

Scottish crop yields in the second half of the seventeenth century: evidence from the Mains of Castle Lyon in the Carse of Gowrie*

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Abstract

In the second half of the seventeenth century, Scotland's under-developed economy struggled to recover from the Cromwellian wars and their aftermath. Although there is evidence of an expansion in cereal production in this period, the country was a marginal area for bread grains and a severe famine was experienced in the 1690s. This essay presents crop yield data recorded over a 23-year period (1673–95) on a farm in the Carse of Gowrie, one of Scotland's most favoured arable areas. It explores the nature and context of the improved agrarian practices introduced there and the considerable increase in returns achieved. However, the generally low yields obtained, together with fluctuations in their level from one harvest to the next, also reveals the threat to the supply of staple foods posed by an extended period of poor weather.

The Cromwellian Wars and their aftermath left Scotland a defeated nation, effectively bankrupt, with little more than primary products to trade and only a handful of ships in which to carry them.¹ In the third quarter of the seventeenth century her economy was still recovering from the damage it had sustained.² Climate and physical geography made Scotland a marginal area for bread grains with cereal production confined for the most part to the staples of oats and bere.³ Soils were in general impoverished, having suffered environmental degradation over the course of millennia that involved a steady leakage of nitrogen.⁴ Crop yields during the second half of the seventeenth century were for the most part low, surpluses were limited and any extended shortfall brought the threat of dearth. In the 1690s, severe weather conditions launched

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¹ An example of the extent of the damage done to the country's trade is evident from the 1656 survey by Thomas Tucker. Only 80 ships above 25 tons burden were recorded in the whole of Scotland. J.D. Marwick (ed.), 'Report by Thomas Tucker upon the settlement of Revenues of Excise Customs in Scotland, AD 1656', *Miscellany of the Scottish Burgh Records Society* (1881), pp. 1–48.

² For some far from flattering contemporary descriptions of the country, see P.H. Brown (ed.), *Early Travelers in Scotland* (1891).

³ Bere (bear, beir, beer): a hardy, primitive, four-rowed variety of barley used primarily for brewing.

⁴ T. C. Smout, 'The Improvers and the Scottish Environment', in T. M. Devine and J. R. Young (eds), *Eighteenth-Century Scotland, New Perspectives* (1999), pp. 210–14.



FIGURE 1. Detail from John Adair, *The Mappe of Straithern, Stormont and Cars of Gourie* (1720 imprint of the 1683 Survey). Circled is the depiction of the enclosures created by Patrick, Earl of Strathmore on the Castle Lyon estate and by Lord Kinnaird on the neighbouring estates of Drimmie and Inchture. Location map inset.

devastating famine to large areas of the country.⁵ The seriousness of this famine offers evidence, superficially at least, for the backwardness of the Scots economy at this time. This paper examines crop returns for the consecutive years 1673–95 from the Mains of Castle Lyon in the Carse of Gowrie. It will show that upon the seemingly bleak landscape described above, there were real signs of improvement in agrarian practice in the years for which data is available.

The survival from this period of systematic recordings of the yields obtained on Scottish farms is extremely rare. The amount of information that is extant for Castle Lyon affords a valuable opportunity to explore the reality of crop production at this time, the systems and practices employed, the difficulties faced, the levels of the yields achieved and, not least, the nature, extent and the context of the improvements that were introduced. This, at a time when there was little growth in Scotland's urban population and the poor situation with regard to overseas trade, kept grain prices low except in times of dearth.⁶ The farm's situation in the Carse of Gowrie

⁵ R.E. Tyson, 'Famine in Aberdeenshire, 1695–1699: anatomy of a crisis', in D. Stevenson (ed.), *From Lairds to Louns: country and burgh life in Aberdeen, 1600–1800* (1986), pp. 32–50; K. Cullen, C.A. Whatley and M. Young, 'King William's Ill Years: new evidence on the impact of scarcity and harvest failure during the crisis of the 1690s on Tayside', *Scottish Historical Rev.*, 85 (2006), pp. 250–76; K. J. Cullen, 'Famine in Scotland in the 1690s: causes and consequences' (unpublished PhD thesis, University of Dundee, 2004). See also R.A. Dodgshon, 'The Little

Ice Age in the Scottish Highlands and Islands: documenting its human impact', *Scottish Geog. J.*, 121 (2005), pp. 321–37.

⁶ For figures on Scotland's urban population at this time, see I.D. Whyte, 'Scottish and Irish urbanisation in the seventeenth and eighteenth centuries: a comparative perspective', in S.J. Connolly, R.A. Houston and R.J. Morris (eds), *Conflict, identity and economic development. Ireland and Scotland, 1600–1939* (1995), pp. 18–19.

adds further significance. (For its location, see Figure 1.) The district was well established as one of the premier grain producing areas in Scotland. Wheat was grown there on a commercial scale for supply to urban centres and, in good years, large quantities of oats, bere and malt were exported to Scandinavia and the Low Countries.⁷

The land on which the Mains of Castle Lyon (later renamed Castle Huntly) was situated is south-facing and relatively sheltered at an altitude of between five and twenty metres above sea level, one and a half miles to the north of the Tay estuary. The soil is predominantly a mixture of estuarine silts and clays with a capability for agriculture classified by the Soil Survey of Scotland in part as Grade 2 and in part as Grade 3.⁸ The ground is, in general, naturally fertile, but with cropping inhibited by poor drainage in low-lying areas of heavy clay. The Sidlaw hills to the north and the Fife hills to the south effectively encircle the Tay estuary and provide shelter from extremes of weather. Rainfall is consistently less than thirty inches per annum. An above average number of frost-free days, together with the long hours of summer daylight to be found at latitude 56° 27' North, provide a relatively long growing season.⁹

I

The data from which the run of yields have been calculated are contained in the *Papers of the Earl of Strathmore* [NRA(S) 885]. The amount of information to be found in the muniments together with comments by Patrick, first Earl of Strathmore, in the *Glamis Book of Record*, reveal much about the Castle Lyon estate during the second half of the seventeenth century.¹⁰ The insight these records allow into the circumstances of the farm, the methods of production employed and the manner in which the estate was being developed and improved, enables the level of crop returns there to be seen in their wider context and so provide a basis for comparison with yields found elsewhere. The level at which crops yield is dependent on several factors and where only isolated instances of yields from single years are available there is no way of knowing how representative these might be, or whether they reflect a particularly good or bad harvest. In practice, even farms of a similar size and within a few miles of each other can produce very different returns in the same year. In 1695 for instance, a year of very serious dearth and in some areas famine, the corncaster measured the total cereal harvest at Dronlaw, a farm of two ploughgates to the north-west of Dundee, to be 140 bolls. In the same year, only five miles distant but in a more sheltered location, the grain and pease grown on the Mains of Castle Lyon (also a farm of two ploughgates) totalled 300 bolls.¹¹

⁷ I.D. Whyte, *Agriculture and society in seventeenth-century Scotland* (1979), pp. 63–4; M. Young, 'Rural society from the Restoration to the Union. Challenge and response in the Carse of Gowrie, c.1660–1707' (unpublished PhD Thesis, University of Dundee, 2004), pp. 201–3.

⁸ Soil Survey of Scotland, *Land Capability for Agriculture*, Sheet 5, Eastern Scotland, (1983).

⁹ A.N.L. Hodd, 'Agricultural change in the Carse of Gowrie, 1750–1875' (unpublished PhD thesis, University of Dundee, 1974), pp. 22–6.

¹⁰ A.H. Millar (ed.), *Glamis Book of Record* (1890), *passim*.

¹¹ National Register of Archives (Scotland [hereafter NRA(S)] 885, Papers of the Earl of Strathmore, 50/3 and 64/1/21, 1695. (The archive remains at Glamis and access may be arranged through the National Register of Archives (Scotland.)) Amongst local terms, the Corncaster was an independent assessor employed to measure and attest to the amount of grain thrashed and contained in stacks; a ploughgate was nominally the amount of land that could be ploughed by a team of eight oxen in a season.

A guide to the value of the land on the Mains of Castle Lyon, which offers the possibility of comparison with other estates and holdings in Scotland in the seventeenth century, is through its 'valued rent'. In accordance with an act of the Parliament of Scotland in 1643, the real rent of every holding was assessed by local commissioners to facilitate the raising of a land tax.¹² The rent of the arable ground on the Mains of Castle Lyon was assessed as 100 bolls (20 bolls each of wheat, bere, oats, meal and pease).¹³ At the rule of thumb rate for the application of rent in the pre-Improvement era of one third of production, the expected long-term average yield of victual from the arable ground at that time would, therefore, have been in the region of 300 bolls. At 100 bolls, the valued rent was slightly more than the actual rent of 92 bolls of victual being paid in the 1670s by three Castle Lyon tenants who each farmed holdings of two ploughgates adjacent to the Mains. The proportion of ferme (rent paid in grain) being paid by these tenants in the more valuable crop of wheat was however higher, at 26 per cent, than the assessed valuation of 20 per cent in wheat for the Mains.¹⁴

The factory accounts that pertain to the crop years 1672 to 1695 include the amounts of the three principal grains, plus pease, sown on the Mains of Castle Lyon and the quantities harvested.¹⁵ A 'crop year' was not a calendar year but corresponded to an accounting period that began with each harvest. Its usage was standard in Scotland's grain-growing areas throughout the early modern period. Grain harvested in the autumn of 1680, for example, was the basis for the crop year 1680 and all subsequent sales of, payments in, or use made of grain from that harvest, be it in 1680, through 1681 or even beyond, would be accounted for as 'crop 1680'. This included all debts falling due from that harvest such as stipends, wages and rents. Grain discharged as having been sown in the accounts of crop year 1680, was the seed corn for the following crop, i.e. the harvest of crop year 1681. During the period from which the records of yields survive, four different factors had the day-to-day management of the estate but Earl Patrick was resident at Castle Lyon for long periods and took a very close personal interest in its affairs and development. The account books follow for the most part a similar pattern: the nature of their contents is fairly consistent, though the level of detail varies, sometimes considerably. From 1696, the year of Earl Patrick's death, no records with comparable information on the crop yields at Castle Lyon have been located.

The extant volumes contain the summaries of the receipts (the 'charges') for the estate as a whole: they include the amounts of ferme and money received from the tenants as well as the return of the crops grown on the Mains. They include the manner of the disposal of the crops and ferme (the 'discharges'), listing the quantities sold, what was consumed on the estate by the household and livestock, the maintenance and payments made to workers and, importantly, the amounts sown as seed on the Mains' land. The yield figures include only the amount of usable grain obtained from each Mains' harvest and take no account of any losses that might have

Note 11 continued

One Perthshire boll of wheat or pease was equal to 4.21 English bushels [1.53 hectolitres]; one Perthshire boll of oats or barley was equal to 6.21 bushels [2.26 hectolitres], as calculated from the county table for Perthshire in Charles Elliot, *A Proposal for uniformity of Weights and Measures in Scotland by execution of the Laws now in*

force (1779), pp.110–11.

¹² *The Acts of the Parliament of Scotland*, VI (i), 1643–47 (1870), p.31.

¹³ NRA(S) 885, 64/1/2.

¹⁴ NRA(S) 885, 64/1/1, Compt Book for 1671.

¹⁵ Factory accounts: the accounts kept by the factor, i.e. the land steward or agent.

TABLE 1. Crop Yields on the Mains of Castle Lyon, 1672–1696 (Amounts sown and the yield are measured in bolls.)

Crop Year	Wheat			Bere			Oats			Pease		
	Sown	Yield	Ratio	Sown	Yield	Ratio	Sown	Yield	Ratio	Sown	Yield	Ratio
1672		73.5			53.00			168.75			49.63	
1673	14.75	65	4.41	17.75	57.75	3.25	63.00	172.00	2.73	12.00	26.00	2.17
1674	18.5	43.31	2.34	20.00	40.81	2.04	64.00	155.15	2.42	18.00	38.13	2.12
1675	16.00	60.56	3.79	21.43	60.24	2.81	56.81	148.75	2.62	12.25	35.38	2.89
1676	13.81	54.38	3.94	19.75	25.69	1.30	64.03	169.94	2.65	15.00	61.63	4.11
1677	15.88	46.56	2.93	14.13	35.72	2.53	52.63	154.25	2.93	17.09	79.63	4.66
1678	21.00	62.94	3.00	14.94	56.81	3.80	47.00	109.69	2.33	18.00	62.13	3.45
1679	18.85	19.25	1.02	18.80	59.88	3.19	43.00	91.00	2.12	11.33	28.00	2.48
1680	—	43.88	—	15.50	59.75	3.98	45.50	114.00	2.50	14.18	74.51	5.25
1681	19.38	52.86	2.73	14.00	83.88	5.99	48.31	138.88	2.87	14.38	21.14	1.47
1682	16.63	47.44	2.85	16.63	28.56	1.72	55.83	121.63	2.18	18.75	60.75	3.24
1683	16.88	64.00	3.80	17.25	59.63	3.46	65.69	219.81	3.35	15.68	122.25	7.80
1684	19.06	40.88	2.14	19.75	82.50	4.18	62.91	166.56	2.65	16.31	57.63	3.53
1685	14.19	46.94	3.31	23.50	97.44	4.15	55.75	142.53	2.56	27.13	111.06	4.09
1686	16.75	29.19	1.74	17.75	44.00	2.48	62.19	181.38	2.92	24.50	84.00	3.43
1687	14.50	88.69	6.12	21.41	72.00	3.36	56.50	187.00	3.31	20.25	71.00	3.51
1688	23.00	115.75	5.03	20.00	60.25	3.01	48.50	186.63	3.85	17.50	44.63	2.55
1689	26.75	101.75	3.80	23.00	82.25	3.58	44.75	126.25	2.82	20.44	102.32	5.01
1690	21.88	93.50	4.27	23.75	75.50	3.18	47.50	184.25	3.88	24.88	71.75	2.88
1691	25.50	82.00	3.22	21.81	96.00	4.40	46.25	202.50	4.38	29.00	119.75	4.13
1692	22.50	123.06	5.47	23.50	70.00	2.98	54.00	216.13	4.00	23.38	66.69	2.85
1693	23.75	107.25	4.50	19.50	84.25	4.32	37.19	120.93	3.25	27.88	38.50	1.38
1694	30.63	70.70	2.31	19.00	68.25	3.59	69.49	207.19	2.98	29.88	64.00	2.14
1695	26.13	27.00	1.03	22.00	67.47	3.07	50.25	83.13	1.65	56.50	123.00	2.18
1696	23.50			26.75			80.88			19.75		

Source: Papers of the Earl of Strathmore, NRA(S) 885; 1672, 190/2/8; 1673, 190/2/5; 1674, 51/1/15 and 190/2/5; 1675, 51/1/15 and 16; 1676, 51/1/16 and 190/1/9; 1677, 190/1/9 and 10; 1678, 190/1/10 and 12; 1679, 54/1/10 and 190/1/12; 1680, 54/1/10; 1681, 64/1/7 and 8; 1682, 64/1/8 and 9; 1683, 64/1/9 and 11; 1684, 64/1/11; 1685, 64/1/12; 1686, 64/1/13; 1687, 64/1/13; 1688, 64/1/13; 1689, 64/1/14; 1689, 64/1/15; 1690, 64/1/16; 1691, 64/1/17; 1692, 64/1/18; 1693, 64/1/19; 1694, 64/1/20; 1695, 64/1/21; 1696, 64/1/22.

occurred through storm, vermin damage or theft prior to the thrashing of the corn stacks. The grain harvested on the Mains was held and accounted for separately to that received as ferme, bought in, or held over from previous years. The Mains' crop, excepting that wheat set aside for seed (which was thrashed and used almost immediately for autumn sowing), was stacked and stored unthrashed until needed. At the thrashing of each stack the grain was measured and proofed by a corncaster. Corn taken in as teind sheaves was accounted for separately. Teind was payable on the 'toun' land of Longforgan, but not across the estate as a whole or on the Mains land and none has therefore been included in the yields from the Mains.¹⁶

The accounts were audited with declarations as to their veracity signed by the factor and the Earl of Strathmore. The Earl contested only one figure. The very low amount recorded as the yield of bere in 1676 prompted him to write in the accounts that it was 'very presumable that there is wrong done which in due time may not only be found out but punished'.¹⁷ However, yields in that year were generally low and, in the absence of any alternative figure being given, the yield as stated in the account book is the figure that has been employed in this study. One amount from the series is missing. At Martinmas 1679, James Ferryer took over from John Lyon as factor and no account of the wheat sown on the Mains for the following year's crop was recorded by either. The yields in 1679, with the exception of the bere crop, were extraordinarily low, with wheat particularly bad. It is possible that either the entire crop was used as seed, or that the little recovered was too poor for such use and seed wheat for the 1680 crop was brought in without proper account of the transaction being kept. A full list of the figures for wheat, bere, oats and pease for those years where records are extant are set out in Table 1.

II

Crop production on the estate of Castle Lyon was based on the traditional infield-outfield system of cultivation then found across much of Lowland Scotland. Infield land tended to be adjacent to the farmsteads and of better quality; it received as much manure as was available and was kept in perpetual cultivation. On the infield, the four principal crops of pease, wheat, bere and oats were grown in roughly equal proportions and in that order of rotation.¹⁸ This was the preferred system in those areas of Scotland where wheat was grown on a commercial basis.¹⁹ Planted immediately after the pease, wheat was able to derive the greatest benefit from the nitrogen fixing qualities of the legumes. Bere, the crop from which ale, the ubiquitous drink of the time was brewed, was hardier than barley, coped well with acid soils and rewarded the input of fertilizer. It was well suited to the Scottish climate in that it required only a very short growing season. In wet springs it could be sown relatively late, allowing time for the ground to dry.²⁰ Granary accounts from Castle Lyon show that in some years, corn was being fed to horses engaged in the harrowing for the bere crop up to the very end of May.²¹ Although without the same potential for high yields as the other grains, oats were a more reliable crop and able to

¹⁶ Teind: tithes. 'Toun' land: land possessed by tenant smallholders.

¹⁷ NRA(S) 885, 190/1/9.

¹⁸ NRA(S) 885, 190/1/22.

¹⁹ Whyte, *Agriculture and society*, pp. 213–18.

²⁰ *Ibid.*, p. 62.

²¹ NRA(S) 885, 64/1/11, 1685 and 62/3/7, 1697.

perform more successfully in poor conditions, hence their position at the end of the rotation. The extant records do not, unfortunately, give any guidance with regard to the amounts of, or manner in which, dung or other fertilizer was applied to the individual crops. Oats were the only one of the principal crops to be grown on the outfield; this land was farmed less intensively than the infield, being grazed, cropped and rested in rotation. Livestock were herded and kept in temporary folds on the areas of outfield next to be cultivated: they fed on the grasses and herbage that grew there naturally and their manure fertilized the ground. The area was then cropped with oats for a period of three or sometimes more years, after which the ground was rested. Following this break, livestock would again be folded and the cycle of cultivation repeated.²²

The Mains of Castle Lyon is described as being a holding of 'two strong plows'. In Scotland, a ploughgate of land is usually taken as 104 Scots acres (i.e. 130 statute acres or 53 hectares approximately) but in practice it is a far from exact measurement. It is rather an expression of the amount of land that could be kept in cultivation by one team of eight oxen. The same team of oxen would, for instance, be capable of ploughing a greater amount of level, light, sandy land in a season than it would of heavy, carse-land clay. Ian Whyte suggests that a seventeenth-century ploughgate might measure somewhere between 80 and 100 Scots acres.²³

The actual acreage of the ground under crop on the Mains of Castle Lyon during the period for which the figures apply was not recorded and the surviving labour accounts provide little assistance towards this end. The majority of the work on the Mains was carried out by the estate's permanent farm servants who received an annual fee. Ploughmen were the highest paid, receiving £24 Scots (£2 sterling) plus 6½ bolls of livery meal per year. Most additional labour, including the shearing of the corns at harvest, was supplied by the estate's 'aikermen' (tenant smallholders possessing land in the 'toun' of Longforgan) as part of the customary labour services they bore within the terms of their leases. The extent of these labour services is described as 'unlimited'.²⁴ A rare reference to the number of shearers employed to cut the corns was made in regard to the harvest of 1690, when an allowance of 'supper meal' to eight shearers plus their piper was recorded, but no mention of the amount of days worked was included.²⁵ The system of customary labour service also clouds the issue of the actual number of ploughs used. The tenants of the large holdings on the estate were obliged to supply 'bonnage pleuchs' (bondage ploughs) to assist on the Mains when required and also to plough the rigs farmed by the aikermen. In 1691 these smallholdings extended to over 100 Scots acres of infield, plus a substantial amount of outfield land. Accounts pertaining to 1691 and 1692 record payments to only one ploughman on the Mains; in 1695 however, three permanent staff with this epithet were listed, while an inventory from 1713 indicates that there were two teams of plough oxen at that time.²⁶

In the absence of other information, the best estimate of the area under cultivation can be made from the amounts of seed corn and pease that were sown in each year. The writings of

²² A full and detailed description of the infield-outfield system of cultivation as practised in Scotland can be found in R. A. Dodgshon, *Land and society in early Scotland* (1981), pp. 229–41.

²³ Whyte, *Agriculture and society*, pp. 144–5.

²⁴ NRA(S) 885, 190/1/23.

²⁵ NRA(S) 885, 64/1/17.

²⁶ NRA(S) 885, 190/1/23 and 64/1/21.

contemporary commentators and the limited evidence that can be gleaned from estate records suggest that in Lowland Scotland in the later seventeenth century, it was regarded as the norm for one boll of seed corn to be sown per Scots acre.²⁷ From 1673 to 1696 the total seed sown each year on the Mains averaged just over 115 bolls; in the region of 20 bolls each of pease, wheat, bere and oats were sown on infield land with a further 35 bolls of oats on the outfield. On this basis, the total area of cultivated land on the infield devoted to the four main crops would have been in the region of 80 Scots acres plus an area of outfield that averaged 35 Scots acres (approximately 40 and 18 hectares respectively). It should be noted however, that sowing rates substantially above one boll per Scots acre were sometimes used. On a smallholding worked temporarily by the estate following the death of the tenant during the winter of 1680–81, the records show that six bolls of seed (comprising oats, bere and pease, the wheat being already in the ground) were sown on four Scots acres.²⁸ When the quality of seed-corn was poor, it was usual to sow more densely and it may be that the seed used on that occasion was inferior. Rates of sowing in excess of one boll per Scots acre would represent a proportionate reduction in the area under cultivation.

Across the period the records show a significant increase in the amounts of grain sown on the infield land. In the seven-year period 1673–9 the total amount sown averaged 67 bolls. From 1680 to 1686 this increased to 72 bolls, from 1687 to 1693 there was a further increase to 90 bolls, and for the three years 1694–6 – years of poor weather, poor yields and dearth – the total amount of the four crops sown averaged 113 bolls. On the outfield, the average of 39 bolls of oats that was sown throughout the 1670s and 1680s, fell to 22 bolls between 1690 and 1693, but was increased again to 39 bolls in the ‘Ill Years’ 1694–6. The larger amounts sown from 1694 were without doubt a response to the crisis and possibly represented both a heavier sowing rate as well as an extension in the area cropped. However, the amounts sown on the infield between 1686 and 1693 were on average more than a third higher than that sown in the 1670s. On the basis of seed being sown at a rate of one boll per Scots acre, a substantial increase in the acreage of the infield land is indicated, rising from possibly little more than 60 Scots acres at the start of the 1670s (31 hectares) to as much as 96 Scots acres in the early 1690s (49 hectares). These figures reflect the considerable changes and improvements that were being carried out at Castle Lyon by Earl Patrick during the period to which the crop yields pertain.

Earl Patrick took over the running of the Lyon estates in 1660 at the age of 17 on the death of his mother, his father having died of plague in the severe outbreak of 1646 when Patrick was only four years of age. Family debts, the costs of war and the heavy fines afterwards imposed by the English, the occupation of Glamis by English troops and their quartering on Castle Lyon during the Interregnum, as well as the general disruption to trade, left the young earl effectively bankrupt. His situation was further exacerbated by the stripping of money and assets from the estates by his step-father, the Earl of Linlithgow. Glamis was uninhabitable following fire damage when in the hands of the English and its lands ‘wadset to the castle walls’.²⁹ The large estate of Belhelvie in Aberdeenshire and some lesser landholdings were sold.

²⁷ Whyte, *Agriculture and society*, p. 77.

²⁸ NRA(S) 885, 190/1/14.

²⁹ Wadset: a form of mortgage, subject to reversion, where the land is exchanged for a capital sum.

On his arrival at Castle Lyon from 'school' at St Andrews, the Earl found the house intact, but bare to the extent that he had to borrow a bed for himself from the local minister.³⁰

Records pertaining to Castle Lyon prior to the 1670s are sparse and beyond the brief information to be extracted from a small number of rentals, offer little detail about the state of the land. The Mains itself was in the hands of tenants that Earl Patrick described as '... a race of evill doers desolate fellows and mislabourers of the ground'.³¹ The extent to which the ground of the Mains was in poor heart as a consequence of over-exploitation or the inability of the tenants to work it properly through being under-capitalised, is not clear. By the 1660s, however, at the end of a lengthy period of poor management, lack of investment and general depredation, the tenants were unable to meet their rents and a number had run up considerable 'rests'.³² All were removed from the Mains and the land taken in-hand as the Earl set about transforming the estate. His improvements may have been inspired at least in part by what he saw of English houses and estates as he rode to London in the summer of 1660 'to kiss the new king's ring'.³³

The changes Earl Patrick effected were introduced over a period in excess of thirty years. They embraced the enclosure of the whole of the original Mains infield land and its transformation into parkland. Large areas of waste and outfield land were enclosed for the planting of woods. Orchards and a commercial tree nursery were established. By the end of the 1690s, thousands of young trees were being sold to other estates in the region.³⁴ As the infield land was converted into pasture, a corresponding amount of land was taken in from the outfield and brought up to infield standard to replace it. For the most part this new Mains was ground claimed from the outfield of the original Mains, but also included outfield land previously possessed by tenants.³⁵ At the same time as these changes were being made, a considerable amount of work was carried out on the castle, its outer offices and the farm buildings; these included a new dairy, byres, barns, and sheep houses.³⁶ The servicing and clearing of the debts inherited by the Earl necessitated that the building work was carried on only as and when funds allowed. Driving the enterprise was Earl Patrick's determination to improve, modernize and beautify his estates and to leave his descendants a legacy of which they could be proud, and one far more secure than that to which he had succeeded. The enclosures and the improvements to the Mains farm were an integral part of this wider scheme, part of the Earl's vision and also the more immediate need to increase his income.³⁷

Earl Patrick was not alone in the Carse of Gowrie at this time in the creation of parks, policies

³⁰ Millar (ed.), *Glamis Book of Record*, pp.15–33.

³¹ *Ibid.*, p.10.

³² Thomas Davie, tenant of the largest holding on Castle Lyon, had a debt of 1,000 Scots merks (£56 sterling) in 1660. NRA(S) 885, 190/1/20, 1688.

³³ Millar (ed.), *Glamis Book of Record*, p. 31.

³⁴ NRA(S) 885, 52/1/1

³⁵ NRA(S) 885, 190/1/22, 1690.

³⁶ NRA(S) 885, 190/1/18, 1685.

³⁷ Millar (ed.), *Glamis Book of Record*, pp.16–40. An inventory dated Martinmas 1671 lists the debts of the

Earl of Strathmore as totalling £163,565 (Scots); NRA(S) 885, 163/7/6. The equivalent purchasing power of this amount in 2002 has been put at £1,535,169 (sterling); Economic History Services <http://eh.net>. In 1694 the earl wrote that, in addition to the work done on his houses of Glamis and Castle Lyon, more than half the debt he inherited had been paid off. NRA(S) 885, 22/1/1. For an exploration of the workings of the internal economy of the Castle Lyon estate and the manner in which the costs of the improvements were met, see Young, 'Rural Society', pp.168–93 and 275–9.

and enclosures, or in the extension and improvement of cultivated ground. His neighbours, Thomas Mylne of Mylnefield and Lord Kinnaird of Inchtute, were both active in this way.³⁸ On the Murie estate in Errol, outfield land was being brought up to infield standard and new farms were being created on the Braes of the Carse.³⁹

Among the first changes made by Earl Patrick was the enclosure of meadowland to ensure good pasture for the livestock and facilitate the making of hay for their winter maintenance. English travellers in the seventeenth century did not speak well of the amount or success of Scottish haymaking and contemporary Scottish commentators did not deny its shortcomings.⁴⁰ Apart from the inclemency of Scotland's climate, a major problem was the want of decent enclosures to protect grassland from the wanderings of the local populace and their livestock.⁴¹ Castle Lyon in 1660 suffered in this way. Earl Patrick described the ground to the south of the castle (later enclosed) to be for the most part a quagmire and 'the middows an open and common pasture so that before my time it was not known what the mawing of grass or use of hay was att that place'.⁴² By 1672 Earl Patrick was boasting that there were four hay meadows that amounted to fifty 'good dargs' besides the wards and new paddocks.⁴³ In 1687 he was able to write that the Mains

... is marvellously accommodated with parks and inclosures in which I am stanking deer and serves not only for pasture to a great many horses, cattle and sheep but abounds with hay besides the bounds enclosed for orchards in which there is a great deal of shearing grass for stone c[ar]t horses and for cowes ⁴⁴

The success of the infield-outfield system was dependent on the mutual relationship that existed between livestock and crops and the maintenance of a balance between the two. Livestock were sustained by the produce of the land, while the fertility of the land and hence its productivity was dependent on the manure produced by the livestock. The weakness in the system became apparent when the area of land under cultivation was extended. This, in most cases, involved the ploughing up of land previously used for grazing livestock, which in turn curtailed the number of animals that could be kept. The amount of available manure was, therefore, reduced at a time when more was required to maintain the fertility of an increased area of cultivation. If soil fertility was not to suffer progressive depletion and a consequent decrease in production, additional sources of manure had to be found, or improved systems of land management

³⁸ NRA(S) 885, 198/2/3, 1692. Perth and Kinross Archive Centre [hereafter PKAC], Hunter of Glencarse Papers, 97/9. An impression of the scale of the enclosures and planting can be gained from John Adair's *Mappe of Strathern, Stormont & Cars of Gourie* (1683), Fig. 1 above.

³⁹ National Archives of Scotland [hereafter NAS], Matthew of Gourdiehill, GD 316/8, 1683. PKAC, Threipland of Fingask Papers, MS169/14/2/8, 1668.

⁴⁰ See for instance T. Morer, 'A short account of Scotland, 1689', in Brown (ed.), *Early travellers in Scotland*, p. 275. Also Whyte, *Agriculture and society*, p. 82.

⁴¹ Damage by local inhabitants included the cutting of grass for their own livestock, of divots and turfs for their

houses and their fires, or to add to their manure heaps, as well as simply flattening the grass as they walked through it.

⁴² Millar (ed.), *Glamis Book of Record*, p. 35.

⁴³ Darg: the amount of meadow that could be mowed by a man in a day. NRA(S) 885, 190/1/2, 1672.

⁴⁴ NRA(S) 885, 190/1/20, 1687. Stanking: [here] feeding well. 'Shearing grass ... for cowes': during the summer months grass was cut and carried to those horses pulling the stone carts and to the milking cows. This practice limited damage to the grass by trampling and its waste by fouling, and was regarded as being more energy efficient.

introduced. It has been suggested that the need to maintain and enhance the manuring of land was an important stimulus towards agricultural improvement in Lowland Scotland in the eighteenth century.⁴⁵

The enclosing of pasture added an extra dimension to the system of infield and outfield that enabled the total area of cultivated land to be extended while soil fertility was maintained, as well as affording options and versatility in cropping and rotation. It has been argued that the key development in agricultural improvement was the integration of grass and grain and the ability to support a higher density of livestock while simultaneously extending the arable area.⁴⁶ The alternation between arable crops and pasture reduced weed establishment in crops and the build up of parasites and infections among livestock. The soil was able to rest when under grass and the ploughing in of the sward, together with the fertilising effect of animal dung, enhanced its fertility for both arable crops and grass. What the Earl created on the Mains of Castle Lyon was by no means an adoption of the sophisticated system of convertible husbandry as described by Kerridge and which he argued marked the 'Agricultural Revolution' in England.⁴⁷ No evidence, for instance, has so far been found that sown grass seed was used on the Mains of Castle Lyon to establish a ley break, but the improvements that were introduced did mark an important, if far from complete, step in that direction. Both the castle policies and the enclosures that made up the newly created Mains were designed to be capable of carrying either crop or livestock 'that they are all so divided that at pleasure they may all of them or any one of them be made corne again'.⁴⁸

The bringing of the Mains outfield land up to infield standard would seem to have been done almost entirely by the application of dung from the large numbers of livestock kept. No inventories of livestock survive for Castle Lyon for the period of Earl Patrick's tenure. However, when the Dowager Countess Elizabeth took over the estate as part of her jointure lands in August 1713, a valuation of livestock pertaining to the Mains lists, in terms of cattle, 15 drawing oxen with their 'going gear', 12 oxen for fattening, five cows, nine 'queys' (heifers) and four calves. Sheep numbered 55 ewes, 32 wethers, 12 ewe gimmers and 56 lambs. The list does not include horses, but granary accounts from the beginning of the 1690s suggest that during the winter there were generally some ten work horses requiring corn and between five and seven brood mares with foals plus, when the Earl was in residence, six hunting horses, four coach horses and three 'journey' horses.⁴⁹ These numbers contrast with those on a tenanted holding of two ploughgates on the nearby estate of Leyes in 1693, when the following livestock were appraised: 15 oxen with their plough gear; four work horses; four cows; two young oxen, two heifers and one calf; two old and three unbroken horses.⁵⁰ That the principal means of improving the outfield land was the dung from the large number of animals kept on the Mains, was confirmed in a report concerning its valuation in 1720, which states that the land was 'dunged extraordinarily

⁴⁵ J. Shaw, 'Manuring and fertilising the Lowlands, 1650–1850', in S. Foster and T. C. Smout (eds), *The history of soils and field systems* (1994), pp. 111–18.

⁴⁶ M. Overton, *Agricultural revolution in England. The transformation of the agrarian economy, 1500–1850* (1996), p. 131.

⁴⁷ E. Kerridge, *The Agricultural Revolution* (1967),

passim.

⁴⁸ Comment by Patrick, Earl of Strathmore, 1690. NRA(S) 885, 190/1/22.

⁴⁹ NRA(S) 885, 64/1/17, 18 and 19.

⁵⁰ St Andrews University Library, Hay of Leyes Muni-ments, MS3622/748.

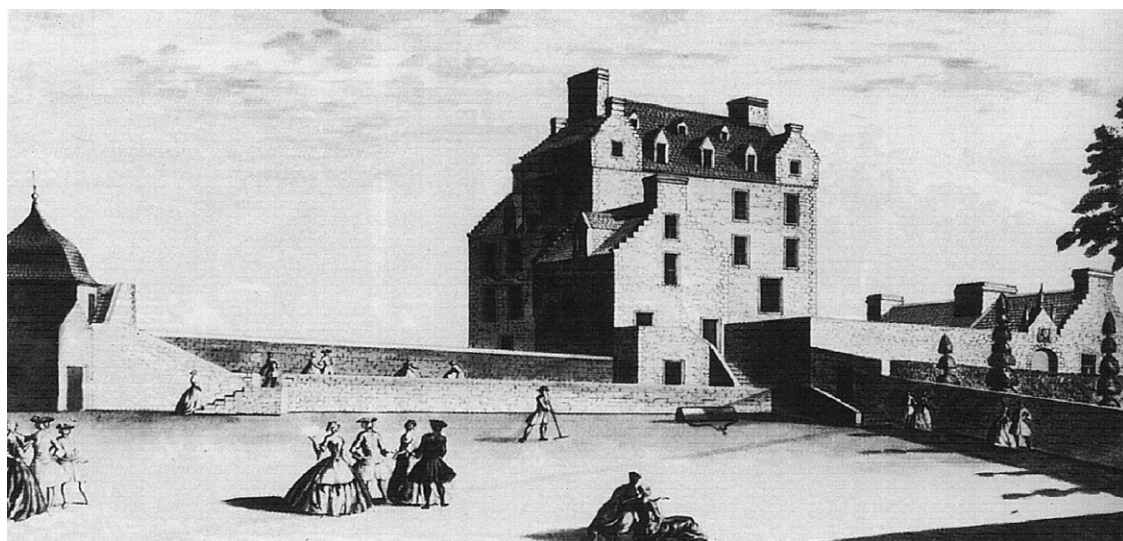


FIGURE 2. Drawing of Castle Lyon c.1720 (artist unknown). The building and its environs are as completed by Patrick, Earl of Strathmore before his death in 1696. © British Museum.

by means of the vast number of bestial he [Earl Patrick] had occasion for in the time of his building, beside his stables ... it produced wonderfully'.⁵¹

An idea of the scale of the building works can be gauged from early views of Castle Lyon (Figure 2). A sense of the number of animals that were needed for haulage can be gained from accounts for stone purchased from the Muirtoun quarries situated more than two miles away. In 1688, when Earl Patrick was writing that a great deal of the work had already been completed, he listed 1,660 wains and 1,153 cartfuls of wall-stone, 4,087 pieces of free tailzie, 109 pieces of long stone, 167 feet tabling and 350 'slaits'. In 1690 charges were made for 1,368 wains and 1,733 carts of wall-stone, 2,112 pieces of free tailzie, 2,095 long stones and a large amount of flooring.⁵² During the period of building, the Earl must have maintained a substantial stable of predominantly traction animals.

No mention of other sources of fertilizer used or brought on to the Mains has so far been found. There is ample evidence that lime was applied to land in other areas of Scotland from a much earlier date and that its use was particularly beneficial on clay-rich soils such as those of the Carse of Gowrie, where the natural level of acidity was high and reduced the effectiveness of traditional manures.⁵³ However, there were neither workable deposits of limestone in the vicinity of the Carse of Gowrie nor of coal with which to burn it. If it is assumed that Earl Patrick was aware of the practice of liming and its benefits, he must not have judged the heavy investment it would have required to import and apply it worthwhile, at a time when grain prices were in general low and he considered himself to be '... leaving nothing unessayd of policie & diligence to render that part of the Mains which is under labour as fruitful as a cotterman does to his

⁵¹ NRA(S) 885, 148/5/62, 1720.

1688–90.

⁵² Free tailzie: free cut rock. NRA(S) 885, 190/1/22,

⁵³ Whyte, *Agriculture and society*, pp.198–208.

single aiker of land'.⁵⁴ The purchases of lime recorded in the estate accounts are entirely for building work. Although seaweed was used widely as a fertilizer in many of Scotland's coastal districts, the conditions that prevail within the estuary of the River Tay inhibit the types and the quantity growing there. No record from the early modern period has so far been found of the application of seaweed in the Carse of Gowrie.

III

While the yield figures obtained for the Mains of Castle Lyon are an important record of the actual amounts being produced on that farm, they also embody two additional and distinct movements: year-by-year fluctuations and the degree of improvement achieved across time. The fluctuation in yields from one harvest to the next was severe. Figures 3–6 include the ratio of yield over seed sown for the individual crops. The charts illustrate the level of fluctuation with which producers and ultimately consumers had to contend. Among the largest swings was a massive improvement in wheat yield from 1.74:1 in 1686 to 6.12:1 in 1687, representing a more than threefold increase in yield. However, drops in yield could be equally dramatic, as in 1682 when the bere yield fell to 1.72:1 from the high of 5.99:1 obtained in the previous year's harvest. Each crop reacted to the prevailing conditions more or less successfully than the others. Where one crop fared poorly, another might do relatively well and to some degree ameliorate the overall level of production. In years of general shortage, benefit could be taken by large-scale producers from the higher prices that prevailed. This was the case in 1676 when the yield from the bere on the Mains of Castle Lyon was a disastrous 1.3:1, the oat crop was a rather average 2.65:1, but the return from the wheat and pease a very sound 3.94:1 and 4.11:1 respectively. The overall yield ratio for the four crops was 2.77:1, which, while far from good, was not the catastrophe it might well have proved on farms situated on more marginal land, where the only crops grown were bere and oats. In 1693, Earl Patrick wrote that the newly created infields of the west and east wards of the Mains of Castle Lyon were to be divided equally and all the four grains sown, 'rather than hazard one graine all in one year ... probably some of the four will hold better'.⁵⁵ The ability to grow successfully a range of crops was an important advantage enjoyed by the Carse of Gowrie and one denied to many wetter, colder and more exposed areas of Lowland Scotland where the failure of one crop could represent the failure of the entire harvest. In the pre-Improvement era, when yield levels were in general low, it highlights how easily and frequently the delicate line that lay between subsistence and want was liable to be breached.

Supplies of victual to the market were therefore uneven, a situation exacerbated by the poverty of on-farm storage facilities at this time. Abundant crops resulted in surplus and low prices, but their retention in any quantity until prices might improve was not feasible for most farmers. Well-built barns were expensive and even they, in the longer term, provided only an

⁵⁴ NRA(S) 885, 190/1/22, 1690. A tenant in the neighbouring parish of Inchtute described the cost of liming land c.1740, as being in the region of £60 Scots [£5 sterling] an acre. PKAC, Kinnaird Papers, MS100/54. For comments on the low price of grain, see Millar (ed.),

Glamis Book of Record, p.91. A cottarman was a farm labourer whose payment consisted of, or included, the possession of a cottage with an area (usually an acre) of land for the subsistence of his family.

⁵⁵ NRA(S) 885, 190/1/25.

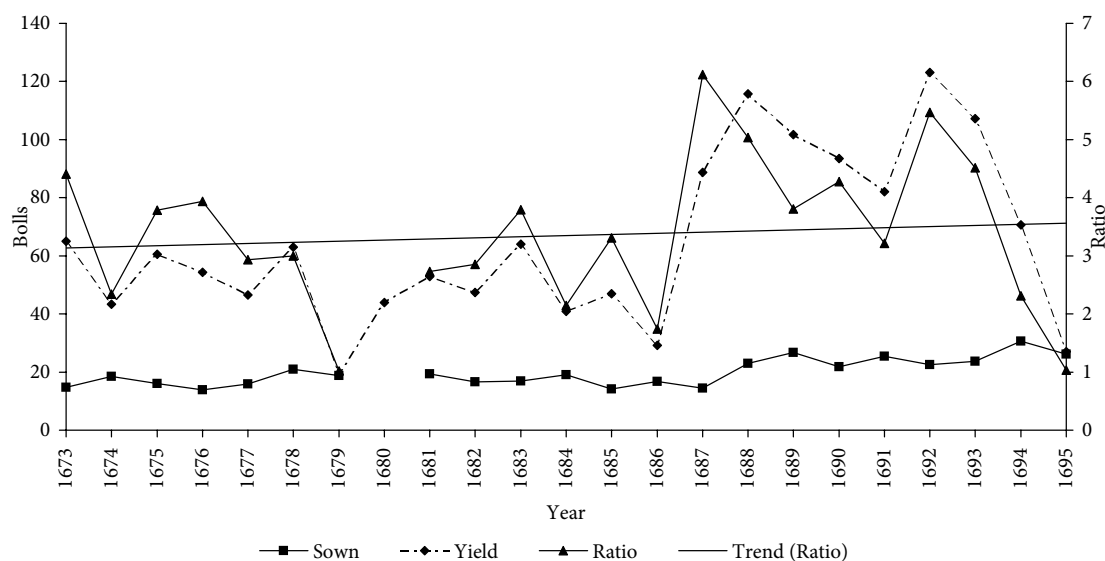


FIGURE 3. Wheat crop, Mains of Castle Lyon, 1673-1695

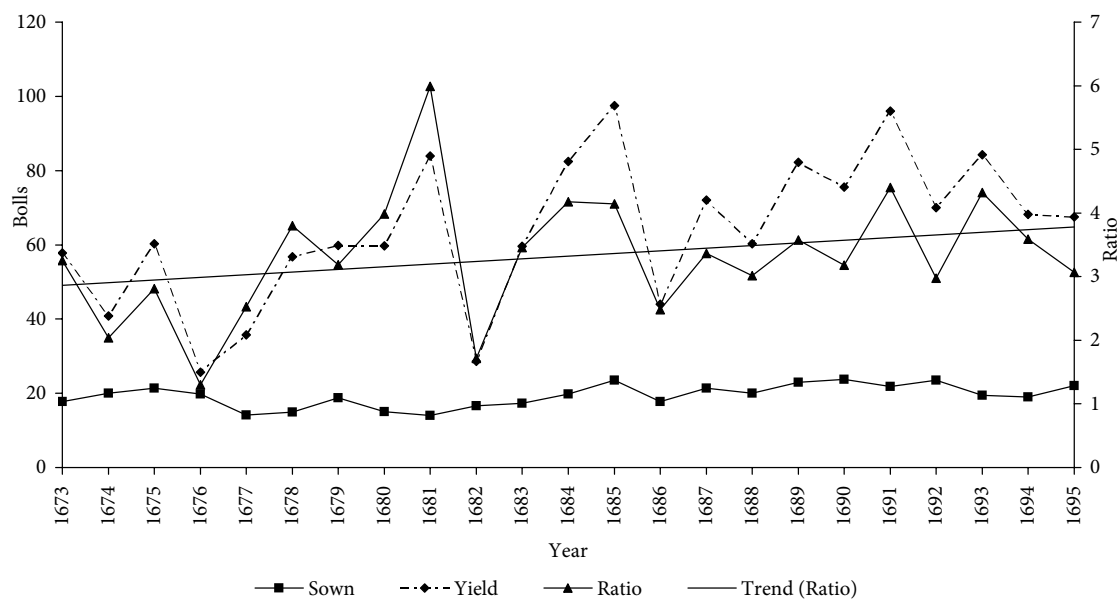


FIGURE 4. Bere crop, Mains of Castle Lyon, 1673-1695

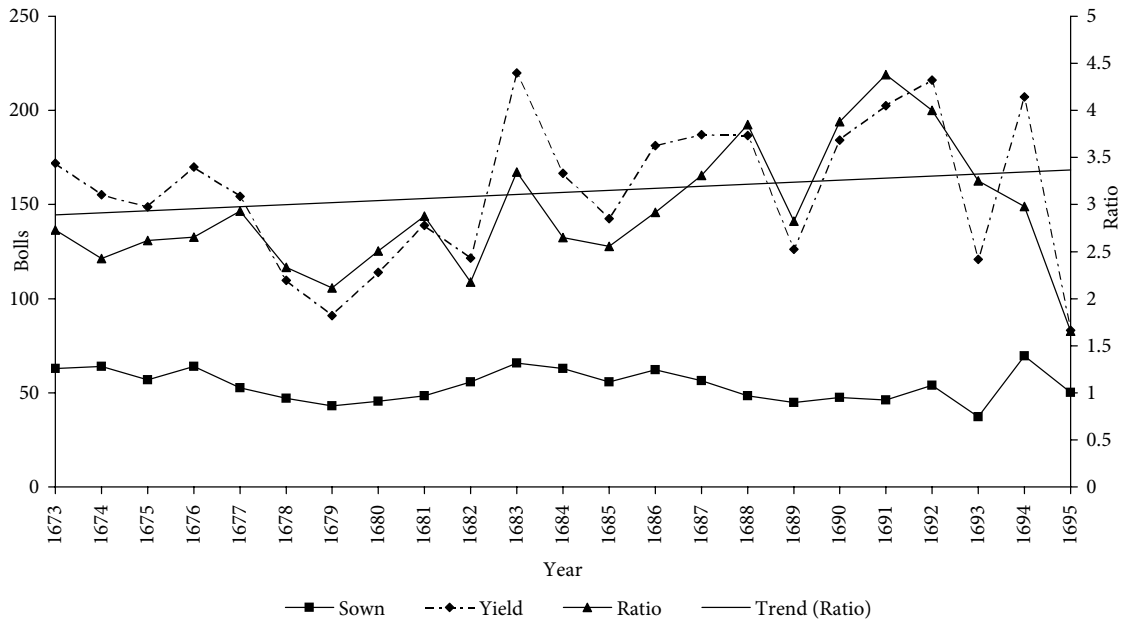


FIGURE 5. Oat crop, Mains of Castle Lyon, 1673-1695

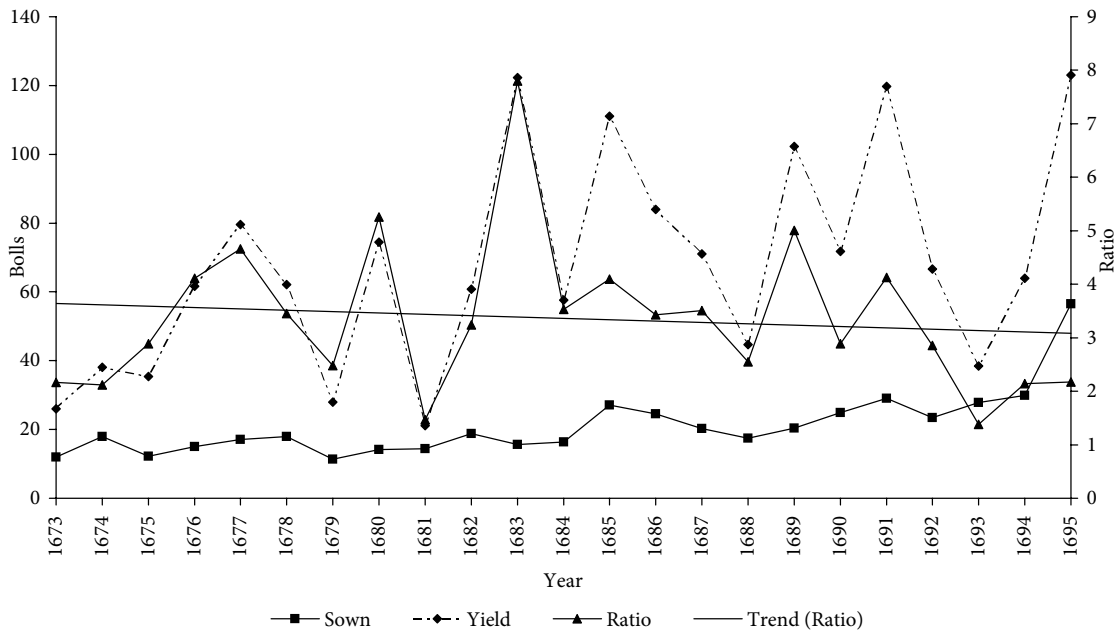


FIGURE 6. Pease crop, Mains of Castle Lyon, 1673-1695

imperfect defence against loss to damp and vermin. For practical purposes as well as the need for income, the majority of grain had to be disposed of before the next harvest. Even at Castle Lyon where barns were among the extensive building works begun by his father and carried on with industry by Earl Patrick, it was rare for any substantial amount of crop to be carried long beyond the following harvest, the thrashing of the new corns normally having begun by December.⁵⁶

The Mains of Castle Lyon was, of course, only one holding, but if the fluctuations experienced there were felt across a wide area, then the consequences for the supply of grain and its price had the potential to be immense.⁵⁷ Of the many factors that can affect grain yields, climate and weather have by far the most immediate impact, be it a wet season when grain sown in waterlogged ground rots rather than grows, a hot dry summer when plants wither, or when storms just before harvest flatten crops and knock the ripening grain from the heads. The limited amount of reserves held on farms meant that even an apparently small dip in yields resulted in prices being driven upward. The very close relationship between yield levels and wholesale prices can be seen when the average yield of the four crops grown on the Mains of Castle Lyon is compared with the average of the fiars prices struck at Perth for the same grains (Figure 7).

The grain grown on land farmed in-hand together with that received as ferme formed a very large proportion of the gross income on most Lowland Scottish estates. Specie was in very short supply in Scotland throughout the early modern period and particularly so in the second half of the seventeenth century.⁵⁸ An important device in the working of what was effectively a grain-based economy was the striking of county fiars prices for the grains and pulses most commonly grown and traded. County fiars prices provided a base conversion rate for grain and a basis for the settlement of various fixed payments such as feu duties, stipends and legal processes. Sheriff courts normally struck fiars in February when the crop from the previous harvest had been in the market for some time and when levels of supply and demand, as well as a good number of negotiated prices, were known. Although fiars prices for, say, the 1680 harvest were not struck until February 1681, they pertained to the crop of 1680 and were, therefore, called and known as the 1680 fiars prices. Much of the evidence taken by the fiars courts in deciding the prices was given by merchants, middlemen and local estate owners. Their information related in the main to large transactions and the prices struck thus reflected a wholesale rate rather than the retail price likely to be paid by urban workers. However, when assessing the general level of corn supply, it is large transactions and wholesale prices that provide the more appropriate guide. An extensive list of the fiars prices struck at Perth has survived and these, along with many from other counties, have been collected and published by Gibson and Smout, together with notes regarding their use for historians.⁵⁹

There were a variety of circumstances particular to the Mains of Castle Lyon that would have

⁵⁶ NRA(S) 885, 50/3, 1698 and, 64/1/7–22, crop years 1680–95.

⁵⁷ For a study of Scottish food prices in this period see A. J. S. Gibson and T. C. Smout, *Prices, food and wages in Scotland, 1550–1780* (1995), *passim*.

⁵⁸ For a discussion of monetary problems in Scotland in this period in relation to payments and trade,

see T. C. Smout, *Scottish trade on the eve of the Union, 1660–1707* (1963), pp. 116–28.

⁵⁹ Gibson and Smout, *Prices, food and wages*, pp. 66–129. See also R. Mitchison, 'The movements of Scottish corn prices in the seventeenth and eighteenth centuries', *EcHR* 18 (1965), pp. 278–91.

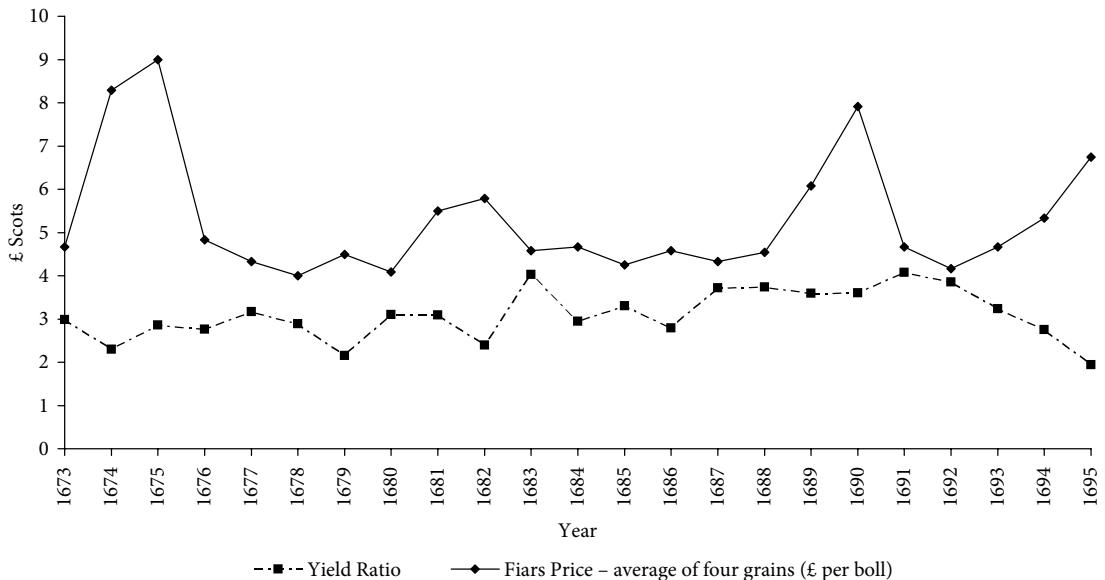


FIGURE 7. Comparison of the fiars prices struck at Perth (average per boll of wheat, bere, oats and pease) and the average yield ratio for the same crops on the Mains of Castle Lyon

lessened – or increased – yields there relative to other farms in the locality. These included the extension of the infield ground, the slow and probably uneven process of bringing outfield up to infield standard and, from 1687, the introduction of improved English wheat seed (which we discuss below). However, there remains a remarkable symmetry between the level of the overall yield in any one year at Castle Lyon and the average of the Perth fiars prices for the same four crops. In 18 out of the 23 years for which figures are available, a dip or rise in yields at Castle Lyon was mirrored by a respective increase or fall in the county fiars (Figure 7). This emphasizes the extent to which prevailing weather conditions were responsible for the fluctuations in yield.

The very high fiars prices associated with times of dearth and famine reflected substantial falls in production. In 1674, a time of serious want across much of Scotland, particularly in upland areas and including Perthshire, the overall yield on the Mains dropped to a low of 2.3:1 (one of the poorest returns recorded prior to 1695) while the average of the Perth fiars for the same crops rose to £8 5s. 10d. per boll.⁶⁰ Although there was some recovery in Castle Lyon yields in 1675, returns remained below 3:1 and the Perth fiars rose further to £9 in that year. This illustrates the vulnerability of early modern Scotland to the occurrence of poor weather in consecutive years, resulting in spent reserves and the potential need for seed corn to be consumed.

In the 1670s and 1680s it would seem that years of poor yields were relatively isolated and dearths, if severe, were short lived. This, however, was not the case in the 1690s. The first year of harvest failure and the onset of the famine across most of Scotland has generally been

⁶⁰ Gibson and Smout, *Prices, food and wages*, p. 169.

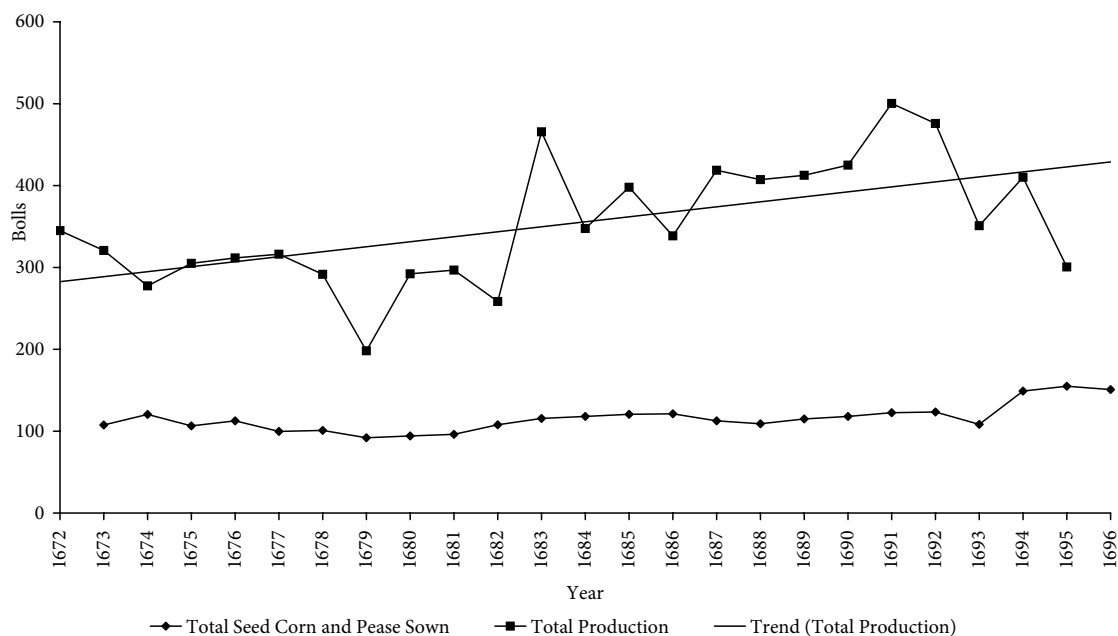


FIGURE 8. Combined production of wheat, bere, oats and peas, Mains of Castle Lyon, 1672–1695

considered to be 1695, but with signs of problems in Orkney and Shetland as early as the crop of 1693.⁶¹ The Castle Lyon figures, however, reveal that even in the relatively sheltered Carse of Gowrie, a slight downturn in the 1692 crop was followed by a substantial fall in yields in 1693. This must have been quite widespread as it was reflected by a sharp rise in the Perth fiars. The situation was compounded by a very poor harvest by Castle Lyon standards in 1694, when a yield ratio of only 2.75:1 was achieved. In 1695 the wheat and oat harvests in particular were a disaster and the yield across the four principal crops grown on the Mains averaged only 1.9:1, 50 per cent below that obtained in 1692. The returns of fruit from commercial orchards on other estates in the district support the case for a serious deterioration in climate in these years. The rent payable on orchards in the Carse of Gowrie was appraised on an annual basis according to the amount of fruit produced. In 1692, rent for the orchard at Gourdiehill in Errol parish was assessed at 13 bolls one firloft of fruit; in 1693 there was insufficient fruit on which to make an assessment and in 1694 only a paltry two firlofts.⁶² These figures indicate that although severe failure may not have been evident until 1695, the roots of famine were established in the poor harvests of 1693 and 1694, with reserves of corn already brought to a critical level by successive years of falling yields. Between 1695 and the end of the century much of Scotland suffered an extremely severe famine. In Aberdeenshire a decline in population of 21 per cent has been calculated, with even higher losses in inland parishes. In the highland areas of Perthshire, the available evidence indicates that conditions were similarly catastrophic and though mortality

⁶¹ Ibid., p. 170.

⁶² NAS, GD316/10. (One firloft was equal to one quarter of a boll.)

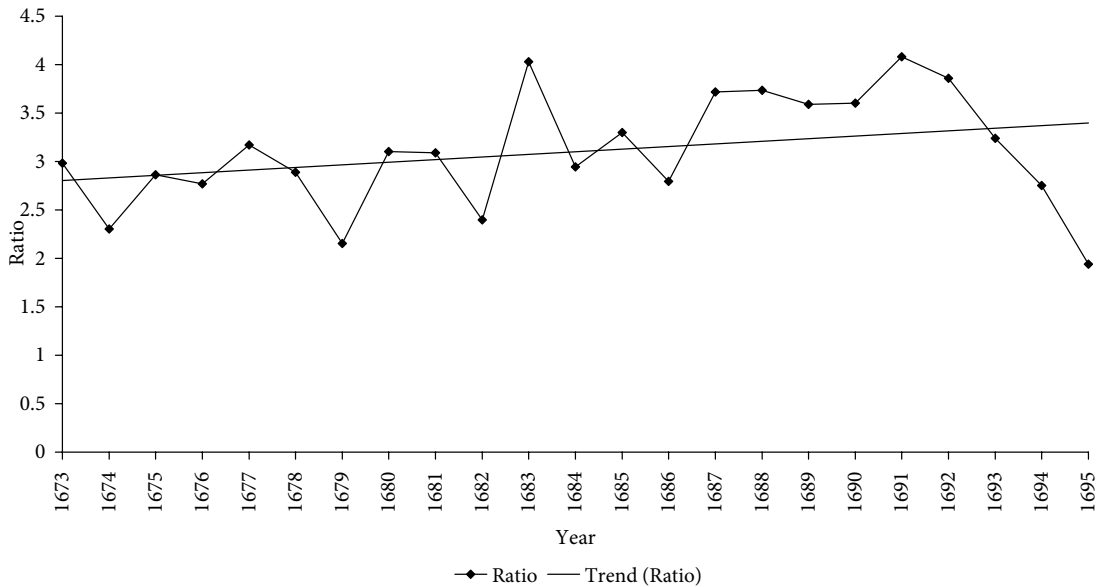


FIGURE 9. Average yield ratio of wheat, bere, oats and pease, Mains of Castle Lyon, 1673–1695

among the inhabitants of the more sheltered and fertile lowlands was limited, there was grave and long-run economic debilitation. The phrase ‘seven ill years’ used popularly to describe the famine of the 1690s, was undoubtedly much nearer the mark in its accuracy than has sometimes been supposed.⁶³

In spite of the year-by-year fluctuations and the catastrophic downturn caused by the weather patterns of the 1690s, the returns for the Mains of Castle Lyon reveal a clear improvement in the overall crop yields achieved there in the 23 years following 1672. The trend line in Figure 8 indicates the general increase in production of the four principal crops grown; it shows a rise from a total of less than 300 bolls per annum to considerably over 400. That this increase was not only in the total produced and the result of an extension in the acreage cropped, but was also in terms of yield achieved, is confirmed in Figure 9 where the trend line indicates an increase in the yield ratio across the period from 2.8:1 to 3.4:1 (approximately 20 per cent). Included in these figures are two years of very poor harvests at the beginning of the famine years. If it is considered that the extreme weather conditions of that period were atypical and the returns for 1694 and 1695 are discounted, it can be seen that in the preceding 21 years, from 1673 to 1693, a much more dramatic increase (in the region of 45 per cent) was recorded. But the level of improvement did not apply evenly to all the crops grown. Even discounting 1694 and 1695, pease, a notoriously erratic crop, showed no overall improvement across the period. The trend in wheat yield improvement between 1673 and 1693 was in the region of 44 per cent, bere 39 per cent, with oats showing the greatest increase at 54 per cent.

Wheat was both the most valuable and the most successful crop in terms of yield on the Mains of Castle Lyon. In the period for which figures are extant, it yielded on average 3.3:1

⁶³ Tyson, ‘Famine in Aberdeenshire’, pp. 48–50; Cullen, Whatley and Young, ‘King William’s Ill Years’.

and in the best seven years 1687–1693, 4.5:1. It is probable that this crop received most of the available manure and there is evidence that efforts were made to improve its production. The importance of the quality of seed and the varying properties of different strains was recognised and understood. A brief note in the account book for the 1685 crop refers to 284 threaves of ‘ried’ [red] wheat out of a total harvest of 307 threaves, the remainder being of ‘whyte’ wheat. Unfortunately no further information is given with regard to the nature, origin, or performance of what would seem to be two quite different strains.⁶⁴ In 1688 half a boll of imported English wheat was tried against ten bolls of Lothian wheat and twelve and a half bolls of Castle Lyon’s own saved seed. The English wheat yielded at 14:1, the Lothian wheat 4.4:1 and Castle Lyon’s own, 5.2:1.⁶⁵ While the English wheat was obviously far superior to the two samples of Scottish origin, it is also interesting that the local seed performed better than that from Lothian, generally regarded as the most advanced area for cereal production in Scotland at that time. However, no judgements can be made on the basis of one trial, particularly when it is not known how typical the Lothian sample was, or the conditions in which it was grown. No further mention is made in the accounts of Lothian wheat. The product of the English wheat was kept for use as seed, but in spite of the much higher yield returned by the English sample, seed of local origin also continued to be used. No information is given in the records on how the different strains were managed, or whether there was any cross fertilisation. In 1692 seven bolls of English wheat achieved a yield of 9:1 against 4.7:1 from seed of local origin. It is not known if this was a new sample brought in or whether it was the product of that first purchased in 1688, but the accounts intimate that all the 62 bolls of English wheat harvested were to be kept for use as seed. Just under 24 bolls were sown on the Mains that autumn and 13 bolls were sent to Glamis. Wheat was not a traditional crop at Glamis (situated in the Vale of Strathmore) and would seem not to have been tried there in any quantity before c.1690.⁶⁶ After 1692, weather conditions deteriorated and there was a progressive fall in yields: of all the grains grown on the Mains of Castle Lyon, wheat registered the largest drop in returns. Whether wheat of local origin would have withstood the conditions more successfully can, at the distance of 300 years, only be a matter for speculation.

Bere was traditionally a crop that responded well to high levels of nutrition and it suffered to some extent on the Mains of Castle Lyon by following the wheat. The average return was 3.3:1 and did not match the kind of yields that have been recorded on other Lowland Scottish farms in the seventeenth century where, in the absence of wheat, it would have received the majority of the manure.⁶⁷ Following the wheat and bere on the infield land, and grown in successive years on the outfield, oats returned the least well of the four Mains’ crops with an average yield over the period of only 2.9:1. However, from their position at the end of the rotation, the rise in yield achieved by the oats over the period for which there is data, demonstrates the core improvement brought about at Castle Lyon, be this through an increase in the underlying fertility of the soil, better management, the use of improved seed, or a combination of all three.

⁶⁴ NRA(S) 885, 64/1/12. Threave: a measure of cut grain, probably two stooks.

⁶⁵ NRA(S) 885, 64/1/15, 1688.

⁶⁶ NRA(S) 885, 64/1/18.

⁶⁷ Whyte, *Agriculture and society*, pp. 75–6.

IV

The scarcity of comprehensive figures from other farms, either locally or from other areas, makes it difficult to gauge how typical were the Castle Lyon yields. When assessments of growing crops were made in testaments pertaining to the Carse of Gowrie and dating from the second half of the seventeenth century, wheat, pease and bere were all estimated as yielding the 'fourth corn' (i.e. 4:1) and oats the 'third corn' (i.e. 3:1).⁶⁸ Donaldson, based in the Lothians and writing in 1697, suggests that 4:1 was a reasonable return from infield land.⁶⁹ His assessment was generally supported by other writers of the period, but they also emphasized that improved practices such as the use of additional dung or other fertilizers were employed and could improve yields considerably. These include Martin Martin's account of the very high returns secured in the Western Isles, where small plots with heavy applications of seaweed were recorded as producing yields of 20:1 in bere and Alexander Troup's description of the north coast of Buchan where manure improved with turf allowed yields of 5:1 and 6:1 to be obtained.⁷⁰ There is obviously the potential for a very considerable difference in the yields obtained from small individual plots benefiting from close care and attention and a great deal of fertilizer, compared to those obtained from the relatively large acreage cultivated on a farm of two ploughgates.

Among the few runs of crop yields for Scotland in the seventeenth century are figures from the Cassillis Estates in Wigtownshire in the south-west of Scotland for 1655–61 and from the Mains of Dundas, near South Queensferry, from 1655–62.⁷¹ The figures for the Cassillis estate comprise oats and some bere. The oat returns are taken from nine farms on the estate. Only five of the yields reached 3.0:1 or above, and the overall average a modest 2.5:1. This compares with the lowest oat yields at Castle Lyon when, for the ten years from 1673 to 1682, the average was also only 2.5:1. Only 15 bere yields were published for Cassillis (from seven farms for the years 1659–61); they are, however, with highs of 8:1 and an average of 5.3:1, considerably better than those achieved at Castle Lyon where the average for the 23-year period 1673–95 was 3.3:1, with a high in 1681 of 6.0:1. This suggests that the bere on the Cassillis farms benefited from most, if not, all the available manure.

The Mains of Dundas, situated in the Lothians, should provide a more useful comparison with Castle Lyon even though there is no common period in terms of the years for which figures are available. Both grew wheat and pease as well as oats and bere and both were situated on the east coast and near sea level. The oat yield at Dundas averaged 3.6:1 and compared comfortably with the best years for oats on Castle Lyon. Wheat yields achieved on the Mains of Dundas were, however, considerably lower, averaging only 2.3:1 compared to Castle Lyon's average of 3.3:1. Bere yields were far superior to those gained on Castle Lyon, averaging above 5:1. No figures are given for the pease. There were two important differences in the practises followed on the Mains of Dundas compared to Castle Lyon that need to be taken into account.

⁶⁸ NAS, St Andrews Commissary Court, 20/4/14.

⁶⁹ J. Donaldson, *Husbandry anatomised, or an enquiry into the present manner of teiling and manureing the ground in Scotland* (1699), p. 28.

⁷⁰ Whyte, *Agriculture and Society*, p. 73; M. Martin,

Description of the Western Isles (1703), pp. 42 and 139; A. Gordon, 'An account of the north side of the coast of Buchan, 1663', in *Collections for a history of the shires of Aberdeen and Banff* (Spalding Club, 1843), pp. 99–107.

⁷¹ Whyte, *Agriculture and society*, pp. 74–7.

At Dundas, lime was used as a fertilizer and bere, rather than wheat, followed the pease in the rotation.⁷² All the Dundas crops should have benefited from the liming that was denied the crops at Castle Lyon. The bere on the Mains of Dundas would also gain from the nitrogen-fixing qualities of the legume crop it followed, while the wheat, sown at the end of the rotation would, on the other hand, receive least assistance. This was almost the opposite of the system employed on Castle Lyon.

Runs of yields from the Melville estate in Fife, but dating from the eighteenth century, have been calculated by Gibson.⁷³ These contain figures for oats and bere for 19 years between 1737 and 1757. The ratio of yield to seed sown for the oats ranged from a low of 2.05:1 in 1744 to a high of 5.41:1 in 1741 and averaged 3.8:1, which was significantly better than that achieved in the previous century at Castle Lyon. Bere yields were even stronger; the lowest was 4.1:1 (also in 1744) and the highest 12.5:1 in 1737 with an overall average of 6.4:1. It should be noted that though the annual average amount of bere sown was just under 16 bolls, the yield of 12.5:1 was achieved from a sowing of only two bolls of seed. Pease at Melville were less successful when compared to the returns from Castle Lyon, averaging, for 11 years between 1746 and 1757, only 2.7:1. Only four figures for wheat are extant – for the years 1741, 1743, 1744 and 1755 – and the amounts sown small, ranging between one and 2.25 bolls. The yields achieved varied widely from a low of 2:1 in 1743 to 7.72:1 in 1741. Their average return – of 4.78:1 – was in line with the better years at Castle Lyon. It is of significance that the year to year fluctuations in yield found in the Melville returns are, in general terms, very similar to that at Castle Lyon.

The longest sequence of crop returns so far published for pre-Improvement Scotland are for the years 1698 to 1753; they pertain to the Mains of Yester, situated close to the edge of the Lammermuirs in East Lothian and are the subject of an article by Whyte.⁷⁴ There are important parallels between Yester and Castle Lyon. The acreage under cultivation was similar, at between 90 and 120 acres, to that on the Mains of Castle Lyon in the 1690s. Also, being a mains farm with the advantage of parks, policies and enclosed hay meadows, it was likely that a similarly large number of livestock would be maintained, making available more dung than would be the case on an average tenanted holding. It is thought that the sequence of cropping at Yester was wheat → bere → oats → pease, the same as at Castle Lyon. However, the yields at Yester were, for the most part, much higher. Although the growing of wheat was discontinued during the Ill Years and did not recommence until 1714, on only five occasions after this date were yields of below 5:1 recorded and on 12 occasions the crop returned better than 10:1. In 1750 a peak of 18.6:1 was reached. It is known that lime was used at Yester. The years following the 1690s also saw an improvement in climatic conditions. Both factors are likely to have contributed to the superior yields at Yester. The variability of the crop from year to year was much greater though than at Castle Lyon. Whyte suggests the level of variability to be a consequence of the sensitive nature of wheat under Scottish climatic conditions and the contemporary standards of husbandry. The Yester wheat yields were well above others recorded for Scotland in the

⁷² Ibid.

⁷³ http://www.ex.ac.uk/~ajgibson/scotdata/scot_data-base_home.html.

⁷⁴ I.D. Whyte, 'Crop Yields on the Mains of Yester, 1698–1753', *Trans. of the East Lothian Antiquarian and Field Naturalists' Society*, 22 (1993), pp. 23–9.

pre-Improvement era and it is possible that a strain of higher yielding seed was in use there.⁷⁵ Again, there are parallels with Castle Lyon where imported English seed was a great deal more productive, but possibly not as capable of coping with poor growing conditions as that of local origin. Although the performance of the peas at Yester was little different to those at Castle Lyon, the returns for the oat and bere crops were much better and revealed a distinct upward trend. At Yester over the full 56-year period, the bere and oats averaged 5:1 and 4.1:1 respectively; for the 14 years 1740–53, their respective averages were 6.3:1 and 4.8:1.

English crop yields that can be compared directly with those from Castle Lyon are rare. A great deal of work has been carried out in England using probate inventories, but the yields determined from these sources are given in terms of bushels per acre or hectolitres per hectare.⁷⁶ Any comparisons between these and the yields from the Mains of Castle Lyon, where the exact acreage cropped is uncertain, must therefore incorporate a large number of estimates and assumptions. The evidence suggests however that on average, the Castle Lyon yields were well below those found in the south of England.⁷⁷ This is to be expected when the shorter growing season, the much greater severity of the Scottish climate and, particularly, the lesser productivity of the local seed is taken into account.⁷⁸ When the yields from the English sourced wheat seed used are taken on their own, these compare more favourably with the average of 9.7:1 found at Lowther in Westmorland between 1657 and 1667, where improvements had been carried out on the demesne lands by Sir John Lowther.⁷⁹ At their best they approach the average of 14.2:1 at West Horsley, Surrey in 1670–1 and the 14.8:1 found at Fowlmere, Cambridgeshire in 1682–3.⁸⁰ The oat yields were however a great deal lower and at an average of 2.9:1, were well below the 5.8:1 at Lowther, and the 8.2:1 and 11.6:1 found at West Horsley and Fowlmere, respectively.

V

Although the data examined is from only one holding, the sequence of crop yields recorded at the Mains of Castle Lyon sheds valuable light on cereal production in Scotland in the second half of the seventeenth century. In spite of the relatively favoured nature of the farm's location, the low general level of the yields, together with the extent to which they fluctuated from year to year, lays bare the difficulties faced in this period. For these results to be translated across the country, particularly in the many more marginal areas, the threat to the supply of staple foods

⁷⁵ R. C. Allen suggests that better seed could well have been responsible for the rapid rises in wheat yields evident in Oxfordshire in the seventeenth century. R. C. Allen, 'The two English agricultural revolutions, 1450–1850', in B. M. S. Campbell and M. Overton (eds), *Land, labour and livestock* (1991), pp. 248–9.

⁷⁶ The pioneer in the use of inventories in England is M. Overton, 'Estimating crop yields from probate inventories: an example from East Anglia, 1585–1735', *JEcH* 39 (1979), pp. 363–78. See also R. C. Allen, 'Inferring yields from probate inventories', *JEcH* 48 (1988), pp. 117–25. Discussion of the various methods used to assess yields and results obtained is in P. Glennie, 'Crop yields in early

modern England', in Campbell and Overton (eds), *Land, labour and livestock*, pp. 255–83. For a contemporary discussion of Scottish yields, see Donaldson, *Husbandry anatomised*.

⁷⁷ Young, 'Rural society', pp. 244–51.

⁷⁸ The effects of wind exposure in Edinburgh has been measured at 270% above that encountered in the English Home Counties (conversation with Prof. Charles McKean, 25 Oct. 2004).

⁷⁹ A. B. Appleby, *Famine in Tudor and Stuart England* (1978), pp. 157–8.

⁸⁰ J. Thirsk (ed.), *The agrarian history of England and Wales*, V, 1640–1750 (2 vols, 1985) (ii), p. 881.

from home sources by any prolonged deterioration in weather conditions is evident. Nevertheless, the changes introduced at Castle Lyon facilitated a considerable increase in the yields of the principal cereals grown, particularly in the case of wheat, the most valuable crop. Where imported English wheat seed was used, production compared with results from English farms in the same period. The importation of English seed indicates a knowledge and appreciation of the farming practices and improvements that were being carried on in that country. It is apparent that where resources were available, substantial returns could be, and were, achieved.

Scotland was a damaged and under-developed country in a period of transition. Patrick, Earl of Strathmore, like many among the Scottish landowning nobility at this time, was heavily burdened by debt. Yet within the economic strictures that prevailed, he was able to make considerable investment in improvements and institute fundamental change to the way in which his land was farmed. The context and nature of the improved agrarian practices that he pursued was part of a growing drive towards modernisation, which would pave the way for the massive strides that would be made in Scottish agriculture in the eighteenth century.