The Extent of Farm Underdrainage in England and Wales, prior to 1939

By M ROBINSON

FIELD drainage in Britain probably dates from Roman times, but it is only in the last 200 years that significant amounts have been carried out. Enclosure of the common lands beginning in the seventeenth century was a necessary precursor to agricultural improvement and from about 1750 there was an increase in the amount of drainage carried out. The drains at this time were mainly made of stones or brush wood, and it was only from the beginning of the nineteenth century with the invention of clay drainage pipes that drainage became more widespread. After 1826 drainage tiles were exempted from tax, and in 1845 Thomas Scragg invented a machine for extruding drainage tiles, which brought their price down by about 70 per cent. This began a period of intensive drainage which continued for about half a century, helped by loans from government and private sources. However in the period of agricultural depression which began about 1890 and continued until the 1930s very little drainage was carried out.[1] In more recent years with grant-aid and advice available from the Ministry of Agriculture, Fisheries and Food (MAFF), and with high food prices, there has been considerable renewed interest in farm drainage.[2] Whilst records are available of grant-aided drainage for the period after 1939, and these are thought by the MAFF to represent almost all the recent drainage that has taken place, there is in contrast, little information on the amount of drainage in the nineteenth century. And what historical records do exist, are conflicting and inconclusive.

I

The most frequently quoted source of information is the evidence that Bailey Denton submitted to the Agricultural Commission in 1880.[3] He estimated that one million acres (approx 4,000 km^2) in England and Wales had been drained with government loans, and that in addition perhaps double that amount had been drained with private finance. Only seven years earlier he had also estimated the total area drained as 3 million acres (12,000 km^2) but based it on equal amounts of privately and publicly funded drainage.[4] The area drained by government loans can be approximated from records of the sums loaned, but estimates of the amount of privately funded drainage are very uncertain and have often been assumed to be a given multiple of the government drainage. Denton changed his estimate of the ratio of public to private finance from 1:1 to 1:2, whilst his contemporary Caird[5] used the ratio of 1:3. Thus with only minor changes in the numbers used, the estimates of the total area drained could vary between 2 and 4.5 million acres. In a review of the historical sources of evidence, Phillips[6] stated that 'It is unwise to put any confidence in estimates which are so variable and unreliable,' and concluded 'The

[1] H H Nicholson, 'Modern Field Drainage', *Journal of the Royal Agricultural Society of England*, 104 (1943), pp 118–35; B D Trafford, 'Field Drainage', *JRAS*, 131 (1970), pp 129–52.

[2] A C Armstrong, 'A digest of drainage statistics', Field Drainage Experimental Unit (1978), MAFF, 68 pp.

[3] J Bailey Denton, 'Submission to the Royal Commission on the Depressed Condition of the Agricultural Interests 1880–2', *British Parliamentary Papers*, XV (1881).

[4] J Bailey Denton, 'Submission to the Select Committee of the House of Lords on the Improvement of Land', *BPP*, XVI (1873).

[5] J Caird, 'Submission to the Select Committee of the House of Lords on the Improvement of Land', *BPP*, XVI (1873).

[6] A D M Phillips, 'Underdraining and the English Claylands, 1850–80: a Review', *Ag Hist Rev*, 17 (1969), pp 44–55.

acreage drained during the period 1850–80 is unknown.' More precise evidence is available for individual local areas from the records of estates.[7] However it would be dangerous to extrapolate their drainage figures to larger areas since the estates often had the money and labour available to carry out this work, and so were not necessarily typical of countryside as a whole.

Trafford[8] examined Denton's records and considered that a more reliable calculation of the area underdrained in the nineteenth century could be obtained from estimates of the number of clay pipes manufactured each year. Assuming an average of 1250 pipes needed to drain each acre and after an allowance for sales outside England and Wales, he concluded that probably about 12 million acres (about 50,000 km^2) were underdrained. This is considerably higher than the earlier estimates of Caird and Denton. In support of this figure Trafford quoted the frequent occurrence of old clay pipes when a field is drained[9] and the findings of a survey of drainage need carried out by the MAFF.[10] The MAFF selected a random sample of 5 per cent of England and Wales and asked the local field drainage advisers for their 'opinions' of the percentage of land which fell into the following categories: (i) drained since 1939, (ii) naturally freely draining (eg chalk soils), (iii) adequate drainage by old (pre-1939) drains, (iv) in need of drainage (either undrained or where existing drainage was inadequate or had failed), (v) uneconomic to drain. This indicated that about 5.3 million acres (21,000 km^2) relied on old drains, and since there was so little drainage in the early part of this century, Trafford argued these might reasonably represent the remnant of up to 12 million acres drained in the nineteenth century. Thus, far from identifying which nineteenth-century estimate was the more accurate, modern agriculturists have cast doubt on all the estimates by computing an area which is greater by a factor of 3 to 6. It is to provide an independent estimate from a new source of evidence that this paper is directed.

II

Clearly, a definitive assessment could be provided by a field to field survey looking for the occurrence of old drains feeding into watercourses. This would be prohibitively expensive and time-consuming, but Green[11] showed that very similar information, however, can be obtained from records that have been routinely collected by the MAFF since 1971. Up to the early 1980s all applications by farmers for government grant-aid for drainage required a visit to the site by a MAFF drainage adviser. The drainage officer advised on the layout of the new drainage scheme and noted a number of features of the site, including the existence of pre-1939 drains. This information was based on site inspection and discussion with the farmer. Since grant-aid for drainage became available in 1939 few farmers have carried out the work privately, and the MAFF statistics provide a very complete record of drainage.[12] Over the decade 1971–80 there were nearly 125,000 grant applications, requiring visits to about 8500 km^2 of farmland, with an average area inspected of under 7 hectares (17 acres). This provides a great deal of information on the extent of old drains, both the total area of land drained, and its regional distribution. These and other statistics were collated by the MAFF for each parish for the period 1971–80, and the data have been made available to the author.

The area with old underdrainage in a parish may be estimated from these data if it

[7] A D M Phillips, 'The development of underdraining on a Yorkshire estate during the nineteenth century', *Yorkshire Archaeological Journal*, 44 (1972), pp 195–206.

[8] Trafford, *op cit.*

[9] H H Nicholson, *The Principles of Field Drainage*, Cambridge, 1953.

[10] E T Belding, 'Drainage Survey in England and Wales', *Agriculture*, 78 (1971), pp 250–4.

[11] F H W Green, 'Field underdrainage before and after 1940', *Ag Hist Rev*, 28 (1980), pp 120–3.

[12] Trafford, *op cit.*

is assumed that the land inspected was a random sample, typical of that parish. Then the percentage of the land found to have old drains would be representative of the parish as a whole. This assumption is not unreasonable for parishes that are homogeneous in soils and topography, but will result in inaccuracies for those in which only a part of the land was suitable for drainage. For example where significant areas had adequate natural drainage, then the area in the parish with old drains would be overestimated. On the other hand, underestimates would result for parishes in which many old drainage systems still function satisfactorily, since those fields would not be inspected, and so would not be included in the data collection. These and other sources of potential uncertainties in the data used in this paper are summarized in Table 1. As with the other estimates of nineteenth century drainage described earlier it is difficult or impossible to quantify the likely magnitude of the inaccuracies, but some qualitative guidance can be given. The possibility that the inspected areas in a parish were an unrepresentative sample is probably the most important source of error. However, it should be noted that the heterogeneity of a parish would be limited by its small size (average area under 10 km^2), and that any error could be positive or negative. Similarly, whilst the drainage adviser's report does not identify cases where only a part of the land contained old drains, there would undoubtedly have been many instances in which old drainage systems were not detected. Some short-lived twentieth-century drainage schemes might have been counted in error, but this is unlikely to have been a serious source of error. Grant aid was only available to replace drains installed before 1939; any later schemes would have been noted in the MAFF's records and not been eligible. Nineteenth-century drainage pipes are very different in appearance to modern pipes, being of different sizes and shapes, often poorly extruded, and many stamped 'DRAIN' to be exempted from tax. The significance (or otherwise) of these sources of error, and the extent to which they cancel out, cannot be determined. What is, however, beyond dispute is that the figures are based on site visits to a much larger sample than is ever likely to be studied again. These visits were discontinued by the MAFF in 1981 due to the enormous amount of work involved. The nineteenth-century estimates have been shown to be unreliable and conflicting,[13] and the present method provides an entirely independent approach to the problem.

TABLE 1
Potential Sources of Uncertainties in Estimating Nineteenth-Century Drainage from the Parish Data

Overestimates

1 Unrepresentative sample of land inspected within parish — other areas might have fewer or no old drains.

2 Only a small part of the site inspected might contain old drains.

3 Short-lived schemes installed earlier in this century might be included in error.

Underestimates

1 Unrepresentative sample — other areas might have adequately functioning old drains.

2 Old drains at a site might be unknown to the farmer, and not found when the site was inspected.

Summing the values for all the parishes produces a figure of 57,000 km^2 (14 million acres) with old drains, which represents 52 per cent of the agricultural land in England and Wales. Given the uncertainties and assumptions of the two approaches this is remarkably similar to the estimate of 50,000 km^2 (12 million acres) obtained by Trafford[14] from figures for clay pipe production. These two independent estimates, taken with the Belding[15] figure of over 5 million acres having nineteenth-

[13] Phillips, *Ag Hist Rev*, 17 (1969).
[14] Trafford, *op cit.*
[15] Belding, *op cit.*

century drains still functioning, indicate that the extent of underdrainage in the mid- to late-nineteenth-century period of 'High Farming' was very much greater than contemporaries such as Denton and Caird realized. Even if the lower figure of 50,000 km² is assumed, due to the sources of overestimation outlined above and on the basis of the regional analysis described in the next section, this represents an enormous achievement by the agricultural community and one which must have been largely financed by private loans or from farmers' own resources (and so largely unrecorded in historical sources). The extent of this effort may be judged by comparison with the amount of drainage in the present century. In the period 1940–81, just under 20,000 km² were drained with government assistance. Although many of these schemes would be expected to be of a much higher standard than those of the nineteenth century they amount to under one half of the land area improved then. Figures for drainage pipe production confirm the difference between the two centuries.[16] Annual production in the mid-nineteenth century was about four times that at present (partly due to closer spacing in old schemes).

Additional, although indirect, evidence of the large extent of drainage in the last century comes from the concern that was expressed about the effect this work was having on the flows in rivers. As early as 1861 a special meeting was convened in London by the Institution of Civil Engineers to discuss whether drainage increased the discharge of water from farmland into the rivers in storm periods, and so resulted in an increase in the incidence of flooding of areas downstream.[17] No conclusions could be reached, however, due to the lack of measurements of river discharges.

[16] Trafford, *op cit.*

[17] J Bailey Denton, 'On the discharge from underdrainage and its effects on the arterial channels and outfalls of the country', *Proceedings of the Institution of Civil Engineers*, 21 (1862), pp 48–130.

III

The parish drainage data described above can also be used to study the regional variations in drainage activity in England and Wales, although it must be recognized that the figures will be less reliable as smaller areas are considered. Grid references of all the parishes were obtained from the Ordnance Survey. To produce an intelligible map based on nearly 12,000 (parish) data points, it was necessary to contour the data, and for convenience and consistency a computer plotting package was adopted.[18] This provides a range of options to control the contouring and the degree of smoothing needed, depending on the amount of variation in the data. A number of trial maps were produced until one was selected as representing the best balance between spatial detail and clarity. This map has been redrawn with shading as Figure 1.

The pattern of drainage shows a good overall agreement with the spatial pattern of soils based on their hydrological properties.[19] Areas of low drainage activity can be readily identified with areas of permeable soils having good natural drainage (eg the Downs, Cotswolds and Chilterns in southern England and the Yorkshire Wolds in northern England). Higher rates of drainage occur in areas with more impermeable soils such as the clay soils of Essex, Suffolk and Lincolnshire, and the Weald in Surrey and Sussex. The highest rates lie in the north and west; these are high rainfall areas associated with low permeability peaty or heavy clay soils. The high frequency of occurrence of old drains in soils with poor natural drainage confirms the observation that 'In those parts of England and Wales where artificial drainage is necessary it is rare to find a field which has not been drained at some time or another; and much of the work

[18] R J Sampson, *SURFACE II Graphics System*, Kansas Geological Survey, 1978.

[19] F A K Farquharson, D Mackney, M D Newson, and A J Thomasson, 'Estimation of runoff potential of river catchments from soils surveys', *Special Survey No 11*, Soil Survey of England and Wales, Harpenden, 1978.

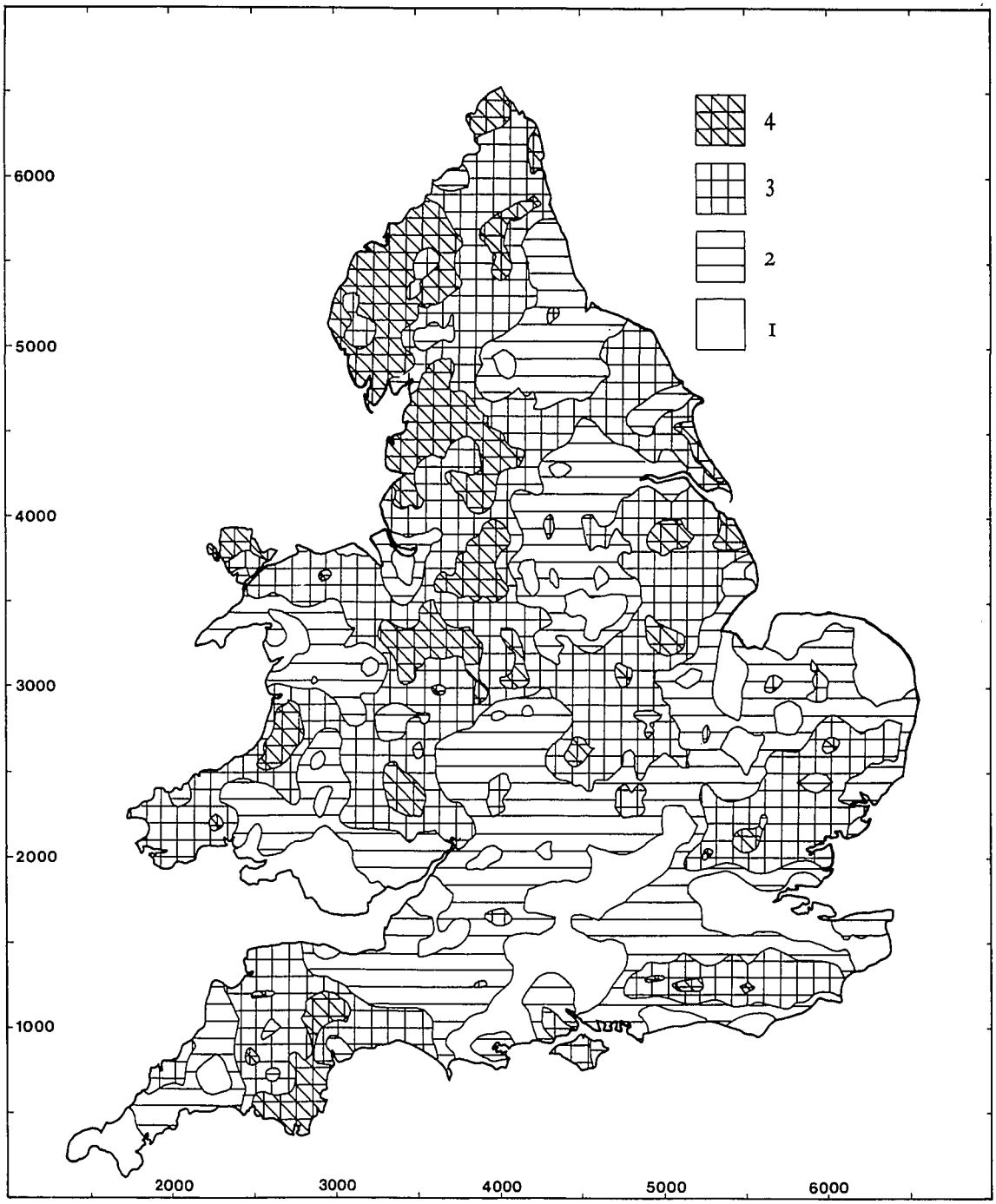

FIGURE I

Percentage of agricultural land found to contain field drains that had been installed prior to 1939. (1 = under 25 per cent, 2 = 25 to 50 per cent, 3 = 50 to 75 per cent and 4 = over 75 per cent)

being carried out today consists of reconditioning or replacing old system.'[20] However, whilst the overall pattern appears reasonable it is questionable that such high percentages were drained in upland areas such as Cumbria and northern Lancashire where the economic return on drainage would be poor. Further investigation indicates that in such areas underdrainage was likely to be concentrated on the enclosed 'in-bye' fields in the valleys with the intervening hill land remaining undrained (both now and in the nineteenth century). The percentage of the land in a parish found to have old drains would thus be biased towards these more fertile valley bottom lands. It is difficult to determine the magnitude of the resulting overestimation but the survey of Belding[21] described earlier and based on a random sample of land provides *minimum* estimates of the area with old drains, since the schemes that had failed would be on land included in other categories. Summing the land in all drainage categories except that with naturally freely draining soil provides a rough estimate of the potential *maximum* area with old drains. These minimum and maximum values yield ranges of about 35–80 per cent of the land in northern England compared with only about 10–40 per cent in southern England and Wales. This confirms that higher rates of drainage occurred in the north and west, but suggests, as indicated above, that the parish data result in a systematic overestimation for hill areas. Taking these figures into consideration it seems reasonable to revise the national estimate of 57,000 km² underdrained in the nineteenth century to a lower figure of about 50,000 km².

The conclusion that drainage rates were higher in the north and west than in the rest of the country has also been made by some agricultural historians, and the role of large estates has been cited. Sturgess[22] argued that nineteenth-century drainage was concentrated on the clay soils of the north and west of the country since only with drainage to prevent waterlogging of crops in winter could agricultural production in those regions be increased. This change took place at a time of depressed corn prices (the traditional clayland crop) and was often associated with a change to grass, mostly for cattle production. On the lighter soils, increased production was achieved by the introduction of turnip husbandry. On the lowland clays in eastern England, the smaller rainfall limited the growth of grass in summer and made the investment of drainage a less economic prospect than in the wetter and more productive grass growing areas of the west and north. It is interesting to contrast this pattern with drainage in the present century which is concentrated on the arable land in eastern England.[23] This is a reflection of economic factors since this land is used to grow cash crops such as corn, sugar beet and potatoes. There is a high investment in equipment, and the need to maximize economic returns. Artificial drainage both improves crop yields and increases the time during the year that heavy machinery can be used on the land.

IV

The site visit records completed by MAFF drainage officers provide a unique source of information from which to estimate the proportion of land with old drains. Due to the agricultural depression in the early part of this century, these will be mostly nineteenth-century drains. This gives an estimate that about 50,000 km² of farmland was drained, and is consistent with an

[20] MAFF, 'Land Drainage in England and Wales', Report of the Land Drainage Legislation Sub-Committee of the Central Advisory Water Committee, 1951.

[21] Belding, *op cit.*

[22] R W Sturgess, 'The Agricultural Revolution on the English Clays', *Ag Hist Rev*, 14 (1966), pp 104–21; *idem*, 'The Agricultural Revolution on the English Clays: a Rejoinder', *Ag Hist Rev*, 15 (1967).

[23] F H W Green, 'Recent changes in land use and treatment', *Geographical Journal*, 142 (1976), pp 12–26.

independent estimate based on drainage pipe production. This suggests that contemporaries greatly underestimated the amount of draining taking place in the last century, although as early as the 1860s fears were voiced of the effects farm drainage might be having on river flows. The area of land drained was considerably in excess of that drained in the present century, much of which is replacing old drains that have reached the end of their useful life. Drainage in the nineteenth century extended to most parts of the country, but was greatest in the north and west. These are areas with high rainfall and soils having poor natural drainage.

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