

On Estimating the Extent of Parliamentary Enclosure

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Abstract

Chapman argues that the acreages presented in the summaries of enclosure acts and awards are often inaccurate. True acreages may be estimated by summing the apportionment acreages for each award. This procedure, applied to a 10 per cent sample of English and Welsh awards, yields a total parliamentary enclosure acreage which appears to indicate that Turner's estimate, based on summaries, is too small. However, this conclusion is reached without reference to the margins of error associated with sample statistics. In a data-set exhibiting a high degree of variation such margins of error will be substantial. Hypothetical estimates, based on acreage data sampled from the Tate 'Domesday', indicate that Turner's figure probably lies within conventionally-acceptable confidence limits for Chapman's sample. A tolerably accurate estimate of the acreage enclosed by parliamentary act is only likely to be available when Chapman's procedure has been extended to the remaining 90 per cent of enclosure awards.

IN his recent work on parliamentary enclosure, John Chapman provides convincing evidence of inaccuracy in earlier estimates based on summary information given in the acts and awards.¹ The detailed award apportionments emerge as the only secure source of evidence about the acreages and character of land affected by the parliamentary method, and the only legitimate basis for making inferential estimates of acreages affected by pre-parliamentary enclosure.² In this comment, I do not question the advantages of estimates based on summed apportionment acreages. Indeed, I share Chapman's belief that these hold the key to an understanding of the true extent of parliamentary enclosure. But I am not convinced that the method which Chapman favours has brought such an

understanding as close as he appears to believe.

Chapman's study involves abstracting the full details of every individual allotment from a 10 per cent sample of all English and Welsh enclosure awards. In order to ensure that the sample is representative of the full range of enclosure acreages and types, it is drawn separately for each county, or group of adjacent counties in the Welsh case. This results in a total of 535 sample awards for England and 24 for Wales, allotting 768,450 and 123,639 acres respectively. Inflating each of these figures by multipliers calculated by dividing the total number of enclosure awards in each country by sample size for each country produces suggested aggregate parliamentary enclosure acreages of 1.18 million for Wales and 7.67 million for England. Correction for spurious enclosures and old-enclosed land exchanged under the terms of some awards gives a parliamentary enclosure acreage for Wales of 1.17 million acres, and a total for England in the range 7.25 to 7.35 million acres, as compared with Turner's English act- and award-based estimate, derived from data contained in

¹ J Chapman and T M Harris, 'The Accuracy of Enclosure Estimates: Some Evidence from Northern England', VIII, *Journ Hist Geog*, 1982, pp 261-264; J Chapman, 'Some Problems in the Interpretation of Enclosure Awards', *Ag Hist Rev*, XXVI, 1978, pp 111-112; J Chapman, 'The Extent and Nature of Parliamentary Enclosure', *Ag Hist Rev*, XXXV, 1987, p 25.

² J R Wordie, 'The Chronology of English Enclosure, 1500-1914', *Econ Hist Rev*, 2nd ser, XXXVI, 1983, pp 483-505; J Chapman, 'The Chronology of English Enclosure, a Comment', and reply by J R Wordie, *Econ Hist Rev* 2nd ser, XXXVII, 1984, pp 557-562.

Turner's edition of Tate's 'Domesday', of 6.79 million acres, and earlier estimates in the range 6 to 6.5 million acres.³ In other words, according to Chapman, Turner underestimates the extent of English parliamentary enclosure by about half a million acres, or by between 6.8 and 8.2 per cent of the true figure.

Surprisingly, Chapman offers his sample estimates without reference to the size of the errors associated with them. Were he merely interested in estimating the mean size of parliamentary enclosures then this omission would be serious enough. Sample means are usually accompanied by some statement of confidence, derived by estimation of the standard error of the mean. The omission is even more serious where, as in this case, the sample mean is multiplied by population size (for this, effectively, is what Chapman's method entails) to give a global estimate of the total acreage enclosed. In these circumstances, even quite modest standard errors of the mean would inflate to substantial aggregate errors associated with the estimation of the total acreage. There is thus a possibility that Chapman's suggested acreage total for England has associated confidence limits which would embrace Turner's much smaller estimate.

Since Chapman gives no information on the standard error or standard deviation of his sample values it is not possible to estimate exact confidence limits for his particular sample. Nevertheless, other data provide some basis for assessing their likely magnitude. Standard error is inversely proportional to the square root of the sample size and directly proportional to standard deviation. In this case, because the sample is large, the net contribution of sample size

to the size of the standard error is slight.⁴ Unfortunately for Chapman, the influence of the standard deviation is unlikely to be as negligible. Despite significant errors in its individual acreage estimates to which Chapman has drawn attention, it seems reasonable to presume that the information given in the Tate 'Domesday' encapsulates the true range of variability, if not necessarily the true absolute magnitude, of the acreages affected by individual enclosure awards. A cursory glance through that volume reveals such tremendous variability in these acreages as to suggest that samples would be associated with large standard deviations and, in consequence, large standard errors. In Devon alone, enclosures range from the 22 acres of Yalberton Tor to the 20,000 acres of Exmoor.

One may give these speculations more concrete form by closer scrutiny of the Tate 'Domesday' and the work by Michael Turner which derives from it. If I am correct in supposing that the acreages affected by individual parliamentary enclosure awards were about as variable as the 'Domesday' suggests, then it follows that a representative 10 per cent sample of 'Domesday' enclosures should give a good indication of the size of the confidence intervals associated with Chapman's acreage estimates.⁵ In addition, we can also compare Turner's total enclosure acreage, derived by aggregation of all the 'Domesday' act or award figures, with the acreages estimated by inflation of my sample

³ Chapman, 'Extent and Nature of Parliamentary Enclosure', pp 25-28; M Turner, *English Parliamentary Enclosure*, Folkestone, 1980, p 179; W E Tate, *A Domesday of English Enclosure Acts and Awards*, ed M E Turner, Reading, 1978. The final figure which Chapman gives for Wales appears to have been misprinted and is corrected here.

⁴ For useful introductions to sampling see Roderick Floud, *An Introduction to Quantitative Methods for Historians*, 1973, pp 161-183; and R S Schofield, 'Sampling in historical research', in E A Wrigley, ed, *Nineteenth-Century Society*, Cambridge, 1972, pp 146-190.

⁵ In using non-random methods I have tried both to mimic Chapman's approach and to derive a sample which is more representative of the overall characteristics of the underlying population. There is a school of thought which holds that since random sampling methods provide one of the key theoretical underpinnings of standard error, then confidence estimates should only be made in respect of strictly random samples. I have sided with those who argue, on the contrary, that the use of prior information to improve the representativeness of a sample is likely to make it more secure as a foundation for inference. See, for example, T M F Smith, 'On the validity of inferences from non-random samples', *JRSS, A*, 146, 1983, pp 394-403.

acreage totals using the method favoured by Chapman. In other words, the Tate/Turner data may be used in two ways as a means of assessing the likely accuracy of Chapman's estimates. Neither of these procedures suggests that Chapman's global parliamentary enclosure acreage is necessarily close to the true figure, which remains unknown.

A 10 per cent sample of enclosures was drawn from the 'Domesday' using a method broadly comparable with Chapman's. For each county, a single digit random number identified the first member of the sample. Every tenth entry thereafter was also included. Following Turner, the award acreage was preferred to the act acreage where both were given. If neither was available, an acreage estimate was taken from the nearest entry to provide one, usually the adjacent enclosure in the listing. This randomized systematic sampling method, which has some similarities with that used on occasion by recent British census-takers,⁶ provided a total sample of 539 enclosure acreages for England and Monmouthshire. Given the way the 'Domesday' data are presented, the sample would appear to be about as representative as any 10 per cent sample could possibly be with respect not only to geographical distribution but also to enclosure chronology and type.

The results of the exercise were a sample mean enclosure acreage of 1229.85 acres and a sample standard deviation of 1466.71 acres. The difference between the first figure and the sample mean for Chapman's English data (1436.36 acres for the uncorrected data, 1376.2 acres for the corrected data) might at first sight appear to vindicate Chapman's conclusion that the act and award data underestimate the 'true' acreage of parliamentary enclosure. However, the enormous size of

the standard deviation, in this case even larger than the mean, counsels against the glib assumption that total acreages may be directly read from samples derived from data of this kind.

Multiplying the unrounded sample mean by Turner's population total, which, when acts affecting land in more than one county are allowed for, is 5265 enclosures, suggests a total enclosure acreage of 6,475,149. This is less by 319,280 acres or some 4.7 per cent than Turner's 'true' acreage of 6,794,429.⁷ If Chapman's method is valid, which it clearly is not, then the match between this 'true' acreage and that derived from the inflation of any representative 10 per cent sample should always be exact.

Calculation of the standard error of the mean (63.18 acres) allows us to set conventional 95 per cent confidence limits for the sample mean of 1106.02 and 1353.67 acres, and equivalent confidence limits for the estimate of the total acreage enclosed of 5,823,215 and 7,127,083 acres, all figures based on unrounded data. We may observe that not only the total acreage figure suggested by our particular sample but Turner's 'true' total both fall within this range, as we would expect. We should also observe the enormous absolute magnitude of the confidence interval, which underlines the limitations and likely deficiencies of estimates based on sampling methods.

If the standard error of the mean for Chapman's sample were the same as that calculated here (and, as I have already indicated, if Chapman's sample is representative it is improbable that it could be significantly smaller) then the 95 per cent confidence limits for Chapman's corrected English sample mean would be 1252.38 and 1500.02 acres, and the equivalent confidence limits for the total acreage enclosed would

⁶ Notably in the 10 per cent sample census of 1966, although some of the more esoteric information presented in recent full censuses was also collected using such procedures. See C Denham and D Rhind, 'The 1981 Census and its Results', in D Rhind (ed), *A Census User's Handbook*, 1983, pp 78-80.

⁷ Turner, *English Parliamentary Enclosure*, pp 176-9.

be 6,601,273 and 7,906,627 acres.⁸ It will be observed that Turner's allegedly inaccurate total, although not my attempt at estimating that total, falls within the wide span of these hypothetical but plausible confidence estimates.

In theory, such wide confidence estimates might be reduced to acceptable proportions if sample size were increased. But an acceptable error in a data-set exhibiting this degree of variation unfortunately implies a sample size not much smaller than the total size of the population, at the very least. If, let us say, we wanted to be 95 per cent certain that the total enclosure acreage estimated by inflating the sample mean lay within 100,000 acres of the true total, then, on the basis of the sample statistics already obtained, it may be estimated that such a margin of error could be achieved by consulting a 'sample' of 22,961 enclosures.⁹ This is well over four times the number of

parliamentary enclosures which actually occurred. Notwithstanding the many attractions of sampling,¹⁰ in some circumstances it simply cannot provide sufficiently accurate estimates.

The implications seem clear. Chapman provides ample evidence of inaccuracies in enclosure acreages derived from act and award summaries. But the application of elementary statistical reasoning shows that we cannot identify the true figure by adopting Chapman's procedure of aggregating apportionment acreages for a mere 10 per cent of parliamentary enclosure awards. Since ESRC or its predecessor agreed to fund both the completion of the Tate 'Domesday' and Chapman's sampling exercise, it seems that at least one funding agency is persuaded of the importance of a better understanding of parliamentary enclosure, not least with respect to the acreages affected. We now know that this important truth can only be finally revealed when some historian with extraordinary reserves of stamina has been given the substantial additional resources needed to extend Chapman's analysis to the remaining 90 per cent of parliamentary enclosures, or at least to as many of those 90 per cent as the vagaries of documentary survival will allow.

⁸ Calculated on the basis of 5271 English enclosures, being Chapman's adjusted total of 5341 enclosures, less an estimated 70 further awards which relate to spurious enclosures. Chapman, 'Extent and Nature of Parliamentary Enclosure', p. 27.

⁹ The estimate of required sample size derives from the formula

$$n = \left(\frac{Zs}{d} \right)^2$$

where n is required size of the sample, s is the standard deviation of the 'pilot' sample (1466.71), d is the tolerable margin of error at a specified level of confidence ($100,000 \div 5,271 = 18.97$), and z is the z value corresponding to the same level of confidence (1.96). See P Hammond and P S McCullagh, *Quantitative Techniques in Geography: an Introduction*, Oxford, 1974, pp. 131-2.

¹⁰ For enthusiastic advocacy of sampling see D N McCloskey, *Econometric History*, 1987, pp. 49-51.