while 98 inventories were analysed when calculating crop yields.⁷ Moreover, due to the shortage of pre-1650 inventories, crop yields have only been calculated from 1660 onwards; while only four examples have been included in the livestock tables for the period 1587–1669. Naturally, with such a limited sample, these figures must be treated with extreme caution. Both inventory samples were fairly well distributed across the region though the livestock figures had two concentrated areas around Framlingham and Helmingham. The livestock sample also had a reasonably even distribution of farm sizes. Eleven farms in the sample were between 20 and 50 acres in size, 23 were between 51 and 150 acres, 17 between 151 and 150 acres, and lastly, 10 between 251 and 360 acres. Though this is likely to be a reasonably fair depiction of farm sizes at the time, it could well be that the smallest size group

⁴ Yelling, 'Probate inventories', pp. 112–13.

⁵ Wade Martins and Williamson, *Roots of Change*.

⁶ O. Rackham, *The History of the Countryside* (1986), pp. 3–5. For more information about the development of the Suffolk clayland landscape in the early modern period, see J. Theobald, 'Changing landscapes, changing economies:

holdings in Woodland High Suffolk, 1600–1850' (unpublished PhD thesis, University of East Anglia, 2000).

⁷ Due to the fact that crops in the field could not be properly valued until the summer months of each year, the sample only uses inventories made between May and early August.

is under-represented. As inventories become increasingly scarce after 1750, complementary sources have been used to complete figures for both crop yields and livestock data after this date. For example, supplementary crop yield data has been gleaned from contemporary agricultural writers such as Arthur Young, the Raynbirds and Caird. The livestock figures given for the period 1786–1803 in Tables 1, 2 and 6 have been extrapolated from five late inventories, three sale particulars and six detailed farm surveys made in the early 1790s for a tithe dispute in the parish of Flixton.

The methodology used to calculate the livestock figures presented below has been adapted from Yelling's case study of east Worcestershire and Campbell and Overton's Norfolk research.⁸ There is one significant difference from earlier calculations, and this is that livestock densities have been calculated by the number of beasts per 100 acres of total farm area, rather than just cereal acres. Though Campbell and Overton accepted that the figures produced by using this method would have been more reliable, they had to adapt their workings to the limits of probate documents. Inventories, of course, only give arable acreages, and not the total farm area being surveyed. However, if inventory data can be used in conjunction with other complementary sources (as Glennie suggested in 1988) it may be possible to overcome this problem.⁹ Estate papers such as rentals, leases, surveys, sale particulars and maps can all be very helpful in ascertaining which farm is being surveyed in probates. Twenty-three farms have been located this way on the Rebow, Tollemache (Helmingham Hall), Grimston, Pettus, Heveningham Hall, Gisligham Town, Mendlesham Town and Pembroke College estates. Consequently, the majority of inventories used in this article are those describing tenant farms. Occasionally, probates can be placed by field names listed within the document, or much less frequently by the actual farm name being given alongside the tenant's name. Nine holdings have been located by these two methods. Tithe surveys, especially in the late eighteenth century, can also be of use. Eleven holdings have been located this way in the sample.

Of course, it can be problematic to affix total acreages to located holdings. For instance, though Tithe Award documents give accurate totals of all holdings in the region, farm sizes may have changed between the earlier source and c. 1840. Nevertheless, if they are reasonably contemporaneous to the inventory it is usually possible to ascertain reasonably accurate acreages for each farm by the use of one or more of the above sources. Furthermore, where a tenant rented more than one farm, it is usually acknowledged within the probate. Certainly, the level of inaccuracy is unlikely to have much impact on the figures given below, making the exercise both worthwhile and valid.

Once a total acreage has been obtained, it is usually possible to estimate fairly accurately the proportion of land in tilth. Of course, surveys and maps with land use given, and dated close to the inventory, are the most reliable for this purpose. However, even probates not taken through the summer months of May to August can still give a reasonable idea of the extent of arable on the farm. Most winter probates record wheat acreages, and multiplying this figure by three or four, depending on the likelihood of a three or four-course shift being employed (i.e. wheat being either roughly a third or fourth of the arable acreage), gives at least a usable

⁸ Yelling, 'Probate inventories', pp. 111–26; Campbell and Overton, 'Norfolk livestock', pp. 377–96; idem, 'A new perspective', pp. 38–105.

⁹ Glennie, 'Continuity', p. 152.

estimate of arable land. This amount can be compared to the number of adult farm horses listed; approximately one working horse was needed for every ten acres in the region. Of course this figure was highly dependent on the type of soil to be tilled, and this accounts for Susanna Wade Martins' higher Norfolk estimate of one horse for every 20 acres.¹⁰ Occasionally, ploughing restrictions in leases can also give some indication to the amount of land in tilth.

Although obtaining livestock proportions was far less complicated than calculating livestock densities, these figures have had to be weighted using feed requirements. Obviously, the fodder inputs needed for one milk cow are not the same, for example, as those for a sheep. The calculation used here is the one first devised by Yelling, and further adopted by Campbell.¹¹ Livestock units are calculated as follows: milk cattle, 1.2 units; immature cattle, 0.8; beef cattle, 1.2; sheep, 0.1; swine, 0.1; and horses, 1.0. It is likely, however, that the weightings for both sheep and swine are set too low here; they may be as high as 0.5 or 0.6 units. The oxen category, as used by Campbell, is redundant in our period; more relevant is the comparison between dairy and beef beasts. Only cows are included in the milk category, whereas heifers, buds, calves, bullocks and steers are all included in the immature category; scots, bulls and 'dry beasts' make up the beef category. Both adult and immature are counted together in the sheep, swine and horse categories.

The methodology used to calculate crop yields (i.e. wheat, barley and oats) was first developed by Mark Overton in 1979. In this original calculation the average value of one acre of each crop was divided by the corresponding average grain price per bushel; the resulting figures are therefore given as bushels per acre.¹² However, Allen and Glennie suggested in the late 1980s that the appraisers of inventories would have deducted labour costs such as reaping and carting, and tithe payments to the church from the expected sale price. Consequently, Overton amended his original equation to take into account such payments. Thus, the new equation for calculating yields was set out in 1991 as

$$y = \frac{(0.9c + r + v)}{0.9pi}$$

where y is the yield in bushels per acre, c is the cost of carting grain per acre, r is the cost of reaping per acre, v is the valuation per acre of growing grain and pi is the inventory price per bushel after harvest. Reaping and carting cost estimates based on a wide variety of sources were also given with this equation and have been used in the calculations given below.¹³

It has to be noted, however, that Overton's crop yield figures were calculated on a county basis, and not just for one distinct sub-region. The main benefit of this approach is that a far larger sample of inventories could be gathered together than is possible in this paper. However, it is possible that by combining the data from very different physical regions, as is the case in Norfolk, to produce one set of figures, Overton disguises and smooths out some of the particular traits of each area. This point is reinforced by examining Wade Martins and Williamson's crop

¹⁰ S. Wade Martins, *Historic Farm Buildings* (1991), p. 172.

¹¹ B. M. S. Campbell, 'Land, labour, livestock and productivity trends', in Campbell and Overton (eds), *Land, labour and livestock*, pp. 156-7.

¹² Overton, 'Estimating crop yields', pp. 363-78.

¹³ Overton, 'Determinants of crop yields', pp. 298-300. The reaping cost estimate for wheat was 5s per acre, while the figure for barley and oats was 2s. The carting cost estimate for all grains was 1.5s per acre.

yield estimates in *Roots of Change*. Though the size of their samples are very small, due in part to their virtuous decision to use only probate inventories where the yield can be directly calculated, they divide Norfolk and Suffolk into various districts based on soil properties and estimate yields for each one.¹⁴ Their results indicate that the yields for each grain crop 'display different scales and chronologies of improvement' from region to region. It is possible, therefore, that the large increases in barley yields in Woodland High Suffolk after 1660 which are outlined in the next section are not as evident in Overton's figures due to his method of aggregating data from disparate farming regions into a single value.¹⁵

I

As Woodland High Suffolk was predominantly a pastoral district, it is appropriate to turn first to the conclusions of the analysis of livestock productivity derived from the inventories. Tables 1 and 2 show that trends in livestock proportions and densities follow each other closely. The principal beast in the landscape was, of course, the milk cow, locally the Suffolk Dun, which for at least the first 180 years of our period formed between 57 and 62 per cent of the region's livestock units. There were roughly between 14 and 16 cows per 100 acres throughout this period, with the 1750s to the 1780s having the highest densities. As the region's farmers began to reduce their stocks through the Napoleonic Wars, milk cattle proportions fell to roughly 43 per cent of livestock units and the density to ten per 100 acres. Other sources suggest that these figures are reliable. For instance, at the very beginning of the 1747–1785, period a lease for Cherry Tree Farm, Bacton instructed that roughly 18 cows per 100 acres were to be kept each year on the holding.¹⁶ At the very end of the same period Arthur Young suggested that there were, on average, 16 cows per 100 acres throughout the region.¹⁷ The corresponding figure in Table 1 is 16.5. Likewise, the figure for the following period of 1786 to 1803 is 9.9 cows per 100 acres, and leases for Great Lodge and Countess Wells Farms at Framlingham in 1806 prescribed that roughly eight cows per 100 acres were to be kept.¹⁸

Other trends worth noting from the tables include the increase in immature cattle after the mid-1660s. The ratio of immature cattle to adult milk cattle more than doubled between the first two periods; the figure rose from 0.22 to 0.49 and this was principally due to the discernible rise in the number of steers, bullocks and heifers listed in inventories. A similar pattern has been found by Campbell and Overton in Norfolk.¹⁹ This level is nearly maintained for the next two periods, but the figure rises more substantially to 0.80 when dairy herds begin to decline. Adult beef stocks stay reasonably constant, although there is a drop in the 1747–85 period. Sheep proportions and densities hover between two and three per cent, and six and ten per hundred acres, respectively; sheep seem to have been more widespread in the period 1670 to 1714. Conversely, horse numbers fall after 1670, and do not recover to the earliest density of five per

¹⁴ Wade Martins and Williamson, *Roots of Change*, pp. 158–170.

¹⁵ Overton, 'Determinants of crop yields', p. 302.

¹⁶ Public Record Office (hereafter PRO), C112/181.

¹⁷ A. Young, 'Minutes relating to the dairy farms of High Suffolk, taken at Aspell, the seat of the Rev. Mr.

Chevallier, in January 1786', *Annals of Agriculture* 27 (1786), p. 214.

¹⁸ Pembroke College Archives, Cambridge, (hereafter PCAC), Framlingham Y49; Suffolk Record Office, Ipswich, (hereafter SROI), GB10/1/1.

¹⁹ Campbell and Overton, 'A new perspective', p. 82.

TABLE 1. Livestock per hundred farmland acres.

	1587-1669	1670-1714	1715-46	1747-85	1786-1803
sample size	4	21	14	8	14
Mean farm size	66	136	190	204	156
Milk cattle	15.2	13.5	14.2	16.5	9.9
Immature cattle	3.4	6.6	6.0	7.2	7.9
Beef cattle	1.9	1.9	1.4	0.9	1.8
Sheep	13.3	8.9	5.7	10.2	9.0
Swine	3.0	3.8	3.9	9.7	14.4
Horses	4.6	3.1	3.1	4.2	5.0
TOTAL					

Notes: The sample sizes are as follows: 1587-1669, 4; 1670-1714, 21; 1715-46, 14; 1747-85, 8; 1786-1803, 14. The arable proportion for farms 1587-1669 - 1715-46 is calculated to be in the range 15-30% (except for seven farms in the sample); for 1747-85 it is calculated to be 30-40% (except for one farm); and for 1786-1803 it is 40-70% (except for one farm).

Source: all probate inventories listed in Appendix 1.

TABLE 2. Livestock units.

	1587-1669 (%)	1670-1714 (%)	1715-46 (%)	1747-85 (%)	1786-1803 (%)
Milk cattle	61.9	57.5	61.7	60.3	42.7
Immature cattle	9.2	18.8	17.4	17.6	22.9
Beef cattle	7.8	8.3	6.1	3.1	8.0
Sheep	4.5	3.2	2.1	3.1	3.3
Swine	1.0	1.3	1.4	3.0	5.2
Horses	15.6	10.9	11.3	12.9	17.9
TOTAL	100.0	100.0	100.0	100.0	100.0

Note: the sample sizes are as in table 1.

Source: All probate inventories listed in Appendix 1.

hundred acres until the final period of 1786 to 1803. However, the most pronounced change in trends is reserved for swine stocks. Though proportion and density figures stay constant up to 1746, by 1803 both numbers have nearly quadrupled.

The figures obtained from non-inventory sources for the period after 1803 clearly indicate the dramatic move away from dairying in the region. A sale catalogue for Goswold Hall, Thrandeston, c. 1810, for example, shows that all cattle types on the farm had been reduced, but the fall in milk cattle densities was by far the largest (Table 3).²⁰ There were only 3.7 dairy cows per 100 acres, while immature cattle numbered 5.3 per 100 acres and beef cattle 0.5 per

²⁰ SROI, HD291/1.

TABLE 3. Livestock densities for Goswold Hall, Thrandeston, c. 1810.

Type of beast	Milk cattle	Immature cattle	Beef cattle	Sheep	Swine	Horses
No of beasts	7	10	1	0	32	17
% units	22.2	21.1	3.2	0	8.5	45
No per 100 farmland acres	3.7	5.3	0.5	0	17	9

Note: Goswold Hall was a farm of 188 acres.

Source: SROI, HD291/1.

100 acres. Though there were no sheep present on the holding, swine and horse numbers seem to have been increasing further. There were 17 per 100 acres of the former animal and 9 per 100 acres for the latter. Moreover, there seems little to choose between these figures and those compiled forty years later for the same farming region, the 1854 crop returns finding that there were 3.6 milk cattle and five immature and beef cattle per 100 acres. Swine densities were also roughly at the same levels as the Goswold Hall data, namely 17.5 per 100 acres. Sheep numbers seem to have increased markedly by the 1850s, with 44.4 kept per 100 acres, while horse densities were roughly at five per 100 acres.²¹

Though it has therefore been possible to show changes in the proportion and density of livestock kept in the region, a lack of documentary evidence prevents us from determining improvements in the productivity of farm stock. Much of the work completed on this subject in the past has had to rely heavily on national prices and contemporary commentators such as Gregory King for their data. From such material Overton has suggested that though the turnover of cattle in the eighteenth century was increasing, there was little improvement in the amount of meat produced from each beast.²² There is little doubt in his mind, however, that pig weights and sizes were rapidly increasing in the eighteenth century. He notes that the price of pigs relative to cattle had more than doubled between 1600 and 1750.²³

Corn yield trends for the region can now be given. Estimated grain yields for the period 1660–89 show that roughly 15 bushels of wheat, 18 bushels of barley and 17 bushels of oats could be produced per acre on average (Table 4). In Campbell and Overton's opinion, these were yields at 'essentially medieval levels'.²⁴ However, this ceiling was breached by the figures for the following period, 1690 to 1719. Wheat yields rose by two bushels, barley by eight, and oats by six. For the rest of the eighteenth century wheat levels rose steadily, but undramatically; the rises were reasonably uniform, except for a lull in the middle decades of the century. Barley and oat yields rose more erratically; the initial steep climb was followed by fifty years of stagnation, and then another pronounced increase at the end of the century. In the first half of the nineteenth century wheat and barley yield trends followed each other very closely. There is a hiatus in the figures between 1800 and 1836, followed by the largest rise for the whole of our period. Increases that had taken over a century to accumulate were produced again in

²¹ J. P. Dodd, 'Suffolk crop returns of 1854', *Proc. Suffolk Inst. Arch.*, 34 (1979), pp. 191–204.

²² M. Overton, 'Re-establishing the English Agricultural Revolution', *AgHR* 44 (1996), pp. 13–14.

²³ M. Overton, *Agricultural Revolution in England: the transformation of the agrarian economy, 1500–1850* (1996), p. 115.

²⁴ Campbell and Overton, 'A new perspective', p. 74.

TABLE 4. Crop yields, 1660–1850.

	Wheat	Barley	Oats
1660–1689	(20) 15.5	(14) 18.3	(7) 17.2
1690–1719	(23) 17.5	(8) 26.7	(8) 23.3
1720–1749	(16) 19.6	(8) 27.4	(2)
1750–1769	(26) 20.1	(7) 25.3	(4) 22.7
c.1800	(4) 22	(7) 32	(2) 36
1836	(30) 23.2	(20) 32.4	(3) 36.9
1850	(7) 32	(5) 44	

Notes: The top figure in brackets is price per bushel sample number; the bottom figure in brackets is valuation per acre sample number.

Source: Figures for 1660–1689 – 1750–1769 are drawn from the sample of probate inventories as listed in Appendix 1; figures for c.1800 drawn from Young, *General view of Suffolk*, pp. 71–6; for 1836 from R. J. P. Kain, *An atlas and index of the tithe files of mid-nineteenth century England and Wales* (1986); for 1850 from J. Caird, *English agriculture in 1850–51* (1852).

barely 15 years. These patterns in yields have many similarities with the trends described by Overton and particularly those reported by Wade Martins and Williamson in *Roots of Change*.²⁵

II

Before these figures can be used to estimate agricultural outputs, some understanding is needed of the changing nature of farm production in the region. Perhaps the most important issue in this context is the dramatic and relatively rapid switch from a pastoral dairy-led economy, to one dominated by arable production. Up to 1750 the region was mostly under grass, with farmers usually having only between 15 and 30 per cent (typically 20 per cent) of their land under the plough in any one year. Only the smaller farms of 50 acres or less had a greater proportion of their land in tilth in this period, and this was normally between 40 and 50 per cent. These land use ratios were in place till at least the late 1740s, but after this time grassland was gradually converted to arable. This transition progressed steadily over the following four decades, so that by the early 1790s most parishes had reached a point where arable and grassland could be found in equal measure. The livestock data given above has already shown the region's farmers were

²⁵ Overton, 'The determinants', p. 302; Wade Martins and Williamson, *Roots of Change*, pp. 157–170. One noteworthy difference between this paper's findings and Overton's figures is that Overton's barley yields were less pronounced between 1660 and 1740. Overton's wheat and barley yields are closer together in this period, with no more than 1.5 bushels between them.

still dairying at this point, albeit with slightly reduced milk cattle densities. Though not of major concern to the purposes of this article, it is likely that this initial shift in the local economy was stimulated by both positive and negative factors. For example, it seems probable that the gradual rise in grain prices between 1750 and 1790 encouraged the region's farmers to break with the established status quo and put more of their land in tilth. In addition, the outbreak of the cattle plague in the late 1740s and the loss of the naval cheese contract in the following decade probably undermined the confidence of many of Suffolk's dairy farmers. Of the two misfortunes, it is possible that the cattle plague had a greater impact on the local economy. To restock part or all of ones' herd would have been a considerable financial burden, and even if landlords helped their tenants in this respect (as was the case at Cherrytree Farm, Bacton in 1748), it would still take a number of years to build up a quality-milking herd.²⁶

Nevertheless, the twenty or so years of the French Wars altered the farming economy of the region for good. By the end of hostilities in 1815 most farms had 65 to 70 per cent of their land under the plough. For many farms the five years either side of 1800 saw as much land being broken up as occurred in the previous forty. As a rule, if farmers had not sold the majority of their dairy herds by 1815, they did so in the five years following the end of the war. The transition to arable had therefore been largely completed by 1820, and this is shown by the fact that land use ratios had barely altered when the Tithe Award documents were drawn up twenty years later. According to these sources most of the region's farms had only between 20 and 25 per cent of their land under grass, a direct reversal of the situation in place at the beginning of the period studied here.²⁷ This second wholesale shift to arable was chiefly brought about by the dramatic surges in grain prices seen through the French Wars, and by the adoption of more comprehensive schemes to drain land and counteract soil acidity in the region. Though there are a few examples of landlords, such as the Fellows of Pembroke College, Cambridge, initially preventing their tenants from moving away from dairying, most were persuaded of the merits of ploughing up grass lands when healthy increases in rent were offered in return.²⁸

There is little doubt, then, that arable acreages in the region increased dramatically between 1750 and 1850, but was there a noticeable change in the type of produce taken from the land? To start with, the region's arable fields were farmed in a three-course system in the seventeenth century with the basic principle that two corn crops were to follow a fallow, or 'summerland'. It was usual for the wheat crop to follow the fallow shift, and barley or oats to follow wheat.²⁹ Probate inventories suggest that wheat was the principal crop grown and that barley and oats shared the following shift: however, barley certainly seems to have been grown more frequently and in greater quantities than oats in the second half of the century.³⁰ A good example of this cropping system in action can be seen on a farm at Horham in the mid-1660s. In 1664, for example, the holding's arable land was farmed in the following way: 14 acres (34 per cent) of wheat, 15 acres (37 per cent) of barley and oats and 12 acres (29 per cent) lying fallow.³¹

²⁶ PRO, CRES 2/1179, small bundle of letters.

²⁷ Theobald, 'Changing landscapes', pp. 26-48.

²⁸ PRO, C112/181. It would indeed be interesting to determine whether the farms most severely hit by the plague were those that brought in 'fair' cattle most frequently.

²⁹ Theobald, 'Changing landscapes', p. 113.

³⁰ B. A. Holderness, 'East Anglia and the Fens', in J. Thirsk (ed.) *The Agrarian History of England and Wales* V, 1640-1750 (2 vols, 1985), I, pp. 218-19; Theobald, 'Changing landscapes', p. 114.

³¹ PRO, E134/20Chas2/East. 18.

Though it is very likely that pulse crops such as beans and peas were occasionally grown in part or all of the fallow course before 1650, an important innovation came in the last third of the seventeenth century when the field turnip began to be cultivated in this shift. Overton has suggested that the adoption of the root in Norfolk and Suffolk begun in earnest in the 1670s.³² This statement is supported by information in tithe suit depositions. One such document suggests that turnips were first grown in the Spexhall district (near Halesworth) around 1670, and that before this time the crop was 'such a rarity that not one farmer in twenty had an acre of turnips growing'.³³ By the 1690s farm leases were beginning to note that tenants could plant their fallows with turnips if they saw fit. Overton has suggested that by 1710, 50 per cent of farmers in Norfolk and Suffolk were growing the root.³⁴ The normal procedure when growing turnips was to sow the crop in late June or early July after the last harvest, and extract the crop between December and late February. This method of cultivation had an impact on the order of rotations, which was that barley or oats had to now be grown straight after the fallow shift rather than wheat. The reason for this was that when wheat needed to be sown in October the root was in full growth. Barley and oats, on the other hand, could be sown soon after the the turnip crop had been pulled as they were both spring-sown cereals.

However, though it is safe to assume that by 1700 the turnip was often cultivated by farmers, it seems that the crop never became a permanent fixture in rotations in the following century. This was chiefly due to the problems encountered when cultivating and particularly extracting the root from the heavy, wet soils of the region. From the few available eighteenth century cropping accounts, it would seem that the root never occupied more than one-third of the fallow shift. At farms such as Wetheringsett Lodge and Great Lodge Farm, Framlingham in the 1790s it seems the crop was barely grown at all.³⁵ Overton stated that up to 1740 and perhaps later, the proportion of the cropped acreage under the root was modest, at no more than nine per cent; this translates into between one and two and a half acres of turnips on each farm.³⁶ *Roots of Change* suggested that this figure is perhaps too small for the Central Claylands, where farmers were typically growing between three and seven acres of the crop.³⁷

Furthermore, though the introduction of turnips may have altered the sequence of cropping between wheat and barley, the crop did not change the basic structure and principle of the old three-course system. The next and most critical stage in the evolution of the celebrated four-course system involved the full-scale insertion of leguminous crops, such as beans, peas and especially clover, into arable rotations. Though some pulses were grown in the old three-course shifts of the seventeenth century, clover was not adopted in the region until after 1700. In the early decades of the eighteenth century this artificial grass was only used to lay down exhausted

³² M. Overton, 'The diffusion of agricultural innovations in early modern England: turnips and clover in Norfolk and Suffolk, 1580-1740', *Trans. Institute British Geographers*, new ser., 10 (1985), p. 208.

³³ PRO, E134/4Anne/Mich. 4. Overton noted that 'about five per cent' of farmers were growing the crop in the 1660s. Overton, 'Diffusion of agricultural innovations', p. 211.

³⁴ SROI, HA240/2508/30, 271; Essex Record Office, Chelmsford (hereafter EROC), D/DH/VI/B/51; Overton,

'Diffusion of agricultural innovations', p. 211.

³⁵ A. Young, *A general view of the agriculture of the county of Suffolk* (1813), p. 370; SROI, FC101/N1/3. On Brooks Farm, Framlingham and Fair Oaks Farm, Dennington in the 1760s, between 20-25% of the fallow shift was cultivated with turnips; GB1/13C/1.

³⁶ Overton, 'Diffusion of agricultural innovations', p. 213; id., 'Determinants of crop yields', p. 312.

³⁷ Wade Martins and Williamson, *Roots of Change*, p. 108.

arable land for a period of several years, or to re-seed poor quality meadow land. Its use in an arable shift does not seem to have occurred until the middle decades of the century.³⁸ Overton's data suggests that only three per cent of the cropped area in Norfolk and Suffolk was under clover up to 1739, but that the diffusion of the crop after this date must have been 'very rapid'.³⁹ Documentary evidence for Woodland High Suffolk suggests that it was the 1740s when farmers began to include clover within an arable shift. Depositions for a tithe dispute at Westhall state that the grass was beginning to be taken up by farmers in the village in the late 1730s and early 1740s; while the first lease on the Tollemache estate at Helmingham that permitted its growth as an arable crop was drawn up in 1739.⁴⁰ Even in these early years of its adoption as an arable crop clover was normally placed after the barley/oats shift. The reason for this probably lies with the fact that the barley/oats shift had traditionally been the last course before land was laid down to grass for a period of rest. Past generations of farmers would have therefore become accustomed to growing clover (and before that wild hayseed) with their barley/oats crop.

By the 1760s there is evidence on several farms that a flexible four-course rotation was being operated, with clover, beans and peas all forming part of this system. For example, at Brook Farm, Framlingham and a holding in Parham between 1760 and 1766 the proportion of the arable acreage under clover, beans and peas was 26 per cent (15 per cent for clover and 11 per cent for beans and peas). Wheat totalled 29 per cent of the arable area, while the figure for barley and oats was 25 per cent. The fallow shift totalled 20 per cent, with only about one quarter taken up with turnips on both holdings. At Wetheringsett Lodge in 1764 the proportions were almost identical for the wheat and barley/oats courses, but the fallow and legume shift figures were reversed, i.e. 26 per cent fallow (probably completely bare) and 20 per cent clover, beans and peas (12 per cent clover, 8 per cent beans and peas).⁴¹ Further examples from this period include the Pembroke College fellows directing their tenant at Wyverstone to run a conventional four-course system in the 1770s. The college's farms at Framlingham were following such a system between 1797 and 1815, though once again bare fallows were largely preferred to turnips or their substitute, cabbages.⁴²

It is perhaps safe to assume then that by the last quarter of the eighteenth century, if not before, the region's farmers regularly cultivated clover and pulses within their cropping rotations. With this the four-course structure of fallow/roots, barley/oats, clover/beans/peas, wheat had taken shape. Physical conditions, such as heavy, poorly drained land limited the amount of root crops that could be taken in the fallow shift. Clover had to be regularly alternated with pulses to prevent the soil becoming 'clover sick'. Conversely, if the soil was in good heart, a fifth shift (often of oats) could be added to the cycle before the fallow returned. Nevertheless, despite these variations, the basic principles and shape of the four-course system were largely adhered to by the region's farmers from this time through to the end of the period studied here. In 1854, for example, grain proportions in the region were the same as those given above in the 1760s, namely 29 per cent of the arable area under wheat, and 25 per cent under barley (oats were not listed).

³⁸ Theobald, 'Changing landscapes', pp. 120-1.

³⁹ Overton, 'Re-establishing the English Agricultural Revolution', p. 12.

⁴⁰ PRO, E134/17Geo2/East. 3; Helmingham Hall Archives (hereafter HHA), T/HEL/127/1/1.

⁴¹ SROI, GB1/13C/1; SROB, IC500/3/51/116.

⁴² PCAC, Wyverstone/C10, C10a; SROI, FC101/N1/3. Wade Martins and Williamson have noted the scarcity of root crops on other clayland farms in this period; *Roots of Change*, pp. 110-11.

The clover, beans and peas shift was 25 per cent, with pulses and artificial grasses divided roughly half and half. The fallow shift totalled 21 per cent, but it is noticeable here that a far higher percentage of the shift was planted with root crops. Half of the shift was taken up with turnips, one quarter with mangolds, and one-quarter bare fallow.⁴³ An explanation for this increase in root cultivations will be given in the following section.

Though not as significant as these shifts in arable production, it is still worth noting two changes concerning livestock farming before the general move away from dairying. Firstly, in the last thirty years of the seventeenth century, the region's farmers increased the turnover of immature cattle sold to the butchers for beef and veal. This was achieved by buying in extra cattle, both local stock and northern/Scottish droves, from fairs. Holderness believed that the Scottish 'runt' was the most common imported beast in East Anglia in this period.⁴⁴ According to tithe depositions, the buying in of 'fair cattle' seems to have started at the same time as turnips began to be grown, namely around 1670. For example, in the parish of Wilby, near Framlingham, four farmers began to buy in such stock between 1668 and 1674.⁴⁵ Nevertheless, though this practice was taken up across the whole of the region from this time onwards, it never replaced dairying as the main prop of the local economy. Beef fattening proved instead to be a valuable sideline for the region's farmers, especially when meat prices were relatively high, though its worth may have been questioned after the outbreak of the cattle plague in the 1740s. Secondly, it would seem that in the second half of the eighteenth century farms in the region moved away from cheese production to concentrate more on butter making. This shift away from cheese was probably brought about by the loss of the contract in 1757 to supply the navy with Suffolk 'bang' (cheese). From this time onwards much of the cheese sent to the navy's stores came from Cheshire.⁴⁶

III

Though it is not possible to obtain all the farm output data needed to calculate changes in land productivity, the figures produced so far allow for an estimation of overall outputs to be made by modelling. Table 5 gives the changing grain and fodder outputs for a typical 100-acre holding. In reading this table, it should be noted that the cultivated fodder and grain areas are all part of the total arable area. The total acreage of the model farm for each year can therefore be calculated by adding the arable area and uncultivated fodder areas together. Moreover, bare fallow estimates can be made for each period by subtracting both grain areas and the cultivated fodder area from the total arable area. Included in the uncultivated fodder area figures are the temporary or 'new' leys, exhausted arable lands that were laid down to grass for anything between five and fifteen years. It has been suggested elsewhere that these lands never amounted to more than ten per cent of the total acreage of the farm, and that nearly all holdings in the region had at least 50 per cent of their lands under permanent 'ancient' pasture.⁴⁷ The results have been derived by using the information given earlier relating to land usage, yield levels and the introduction of the four-course system. For the purposes of the exercise the output estimates

⁴³ Dodd, 'Suffolk crop returns', p. 199.

⁴⁴ Holderness, 'East Anglia', p. 236.

⁴⁵ PRO, E134/26Chas2/East. 24.

⁴⁶ W. Beveridge, *Prices and wages in England from the twelfth to the nineteenth century* (1939), pp. 555, 576, 939.

⁴⁷ Theobald, 'Changing landscapes', pp. 102-4, 108-10.

TABLE 5. Grain and fodder outputs from a model hundred acre farm.

	Arable area (acres)	Grain area (acres)		Yield (bushels)		Total grain yield (bushels)	Fodder area (acres)		Total fodder area (acres)
		Wheat	Barley	Wheat	Barley		Uncultivated	Cultivated	
1670	21	7.0	7.0	105.0	126.0	231.0	79	2	81
1770	35	8.75	8.75	175.0	218.75	393.75	65	12	77
1800	50	12.5	12.5	275.0	400.0	675.0	50	17	67
1815	65	16.25	16.25	357.5	520.0	877.5	35	22	57
1850	75	18.75	18.75	600.0	825.0	1425.0	25	35	60

Notes: Outputs for 1670 are calculated on the assumption that a three course system is in operation: after this date, a four course system is assumed to be in place.

Source: Calculated from Table 4.

for oats have been included in the barley figures, and it has been assumed that wheat and barley/oat proportions were the same as each other throughout the period. Cultivated fodder area totals have been calculated on the premise that two thirds of the fallow shift was bare up to, and including, 1815, but that by the 1850s the same percentage of the rotation was taken up by turnips, mangolds and tares. Additionally, for all the figures after and including those for 1770, one quarter of the arable area has been calculated as producing leguminous crops.

The introduction of green fodder crops into rotations with corn meant that by 1770 the total grain yield from our model farm would have gone up by 70 per cent since 1670. The area under grain would also rise, but only by 25 per cent. Though the total fodder area would be marginally down, by five per cent, there was a six-fold increase in the cultivated fodder area. Forty-five years later, in 1815, the area under grain had virtually doubled, while the total grain yield had gone up by 123 per cent. The total fodder area had decreased by 26 per cent, but the cultivated fodder area had nearly doubled. Finally, though the area under grain had only gone up 15 per cent by 1850, the total grain yield had increased by 62 per cent. The total fodder area had remained the same between the final two dates, but for the first time the cultivated fodder area exceeded the uncultivated area.

Overall livestock density trends can also be produced here for the period 1587 to 1803 by weighting the figures from Table 1 with the feed requirements used in Table 2. The later non-inventory data can then be added to these figures (Table 6). The results show little change between 1587 and 1746, with densities ranging between 27.6 and 29.4 livestock units per 100 acres; there is then an increase in the period 1747–85 when densities rise to their highest level of 32.8. Figures in the final period, however, fall to their lowest level of 27.7. These figures are very similar to the densities given in *Roots of Change* for Stansfield in 1760 (29 units per 100 acres) and in 1808 (24 units per 100 acres). As Wade Martins and Williamson noted, this data fits neatly within the range of 15 and 40 units per 100 acres extrapolated from Campbell and Overton's figures.⁴⁸ Once the region's farmers began to reduce their dairy herds in the early years of the nineteenth

⁴⁸ Wade Martins and Williamson, *Roots of Change*, pp. 172–73.

TABLE 6. Livestock units per hundred acres

1587-1669	1670-1714	1715-46	1747-85	1786-1803	1810	1854
29.4	28.1	27.6	32.8	27.7	20.1	20.5

Source: data for 1587-1803 calculated from Tables 1 and 2 above; for 1810 from Table 3 and for 1854 from Dodd, 'Suffolk crop returns', p. 199.

century, however, livestock unit totals shown in Table 6 naturally began to fall. By 1810 at Goswold Hall, Thrandeston, the figure was 20.1 units per 100 acres (Table 3). In 1854 the livestock unit total per 100 acres was 20.5, which is only a marginal increase on the Goswold Hall figures.⁴⁹

IV

The data produced in the last two tables help to bring to the fore several issues that are central to the debate over the English agricultural revolution debate. No more significant is the question of the extent and timing of land productivity increases, which can be clearly illustrated by examining the results given in Table 5. For example, the figures show that although the area under grain rose by approximately 160 per cent between 1670 and 1850, the total grain yield in this period increased by over 500 per cent, implying that land productivity was noticeably improving. In addition, though the region's farmers sold off the majority of their dairy herds after 1800, which in turn dragged down the livestock unit totals in Table 6, the densities of some types of farm stock, namely immature cattle and swine, increased at various points through the period studied here. In other words, the same amount of land seems to have been able to produce more crops and support extra numbers of certain types of livestock. Such trends strongly suggest that the 150 years or so after 1700 saw very significant rises in agricultural productivity. It is necessary, therefore, to explore fully the possible causes of these improvements.

To take livestock issues first, it seems probable that the increased cultivation of the field turnip helped farmers boost their cattle numbers, especially the numbers of immature stock. Even though the cultivation of the root was problematic and its adoption therefore patchy, it is unwise to underestimate its importance. On a farm that had only 20 or 25 acres in tilth, two or three acres of turnips (roughly one third of the fallow shift), would have still made an impact on livestock densities. The value of the root to the farmer is clearly illustrated by a deposition made in a tithe dispute for the parish of Spexhall. One witness stated in 1704 that one acre of 'good turnips will go as far as three loads of hay'; Fream's *Agriculture* notes that turnips contain nearly double the amount of protein of low value grass.⁵⁰ The same witness also claimed that by growing eight acres of turnips at Spexhall Manor Farm (of approximately 220 acres), the farmer could winter between six and eight additional cattle. It would seem that the majority of these extra beasts were brought in by the tenant, Thomas Stopher, to be fattened up on turnips for beef; Stopher had three scotch bullocks on his farm in the spring of 1703.⁵¹ The ability to increase winter feed stocks meant these beasts could be fattened and 'finished' more rapidly.⁵² Further

⁴⁹ Dodd, 'Suffolk crop returns', pp. 191-204.

⁵⁰ W. Fream, *Elements of Agriculture* (1892 edn), p. 524.

⁵¹ PRO, E134/4Anne/Mich. 4.

⁵² Campbell and Overton, 'A new perspective', p. 82.

documentary evidence illustrates this strong link between beef cattle and turnips. John Frere of Finningham referred to his beef cattle as 'turnop beasts and steers' in the 1680s; while Defoe noted in the 1720s that the method of fattening up beef cattle on the turnips was well established in High Suffolk.⁵³

There is evidence that other livestock also benefited from the cultivation of turnips. For example, on some farms in the early years of the eighteenth century the root was being fed to pigs; the above-mentioned Thomas Stopher was giving his hogs turnips in 1702 and 1703.⁵⁴ Dairy stocks were also fed turnips, but the root was only used for this purpose to a limited degree, due to the dairy produce being tainted with the taste of the crop. A better alternative in this respect was the cabbage, and this plant also proved easier to extract from heavy soils than the turnip. Cabbages began to be taken up by the region's farmers after 1760, and it is possible that the crop played a part in raising both milk cattle and pig densities between 1747 and 1785. In the 1790s Young testified to the enthusiasm that pigs had for this food source.⁵⁵

Besides root crops, the increasing use of clovers and pulses probably helped stocking densities reach their zenith between 1750 and 1780. Perhaps most important was the introduction of clover. Whether mown for hay, or fed from the fields, the artificial grass would have added greatly to fodder supplies, especially in winter. Besides dairy stocks, the main consumers of clover and pulses were horses and swine, and increases in the density figures for both animals, but particularly the latter, can be seen from the various data for the periods after 1747. The increased cultivation of leguminous crops therefore not only gave sustenance to the growing number of horses kept in the region, but may have also helped to improve the age-old husbandry of pig keeping. Nevertheless, a change in emphasis in dairy production after 1760 probably played a part in boosting pig densities. The above-mentioned move towards producing more butter in place of cheese would have led to increased amounts of skimmed milk being available on the farm, and this was ideal for feeding and fattening up swine. A comment made by Young in 1786 seems to support this view. To quote, 'if the butter is increased considerably, and the hogs should be the more favoured, which seems obvious, it may answer better than cheese making'.⁵⁶

As well as helping stocking densities, the implementation of roots and leguminous plants into arable rotations would have also improved soil fertility, and consequently crop yields. Of the two there is little doubt that leguminous crops had the most direct impact on land fertility by increasing the supply of nitrogen to the soil. All leguminous plants, but especially clover, are ideal at 'fixing' nitrogen into the soil via the atmosphere. Chorley has estimated that the cultivation of clover increased the supply of nitrogen to the English farmer by over 60 per cent.⁵⁷ Moreover, Overton has noted that out of all the green fodder crops, clover seems to have had the most beneficial effect on wheat yields.⁵⁸ Turnips, by themselves, may have also helped to improve the fertility of the soil. For example, the crop would have left organic residues if it were ever ploughed in, and when sown in rows would have allowed the land to be kept free of weeds by regular hoeing.⁵⁹ However, unlike on the light soil districts of East Anglia, the turnips'

⁵³ SROI, HB405/C2/1; D. Defoe, *A tour through the eastern counties* (1962), p. 124.

⁵⁴ PRO, E134/4Anne/Mich. 4.

⁵⁵ Young, *General view of Suffolk*, pp. 116-17.

⁵⁶ Young, 'Minutes', p. 207.

⁵⁷ G. P. H. Chorley, 'The agricultural revolution in northern Europe, 1750-1880: nitrogen, legumes and crop productivity', *EcHR*, sec. ser., 34 (1981), pp. 71-93.

⁵⁸ Overton, 'Determinants of crop yields', p. 314.

⁵⁹ *Ibid.*, p. 294.

deeper roots did little to improve the structure of what was already heavy land; indeed, its extraction in the wet, winter months often led to damage being inflicted to the soil. From this farmers such as Mr. Press of Wetheringsett Lodge concluded in the 1790s that the crop did 'more harm to the land than good to the stock'; while Arthur Young also noted in 1786 that the root was not 'a necessary article in any course of crops, but merely in subservience' to the needs of cattle. On the contrary, 'it was generally the opinion that the husbandry with any other view was disadvantageous'.⁶⁰

It is probable, however, that turnips had more influence on land fertility in the region by improving the manuring capabilities of each farm. It is not surprising that adding new protein rich crops such as turnips, and indeed pulses and clover, to the farm's fodder portfolio enhanced the quality of dung produced. Though it is difficult to quantify these improvements in the eighteenth century, Bacon believed that dung improved in quality by between 20 and 40 per cent once farmers increased root cultivations and brought in oil and corn cake for feed in the 1840s and 1850s.⁶¹ Of perhaps greater significance, however, is the fact that cultivated fodder crops were more likely to be fed to livestock confined in houses, sheds, yards and stalls. A higher proportion of the resulting dung would have therefore been conserved by this action, rather than being wasted out in the pastures. Early examples of such practices can be found after 1670 with the feeding of turnips through winter and early spring to cattle placed in cow (or neat) houses. For example, on the Frere property at Finningham Hall, 12 'turnep beasts' were 'in the house' in 1684, 12 steers were 'tied up at turneps' in 1685, seven 'turnep steers' were at 'my turnep shod' in 1687, and fat bullocks were being sold from 'out of the shed' in 1692.⁶² Similarly, in the early spring of 1704 Thomas Stopher of Spexhall Manor Farm was described as staking up two scotch bullocks in his neathouse and feeding them turnips until supplies ran out.⁶³ There is strong documentary evidence that the construction of purpose built housing for cattle dramatically increased in the region through this period.⁶⁴ Invariably these newly built cow houses were placed away from the farmyard, usually in pasture closes that abutted onto arable fields.⁶⁵

Therefore, it is probable that between 1670 and 1710, improvements in the feeding and housing of cattle had a beneficial impact on the quality and quantity of dung produced in the region. Consequently, it is unlikely to be pure coincidence that the first rise in yields shown in Table 4 is contemporaneous with these advances. Moreover, the disparity between initial wheat and barley/oats yield increases may denote differing levels of manure application for the two crops. The extra manure supplies that were generated by feeding turnips could be spread immediately on the succeeding barley/oats crop from nearby neathouses. Though the poor, wet weather of the 'Little Ice Age' in the 1670s and 1680s would have hurt the growth of barley, which was less resilient than wheat to wet and acidic growing conditions, the crop was more responsive to increased dunging.⁶⁶ The link between the cultivation of turnips and increased barley yields has already been indicated by Overton in 1991.⁶⁷

⁶⁰ Young, *General view of Suffolk*, p. 370; Young, 'Minutes', p. 197.

⁶¹ Wade Martins and Williamson, *Roots of Change*, p. 174.

⁶² SROI, HB405/C2/1.

⁶³ PRO, E134/4Anne/Mich. 4.

⁶⁴ Theobald, 'Changing landscape', pp. 180–1.

⁶⁵ *Ibid.*, p. 183.

⁶⁶ Wade Martins and Williamson, *Roots of Change*, p. 175.

⁶⁷ Overton, 'Determinants of crop yields', p. 314.

Furthermore, it seems plausible that ever improving methods for collecting and processing manure may have helped sustain grain yields between 1800 and 1836. The move away from dairying and the resulting reduction in the supply of animal waste in this period should have adversely effected grain yields; but this seems not to have been so. What factors helped prevent such a drop in productivity? To start with, the amount of manure taken from dairy stocks and used upon the arable sector had always been relatively low. As these herds spent most of their year out in the pastures, much of their dung and urine was lost, and the quality must have been poor, due to the main fodder source being low yielding coarse pasturage.⁶⁸ In addition, at the same time as milk cattle densities were falling, yarded animal numbers were actually on the increase. This change in farming policy had a direct impact on cattle housing in the region. It became increasingly common for new open-fronted cattle sheds to be built much closer to the farmstead, and more distant neathouses to be taken down.⁶⁹ Wade Martins and Williamson have found similar trends at this time in Norfolk.⁷⁰ Consequently, the fall in manure potential in this period was not a catastrophic one. By just the action of falling in the farmyard, dung and urine supplies were far more likely to retain their fertilizing properties. Yards would have been well littered with straw in order to absorb these waste products and in turn, therefore, much of the nitrogen and potassium contained within was preserved.⁷¹ The immediate need to collect this material into dunghills, so as to prevent the loss of nutrients into the atmosphere or by leaching, was more likely to be satisfied if the farmer kept much of his stock within central farm yards.

Nevertheless, though cattle, and indeed all livestock, were far more likely to be yarded by the 1840s, little thought seems to have been given to the arrangement of new and old buildings alike within the yard complex. This is clearly illustrated by a comment of the Raynbirds' in the late 1840s. They noted that many of the region's farm buildings were placed in the yard 'in every form except that which would give economy in the manufacture of manure, or in the feeding of cattle'.⁷² In the following year Caird lodged similar objections about farm buildings throughout England, but particularly in the southern counties.⁷³ What was needed was the complete re-ordering of outbuildings to create a central yard that provided separate folds and sheds for bullocks, dairy cattle and horses. When implementing these improvements it was normal procedure in the region to integrate new structures around older, established buildings (usually the barn). The policy of building completely new 'model' farmyards was rarely, if ever, adopted. *Roots of Change* has found similar 'piecemeal' schemes across Norfolk, including many on large, landed estates in the north and west of the county.⁷⁴ Such alterations took place chiefly between 1850 and 1880. The evidence for such changes having occurred in this period can be easily found if comparison is made between the tithe maps of c. 1840 and the first edition OS maps of the 1880s.⁷⁵ These well-ordered yards were a central feature of the system of 'high' farming, and by

⁶⁸ N. Scarfe (ed.) *A Frenchman's year in Suffolk*, Suffolk Rec. Soc. 30 (1988), p. 145.

⁶⁹ Theobald, 'Changing landscapes', p. 198.

⁷⁰ Wade Martins and Williamson, *Roots of Change*, pp. 94–5.

⁷¹ *ibid.*, p. 173.

⁷² H. Raynbird and W. Raynbird, *Agriculture of Suffolk*

(1849), p. 60.

⁷³ J. Caird, *English Agriculture in 1850–51* (1852), pp. 77, 89, 135, 152, 222, 490–1.

⁷⁴ Wade Martins and Williamson, *Roots of Change*, pp. 143–7.

⁷⁵ Theobald, 'Changing landscapes', p. 198.

greatly improving the production of manure were responsible, at least in part, for the steep increases in grain yields already evident by the 1860s.

Before leaving this subject, it is worth mentioning that the increasing use of other manures in the last hundred years of our period would have further improved the fertility of the land. Prior to the adoption of phosphates by the region's farmers in the 1830s and 1840s, chiefly to aid the cultivation of root crops, the most commonly used substance was 'manner' or compost.⁷⁶ This material was acquired by skimming the topsoil off from the borders around fields and scouring ditches (known in Suffolk as 'outhawl'). Documentary evidence tends to suggest that farmers were seeking to increase the amount of manner produced on their land after 1750. The first reference, for example, to borders being 'mannered' comes on the Tollemache estate at Helmingham in 1759.⁷⁷ The earliest probate inventory to mention manner compost was at Hacheston in 1760, but by the 1790s the substance appears frequently in these records.⁷⁸ Woodward notes that 'earth compost' was being produced by similar methods near Chelmsford in this same decade. To quote, 'soil [is taken] wherever it can be spared from the sides of lanes or roads, or from the skirts of the enclosure'.⁷⁹ Young and the Raynbirds state that though manner was mixed with animal manure, its best application was as a foundation and cover for the dunghill, in order to prevent fermentation and therefore loss of fertilizing power.⁸⁰

So far this section has examined the various ways farmers could improve the fertility of their land by increasing the levels of nitrogen in the soil. The role leguminous crops played in this process has already been discussed, but organic matter, such as animal waste, is somewhat different as it releases nitrogen into the soil when it decays. With this in mind, it is important to understand that the decay rates of manure can be badly checked if the soil is waterlogged or too acidic. To realize the true potential of improved manure supplies, the region's farmers had first to combat soil acidity and poor drainage.

Taking the former of these conditions first, the earliest method farmers used to counteract acidity was to marl their lands.⁸¹ This process involved digging pits to extract the chalky (alkaline) clay subsoil in order to add to the topsoil. This labour intensive method was necessary as the two soils would have never been mixed together by the shallow blade of pre-1840 ploughs. Acidic topsoils would have been most prevalent on lands just broken up from ancient pasture, due to nutrients leeching into the subsoil over a long period of time. It is not surprising therefore, that the first marling references in the archives appear in the 1750s, when arable totals began to increase.⁸² The process of gradual adoption in this decade can be seen at South Elmham Hall Farm in 1753 when it was said that marl would improve the estate, 'but none as yet has been found there as in the neighbourhood'.⁸³ By the 1780s lease covenants that allowed increased

⁷⁶ Raynbird and Raynbird, *Agriculture*, p. 48.

⁷⁷ HHA, T/HEL/26/61.

⁷⁸ Norfolk Record Office, (hereafter NRO), INV82A/175.

⁷⁹ D. Woodward, "'An essay on manures': changing attitudes to fertilization in England, 1500-1800", in J. Chartres and D. Hey (eds), *English Rural Society, 1500-1800: Essays in honour of Joan Thirsk* (1990), p. 264.

⁸⁰ Young, *General view of Suffolk*, p. 195; Raynbird and Raynbird, *Agriculture*, p. 43.

⁸¹ Potash 'muck' began to be used at about the same time as marl, but was not continued for much more than 30 or 40 years afterwards.

⁸² BL, Add. Ms. 19,185, fo. 231; 19,197, fo. 121. However, the technology of marling was known in medieval times, which is borne out by the number of early marlpits found in Suffolk. The process would have been most prevalent in periods of economic prosperity and increased cultivations.

⁸³ SROL, 741/E1/5/86.

arable acreages also gave directives to clay marl newly cultivated land. For instance, in 1783 the tenant of the Mary Warner trust farm in Stradbroke was given an allowance to carry 500 loads of clay marl from a pit in Clay-pit Close.⁸⁴ The normal quantity of marl to be applied per acre was between sixty and seventy tumbril loads. With the economic climate throughout the French Wars in mind, it is obvious how essential neutralising soil acidity was in order to release the great (but temporary) stores of fertility in newly broken up land.⁸⁵ Furthermore, tithe maps and apportionments bear testament to how common clay marl pits had become by the 1840s. However, due to the temporary and sometimes slow impact marl had on the land, and perhaps more importantly the labour intensive methods of its extraction, other calcareous materials were sought to counteract soil acidity. By the 1850s the purchasing and transportation of lime had become viable, and the application of this substance superseded the more costly and time-consuming method of digging pits.⁸⁶

Nevertheless, effective drainage on the region's heavy clay lands was even more important than neutralising acidity. To quote from John Josselyn's 1790 valuation of the Whittingham Hall estate at Fressingfield, underdrainage is 'always the first step towards improvement; for unless the arable land is laid dry, in some wet years they must lose their crops'.⁸⁷ Surface drainage methods were never as effective as ones that carried water down and through subsoils. The normal procedure for the majority of our period was to dig channels across a field, usually with the declivity if there was one, to the nearest ditches, and then place bush material (usually blackthorn or alder) or stubble, straw or stones in the bottom of the trenches before back-filling. The first reference to this form of drainage being implemented in the region comes on one of the lighter soil farms on the Flixton Hall estate in the late 1750s.⁸⁸ The most progressive farmers on heavier land, such as the tenants at Poplar Farm, Ashbocking, and Wetheringsett Lodge, began the process in the late 1760s. The workmen of John Edwards at Poplar Farm were hired out further away than Framlingham to teach the new methods.⁸⁹ By the 1780s and 1790s even smaller holdings such as the forty-acre Wyverstone College Farm were expending 'several sums' on draining.⁹⁰ There is little doubt that these initial schemes would have had some beneficial impact on crop yields, particularly those for barley. However, from minutes taken by Young at Crowfield in 1783 and Aspal in 1786, it is apparent that the amounts expended were woefully inadequate. At the latter village he noted that 'where there is one rod of hollow-drains there ought to be an hundred'.⁹¹ Consequently, though gradually increasing, the level of underdrainage installed by 1800 was still inadequate to drain effectively the region's arable fields.

Though the situation slowly improved during the early decades of the nineteenth century, it is obvious that numerous villages in 1840 still had insufficient levels of hollow drainage. For instance, though the Tithe Files acknowledge that underdrainage was 'generally adopted' in

⁸⁴ SROI, GB412/4125, box 3, B. Alexander's 1783 lease for a farm in Stradbroke.

⁸⁵ Also, the excess of organic matter in newly broken up land would have made even heavy soil loosely textured. Clay marl would have gone some way to correcting this structural deficiency.

⁸⁶ W. M. Mathew, 'Marling in British agriculture: a

case of partial identity', *AgHR* 41 (1993), pp. 108–110.

⁸⁷ SROB, E18/640/5.

⁸⁸ SROL, 741/E1/5/183.

⁸⁹ Raynbird and Raynbird, *Agriculture*, p. 187.

⁹⁰ PCAC, Ms. LI (Valuation Book, 1774–1824).

⁹¹ Young, 'Minutes', p. 196

most parishes, they also recommend further investment in order to rid the region of 'much wet land'.⁹² The Raynbirds suggest that the level of underdrainage installed in the region increased considerably through the 1840s. One commentator, for example, stated that the feature had 'never been carried to a greater extent than it is at the present time'.⁹³ These more comprehensive levels of drainage would have undoubtedly played a far more significant role in improving land productivity than was previously the case. They would have also enabled farmers to cultivate root crops with far more frequency and confidence. Further, more extensive underdrainage schemes were installed between 1850 and 1880, and these were largely encouraged by the introduction of tenant right systems, government loans, and to a lesser extent, the innovation of the tilepipe.⁹⁴ Nevertheless, it has to be noted here that when comparing the above findings with the conclusions made in *Roots of Change* it would seem that the heavy clay parishes of Woodland High Suffolk lagged behind other East Anglian districts in installing effective levels of underdrainage and adopting the tilepipe in place of the bush drain.⁹⁵

V

The data supplied in this paper therefore clearly indicates that farm outputs were significantly increasing in Woodland High Suffolk through the early-modern period. For example, according to the figures from Table 5, grain outputs increased six-fold in the region between 1650 and 1850. These gains were part of a more general trend of improved agricultural production across the whole country. Wrigley illustrates the extent of these increases by stating that the English agricultural sector in 1820 was still managing to feed adequately a population that had quadrupled since 1550.⁹⁶ Improvements in grain output in our region were achieved by a combination of incremental increases in land productivity throughout the two hundred years under discussion and by increasing the area under cultivation primarily after 1750. Improvements in land productivity were achieved by a series of advances in farming husbandry. These included the inclusion of green fodder crops into arable rotations, the increase in yard and stall feeding of livestock with better quality fodder, the resulting improvements in the quality and quantity of manure produced, the counteracting of soil acidity, and lastly, the installation of underdrainage schemes. Though some of these procedures had their origins back in the seventeenth century, none were pursued as systematically and comprehensively as they were in the forty years after 1840. Not surprisingly, therefore, this period also saw the largest and most rapid increases in grain yields.

Probably the most salient point to make when assessing the paper's livestock data is that total densities stayed reasonably constant before 1810, hovering between 27 and 32 units per 100 acres; but this was followed by a fall to roughly 20 units in the 50 years after this date. This data

⁹² PRO, IR18/9582 (Bedfield); 9583 (Bedingfield); 9749 (Fressingfield); 9878 (Mendlesham); 10080 (Wyverstone). As a rule, the heavy land parishes with the highest amounts of roots grown on their fallows were the ones that had been drained the most.

⁹³ Raynbird and Raynbird, *Agriculture*, pp. 121, 129.

⁹⁴ BPP 1847-48, VII (461), *Report from the Select*

Committee on Agricultural Customs, pp. 175-183; A. D. M. Phillips, *The underdraining of farm land in England during the nineteenth century* (1989), pp. 62-88.

⁹⁵ Wade Martins and Williamson, *Roots of Change*, pp. 65-7.

⁹⁶ E. A. Wrigley, *People, cities and wealth: the transformation of traditional society* (1987), p. 112.

therefore quashes any claims that the adoption of new rotations resulted in far higher stocking densities. Nevertheless, the real achievement here was that the area under the plough could be greatly expanded without any drastic reduction in the overall number of animals kept.⁹⁷ Indeed, it would seem from the data that if farms increased their arable to between 30 and 40 per cent of their total area, livestock units could actually rise moderately. Furthermore, the declining figures for milk cattle within the region's overall totals obscure the fact that numbers for predominantly yarded livestock increased noticeably.

Despite these conclusions, it is not the intention of the paper to give a clear defining statement regarding the timing of an 'agricultural revolution' in England. Much ink has been spilt over this contentious issue, but the paper will avoid entering the debate, due in part to the fact that the term revolution is, in itself, unhelpful and misleading. In 1984 Overton went as far to describe it as being 'beyond redemption as it is surely meaningless'.⁹⁸ Little can be gained by dogmatically adhering to such a term. To do so, would, for example, lead us to underplay the importance of the gradual, incremental advances in agricultural procedure and output that occurred in the region before 1840. Another reason for this paper's reluctance to enter the national debate, however, is that the data is too incomplete as it stands to allow an accurate calculation of overall agricultural productivity to be made. Firstly, as already mentioned, the pre-1660 data in the paper is either very patchy (for livestock) or non-existent (for crop yields). The lack of any figures for the latter category prevents the paper from completely dismissing the claims of Kerridge and Allen that the late sixteenth and seventeenth centuries saw the greatest improvements in land productivity.⁹⁹ The information this paper can utilize to place the crop yields shown in Table 4 into an earlier context are Campbell and Overton's figures for Norfolk. Secondly, due once again to the lack of archival material, no attempt has been made to examine changes in the productivity of agricultural labour. Without such data it is not possible to reliably evaluate whether labour inputs rose in accordance with the increases in grain outputs shown above. For the scope and purpose of this paper, however, the sound assumptions made in *Roots of Change* shed some light on this issue. It is stated there that though the adoption of the four-course rotation and the extension of the cultivated area would require significant increases in the amount of labour employed, the region could meet this demand, due to a 'substantial surplus of labour' and relatively low wage levels.¹⁰⁰ It is therefore unlikely that labour productivity in Woodland High Suffolk improved greatly until after this period, when agricultural wages rose and labour saving measures such as the reorganisation of farm yards and the introduction of harvest machinery began to be adopted.

Nevertheless, though incomplete, the data given above can still make a useful contribution to the historiographical debate concerning productivity growth in English farming. Its primary role in this respect is that it gives further credence and support to research completed in the last ten years by Campbell and Overton, Wade Martins and Williamson and Turner, Beckett and Afton.

⁹⁷ Wade Martins and Williamson, *Roots of Change*, p. 173.

⁹⁸ M. Overton, 'Agricultural Revolution? Development of the agrarian economy in early modern England' in A. R. H. Baker and D. Gregory (eds), *Explorations in Historical Geography: interpretative essays* (1984), p. 139.

⁹⁹ E. Kerridge, *The Agricultural Revolution* (1967); R. C. Allen, 'The two English Agricultural Revolutions, 1450-1850', in Campbell and Overton (eds), *Land, labour and livestock*.

¹⁰⁰ Wade Martins and Williamson, *Roots of Change*, pp. 154-6.

This body of work re-establishes the view of an earlier generation of agrarian historians such as Chambers and Mingay, that in the 170 years after 1700 the agrarian economy of England was utterly transformed, and agricultural practice and productivity significantly improved.¹⁰¹ Overton noted in 1996 that 'the magnitude of the changes that occurred [in Norfolk between 1750 and 1850] were out of all proportion to those which had occurred during the preceding 500 years, and changes of similar magnitude were happening elsewhere' in England.¹⁰² It follows inevitably from this that by supporting Overton this paper must also cast doubts over some of the revisionist claims made by Kerridge, Jones, John, Allen and Clark.¹⁰³ The general consensus from this group of historians was that most of the advances in farming practice and productivity occurred between the late sixteenth and early eighteenth centuries, and that little was achieved after this period. Though all these historians were keen to stress the importance of the seventeenth century as a time of improvement, Clark is the most vehement in his dismissal of the eighteenth and nineteenth centuries. He stated, for example, that there was 'little productivity growth in agriculture' between 1700 and 1850.¹⁰⁴ Not surprisingly, this statement cannot be sustained when the evidence for Norfolk and Suffolk is examined. Of course, the convergence of opinion between the work of Overton, Wade Martins and Williamson and this paper may simply reflect the situation found in East Anglia, and that temporal variations in the progress of agricultural improvement occurred from farming region to farming region. Nevertheless, there is enough analytical evidence available now, including the new data given above, to suggest that far from being a time of inertia and stagnation, the 170 years after 1700 was a period that experienced fundamental agrarian change and hugely impressive gains in agricultural productivity.

APPENDIX ONE

Probate Inventory References, 1587–1803

Suffolk Record Office, Ipswich branch:

Chippenhall Hall, Fressingfield, FEI/4/10; Winston Hall, FEI/4/34; Home Farm, Heveningham, FEI/4/113; Bruisyard College Farm, FEI/4/114; Great Lodge, Framlingham, FEI/5/129; Westhouse Farm, Fressingfield, FEI/6/6; Little Lodge, Framlingham, FEI/6/44; Moat Grove Farm, Pettaugh, FEI/6/90; Redhouse Farm, Framsdén, FEI/9/82; an 83 acre farm in Westhall, FEI/21/45; Poplar Farm, Ashbocking, FEI/13/125; Framsdén Hall, FEI/25/67; Countess Wells, Framlingham, FEI/21/6; Park Gate Farm, Helmingham, FEI/22/91; Grange Farm, Otley, FEI/22/93; High Elm Farm, Pettaugh, FEI/27/22; Ivy Lodge Farm, Hoo, FEI/28/12; Whittingham Hall, Fressingfield, FEI/28/34; Spaldings Barn, Framsdén, FEI/28/35; Great Lodge, Framlingham, FEI/28/73; Green Farm, Cookley, FEI/31/48; Towranna Farm, Huntingfield, FEI/30/11; Ashbocking Hall, FEI/31/9; Abbey Farm, Rumburgh, FEI/29/21; Batts Farm, Mendlesham, HA87/B2/1/1; Reads Hall, Mickfield, *Ipswich J.*, 26 Sept. 1801, p. 4, col. 1; Batts Farm, Mendlesham, HA87/C7/1/1; East End Manor & Longland Hall, FEI/32/2.

Suffolk Record Office, Bury St Edmunds branch:

Bartlett/Wood Hall, Rishangles, IC500/3/5/144; Hestley Hall, Thorndon, IC500/3/9/109; Westhorpe Lodge, IC500/3/14/172; Dairy Farm, Thorndon, IC500/3/15/146; Charity Farm, Thorndon, IC500/3/16/186; a 20 acre estate in Rishangles, IC500/3/17/159; Finningham Green Farm, IC500/3/21/161; Common Farm, Rishangles, IC500/3/27/72;

¹⁰¹ J. D. Chambers and G. E. Mingay, *The Agricultural Revolution, 1750–1880* (1966).

¹⁰² Overton, 'Re-establishing the English Agricultural Revolution', p. 11.

¹⁰³ *ibid.*, pp. 1–2.

¹⁰⁴ G. Clark, 'Agriculture and the Industrial Revolution, 1700–1850', in J. Mokyr (ed.), *The British Industrial Revolution: an economic perspective* (1993), pp. 246, 249.

Charity Farm, Thorndon, IC500/3/34/27; Westhorpe Hall, IC500/3/50/36; Wetheringsett Lodge, IC500/3/51/116; Red-house Farm, Thornham Magna, IC500/3/53/17; Badwell Ash Hall, IC500/3/53/93; Wyverstone College Farm, IC500/3/53/100.

Suffolk Record Office, Lowestoft branch:

Six Farms in Flixton c. 1790, (Grange, Abbey, Starknaked, Hill, Wood and Retreat), 741/B1/2/69, 73, 74, 76, 77, 79, 741/E1/8/5.

Norfolk Record Office:

Cuckoo Farm, South Elmham, St. James, INV45/71; Wickham Skeith Hall, INV55A/96; Moat Farm, Mendlesham, INV57B/41; Park Gate, Helmingham, INV62A/40; Old Hall, Helmingham, INV67A/76; a 13 acre estate in Rishangles, INV86/113; Brames Hall, Wetheringsett, INV70/222; Reads Hall, Mickfield, INV73/228; Westhorpe Lodge, INV75B/13; a 35 acre estate in Rishangles, INV78A/14; Cuckoo Farm, South Elmham, St. James, INV82A/193; a 21 acre farm in Saxtead, INV84/3; Grove Farm, Framlingham, INV84/24.