



LOAN SET

No 88
Livestock Movement and
Location in England



English Nature Research Reports

P, S, B, JNCC

English Nature Research Reports

No 88

**Livestock Movement and
Location in England**

Prepared for English Nature
by
Dr C M Saunders and A Moxey
Department of Agricultural
Economics and Food Marketing
University of Newcastle upon Tyne

Further copies of this report can be obtained from
Uplands and Freshwater Team, English Nature,
Northminster House, Peterborough, PE1 1UA

ISSN 0967-876X
© English Nature 1994

PREFACE

The contract for a study on "Livestock Movement and Location in England" was let in August 1993 by the Rural Land Use Branch under the management of Siâron Hooper, Upland Policy Officer. This was in response to grazing management issues and concerns highlighted by English Nature regional staff.

The contract was awarded to the Department of Agricultural Economics and Food Marketing, University of Newcastle Upon Tyne and the work was undertaken by Dr Caroline Saunders and Andrew Moxey. Their report provides valuable information on trends in livestock farming, the relationship with nature conservation and the underlying UK and European policy issues. Such information will inform English Nature decisions and policies for using livestock in the effective management of semi-natural habitats.

LIVESTOCK MOVEMENT AND LOCATION IN ENGLAND

Final report

to

English Nature

by

Caroline Saunders

and

Andrew Moxey

**Department of Agricultural Economics and Food
Marketing**

University

Newcastle upon Tyne

November 1993

EXECUTIVE SUMMARY

- 1 The objectives of the study were to evaluate the historical and current movement and location of livestock in England and to identify and evaluate constraints and opportunities facing livestock movement and location as a habitat management tool.
- 2 The contract was awarded in August 1993 with the first draft to be completed by the 24th September 1993, final report to be submitted by the end of October.
- 3 The review of traditional systems of livestock production highlighted the stratification of the sheep sector with the hill providing not only stores for fattening on the lowland but also the basis of the breeding flock for the lowlands. Some stratification exists in the beef sector with fattening of store calves in the East Midlands, Northumberland and, to a lesser extent, Eastern Counties of England.
- 4 There has been a specialisation of land use from 1945 to 1990 with increases in concentration of grass in the West, particularly from 1975 to 1980, and a reduction in grass area in the East, especially from 1955 to 1965. There has also been intensification of grass use with falls in rough grazing particularly in the West.
- 5 There has been a slight fall in the total number of cows in England from 1945 to 1990. However, their location has changed with considerably fewer in the East and more in the West. The greatest change occurred between 1975 and 1980.
- 6 Shifts in location of cattle over one year old illustrate changes to the beef industry from 1945 to 1990, with increase in concentration in West. This reflects the development of feeding systems for calves from the dairy herd. The fall in production of beef in the East marks the most important change in livestock location since 1945.
- 7 The number of ewes has increased from 1945 to 1990 but more especially in the North since 1980. The number of lambs has increased by over two and a half fold, reflecting increased productivity of ewes.

- 8 The change in livestock movement and location since the war has meant changes in the traditional stratification of production. Whilst the stratification of sheep production still remains largely intact, the intensification of grass use has meant some increase in the retention of stock for fattening. The main changes are however in beef and dairy production. The ability to raise calves from the dairy herd on milk substitutes has opened up new opportunities for beef production. This, together with the introduction of 18 month finishing regimes and cereal based beef production, has changed the beef industry (also encouraged by the calf subsidy). This was reflected above with the reduction in cattle over two years old and the change in location of beef with regions such as the Midlands and Northumberland which traditionally fattened stores, falling in importance.
9. The fall in grass area in the East between 1955 and 1965 is consistent with policy developments during this period when there were incentives for selective expansion, particularly in the cereal sector. Cereal incomes were relatively higher than in any other sector in 1955 and the availability of capital grants further encouraged the conversion of grass to arable.
10. The increase in grass area in the West between 1975 and 1980 corresponds with the rise in support to dairy and beef over this period, following entry into the EC. Dairy incomes per hectare were higher than other sectors and beef incomes per hectare had increased to just below those on cereal farms. Since 1980 the grass area, and number of cows, has remained fairly constant apart from a fall in cows from 1985 to 1990 reflecting the introduction of milk quota.
11. The slight increase in sheep numbers over the post-war period up to 1980 reflects the fact that this sector had relatively low incomes although increasing amounts of support were given to hill flocks through hill subsidies. However, the increase in breeding numbers since 1980 corresponds with the introduction of the sheepmeat regime. This, with falling returns in both the cereal and beef sector and the introduction of milk quotas, made sheep production more attractive. The introduction of the ewe premium and the phasing out of the variable premium has also made the keeping of breeding flocks a more attractive option, especially in the lowlands. However the size of flock necessary to be viable has meant that these have been in relatively large herds rather than in small units utilising the more marginal land under threat of abandonment.

12. The current round of CAP reform will have important implications for livestock movement and location. The reform package is radical in that it marks a change in direction for the CAP away from output related support based upon fixed prices towards a support system based on headage payments or, in the case of cereals, area payments determined by historical production levels. The main change is in the cereal sector with the introduction of set-aside and arable area payments which at first sight may not seem relevant to livestock production. However, the introduction of set-aside has effectively frozen the area of arable production and, by implication, the area of grass. Therefore, there are no incentives for farmers to switch into grass production given the inevitable loss of arable payments
13. The changes to the livestock regimes mainly revolve around the introduction of rights to breeding premia with the maximum entitlement being subject to a stocking limit. This will also tend to freeze the level of production, although the ability to lease or transfer rights will enable some movement of livestock to occur. Rights are not allowed to be removed from the Less Favoured Area except under environmental schemes such as the Moorland Scheme. The introduction of a stocking limit, additional payments for low stocking, and the payment of premia for older calves will tend to encourage extensification of production particularly in the beef sector. This will be welcomed by the environmental lobby in reducing the intensity of grass use but will result in little relocation of livestock.
14. Other factors affecting the movement and location of livestock include developments in the market for sheepmeat. The removal of clawback, an export tax, has reduced the cost of exporting sheep and thus provided greater opportunities for the marketing of English sheep in the growing EC export market. This does not include just traditional fat stock, but also increased demand for store lambs to meet the requirements of Mediterranean countries for small carcasses.
15. The disbanding of the Milk Marketing Board in 1994 will affect the location of dairy herds by removing the effective subsidy on remote production. This may result in an increase in herds near centres of population and a reduction in the number of remote and isolated dairy farms.
16. The CAP reforms will tend to freeze the current pattern of production and inhibit the use of livestock as a habitat management tool. Exceptions to this

occur in specially designated areas but these are limited in scope. However, the current reforms are unlikely to be sustainable, nationally or internationally, in terms of either cost or acceptability. Payment to farmers for 'doing nothing' may prove to be unacceptable politically, leading to demands for support to farmers to provide public goods such as conservation, access and landscape, in the countryside.

- 17 Policy may develop in a number of ways. The EC Commission already shows commitment to change the basis of support with proposals such as linking set-aside to environmental criteria and converting headage payments for livestock to area payments. Environmental compliance for agricultural support thus seems set to increase. Therefore, in the long term, it is conceivable that production based support will be replaced by positive measures to provide public goods in the countryside.

Phase One

Historical and current situation and trends

(i) Stratification of Livestock Sectors in England

Introduction

The structural and spatial distribution of production systems involving livestock is often referred to as stratification. The greater the degree to which particular production systems (including livestock breeds) are confined to particular locations or farm types the greater the degree of stratification. Agricultural livestock in England consist mainly of sheep, beef cattle and dairy cattle. Of these, only sheep can be said to be produced within a particularly stratified sector.

Stratification of the Sheep Sector

The system of sheep production in the UK is stratified by altitude into three tiers of hill upland, and lowland production, as illustrated in figure 1. The top hill tier (sometimes referred to as the top of the pyramid) contains pure-bred, self-sustaining breeding flocks. The ewes here tend to be of traditional hardy breeds, such as the Herdwick, Cheviot, and Swaledale, which have adapted to the local conditions over many generations. Any flock improvements are introduced through the ram. These flocks utilise the limited resources on the hill at low stocking rates with low lambing rates (less than one per ewe). Few other agricultural enterprises are present on hill farms, although some beef cattle may be kept.

The upland tier is characterised by more intensive production. Stocking and lambing rates are higher than on the hill, reflecting the more favourable conditions and the greater variety of sheep breeds used. In particular, cross-breeding occurs, with more productive rams such as longwool or down breeds used to sire higher quality lambs and ewes for

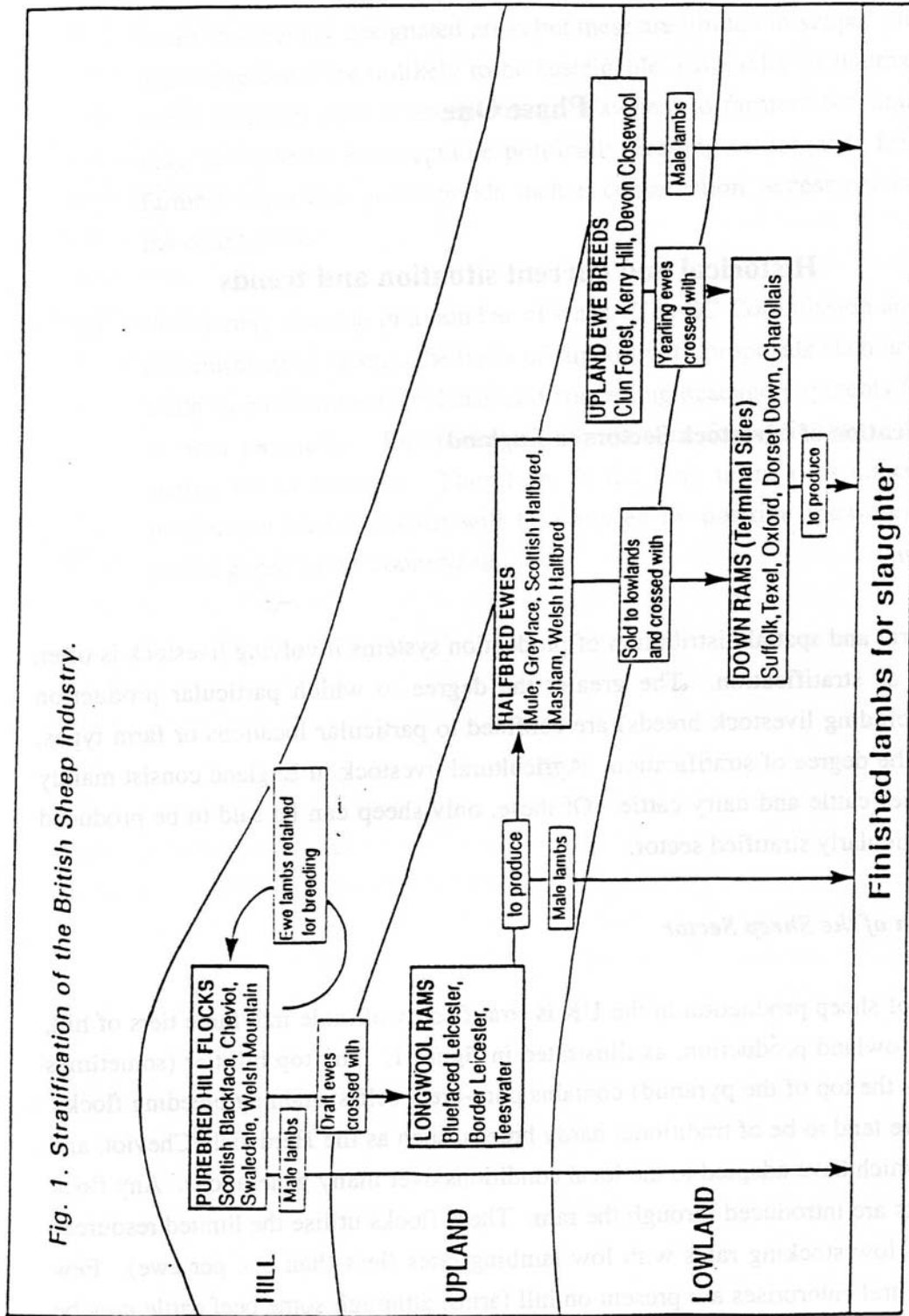


Fig. 1. Stratification of the British Sheep Industry.

SOURCE: COOPER AND THOMAS (1991)

subsequent breeding. Beef and dairy enterprises may be present on upland sheep farms, together with limited arable (primarily fodder) crops.

The lowland tier is characterised by the highest stocking and lambing rates of the sector, reflecting the highly favourable conditions for livestock rearing. A wide variety of breeds are used, many of them specific to lowland areas. Lowland sheep production has to compete with a range of other enterprises and is often geared to fit in with arable rotations.

The three tiers of the sheep sector are linked through movements of lambs and ewes. Lambs born in the hill tier are typically sold to upland farms as store animals for fattening. Hill ewes that have outlived their productive life on the hill (indicated by a deterioration of their teeth) are also sold to upland farms (a small proportion are sold to lowland farms) where they are used to produce crossbred lambs and breeding ewes. Crossbred lambs born in the upland tier are not necessarily fattened there, but are often sold as store animals to lowland farms. Similarly, upland crossbred ewes form an important addition to the lowland breeding flock.

This stratification of the sector ensures that the grazing resources in each tier are exploited optimally, matching sheep characteristics and requirements to environmental constraints. This arrangement has produced a variety of breeds and crosses, giving a wide assortment of lambs and therefore carcass types.

Stratification of the Beef Sector

Traditional systems of beef production do have some features in common with the tiered structure of the sheep industry. This is seen most clearly by the existence of a beef herd in the uplands which provides store calves for fattening on the lowlands. However, improvements in grass production techniques and supplementary feeding have seen increases in stocking rates in the uplands, somewhat reducing the degree of stratification. Moreover, the main source of beef in England is surplus calves from the dairy sector sold for fattening on grass or in intensive cereal systems. Store calves from the Irish dairy herd have also traditionally been fattened in England, particularly in the Midlands. This link with the dairy sector means that a high proportion of beef animals are crossbred from Friesian, or Friesian-Holstein, cows and beef sires such as Hereford or Charolais. This gives fast growing calves with good confirmation. Suckler herds exist on more marginal areas of the lowlands, sometimes with multiple suckling (that is beef cows rearing other calves as well as their own).

Dairy Sector

The dairy sector does not display the same degree of stratification as either the sheep or beef sectors. Dairy herd replacements come from within the dairy herd, with little distinction between upland and lowland farms. Breeding advances have standardised over 90% of dairy herds around the Friesian or Friesian-Holstein breed. Dairy production in England has traditionally been concentrated in the West due to climatic reasons. This concentration has increased as transportation has become cheaper and the system of payment does not differentiate between locations.

(ii) Livestock Movement and Location in England 1945 to 1990

Introduction

The most comprehensive source of information regarding the location of agricultural livestock across England is provided by the annual June agricultural census conducted by the Ministry of Agriculture Fisheries and Food (MAFF). This records a number of variables including grassland area and stock numbers. Although these data are collected for each individual farm, they are released publicly at the parish or, more conveniently, county level. This latter dataset was used to identify the location and intensity of livestock production across England at ten yearly intervals from 1945¹ to 1975, and thereafter at five yearly intervals to 1990. The movement of livestock was estimated by inspection of the age structure of livestock in each county. Although this is a crude measure, lack of data² precludes a more rigorous approach.

For each of the years mentioned above, a number of calculations were made for each county to estimate the importance of grassland and the intensity at which it was utilised. Livestock density is expressed either as head of stock per hectare, or as Livestock Units (LU) per hectare, where 1 LU is equivalent to 1 dairy cow. To reflect the lower grazing capacity of rough grazing, LU were also expressed per hectare of adjusted grassland where 1 hectare of rough grazing was taken as equivalent to 0.2 hectares of sown

¹In 1973 the county boundaries changed, therefore data prior to this date has been adjusted to correspond with the post 1973 boundaries. A main difference between the two was the creation of the metropolitan counties after 1973. Data for these have been estimated for pre 1973 by taking an average of the surrounding counties.

²For example, data on sales of livestock at, say, auction markets, is not readily available. Moreover, such data would not give an accurate picture as to the destination of sales due to the use of intermediaries.

grassland. For illustrative ease, these estimates are presented in the form of a series of maps. Class intervals were chosen so as to remain consistent across maps, thereby aiding inter-year comparisons.

Changes in Grassland, 1945 to 1990

Nationally, grassland represented 45% of agricultural land in England in 1945. Of this, 10% was rough grazing. By 1990, grassland had expanded to 52%, but the relative importance of rough grazing had declined slightly to 8%. This national picture masks considerable variation between counties, as shown by maps 1a to 1g and 2a to 2d.

Map 1a shows that in 1945 only one county, Cambridgeshire, had under 20% of its land under grass (at 15%). Eight other counties in the East had under 30% of their agricultural land under grass. As expected, grass as a percentage of total agricultural area was higher in the North and West of England, reflecting the greater importance of rough grazing. Thus, for example, Northumberland had the greatest proportion (73%) of land down to grass.

By 1990, as shown by map 1g, there had been a specialisation of land use with the proportion of grass in the Eastern counties falling and the proportion in the West rising. For example, in 1990 only 10% of Cambridgeshire was under grass, and six other counties in the East had under 20% grassland. By contrast, 17 counties away from the East had more than 60% of land under grass, including Devon at 83%, Lancashire at 87% and Cumbria at 95%. This compares to only six counties having more than 60% of their agricultural area under grass in 1945.

The timing of these changes is illustrated more clearly by the intermediate maps 1b to 1f for 1955 to 1985. This shows that the greatest changes in grass area in the East occurred between 1955 and 1965, with little change after 1975. The greatest changes in the West occurred between 1975 and 1980.

Focusing on all grassland together masks the relative importance of sown grassland and rough grazing. Maps 2a to 2d reveal how the pattern of sown grassland evolved between 1945 and 1990. As with all grassland, the overall trend of a fall in the East and a rise in the West, with most of the change occurring by 1980, is present. However, there are some exceptions which include the greater area of grass in Surrey, East and West Sussex, rising from 32%, 42% and 36% of their area under sown grass in 1945 to 65%, 61% and 49% respectively by 1990.

More significantly, the area of rough grazing has declined. This decline was most dramatic in Northern counties. For example, falling from 46% to 38% in Northumberland, from 36% to 28% in Cumbria and from 22% to 15% in West Yorkshire. Therefore, although the area of grass has increased in many of these counties, due to a fall in arable area, in addition there has been a considerable reclamation of rough grazing.

Location and Movement of Cattle

The number of breeding cows (dairy and beef) in England fell from 3 million in 1945 to 2.7 million in 1990. The greatest decline was in Cambridgeshire and Essex where numbers in 1990 were only 35% of their level in 1945. In Bedford, Berkshire, Hertfordshire, Lincolnshire, Suffolk and parts of Yorkshire, numbers fell to between 40% and 60% of their 1945 level. However, some counties did experience a rise in cow numbers. The greatest increases, to between 150% and 200% of the 1945 level, were in Devon, Cumbria, Cornwall, Dorset, and more surprisingly, Northumberland. The period of greatest change was between 1975 and 1980. Unfortunately, census data do not distinguish between dairy and beef cows at the county level prior to 1975. Thus it is not possible to map changes in the location of dairy and beef cows separately. However, in England and Wales, dairy cows as a proportion of total breeding cows were fairly constant; 83% from 1955 to 1965 falling to 80% in 1970 and 73% by 1975, rising to 78% in 1980 and 1985, and falling back to 73% again in 1990.

The number of cows per hectare has risen slightly, as illustrated in maps 3a to 3f³. In 1945 only Cheshire had over one cow per hectare with three other counties having over 0.5 cows per hectare. This compares to a similar stocking rate of one in Cheshire in 1990, and over 0.5 per hectare in six other counties. The stocking level did increase in 1975 since when it has fallen. The concentration of cows by county reflects the underlying distribution of grassland, with the lowest density in Eastern counties (with the exception of the counties such as Surrey and Sussex, both of which had relatively large areas of grass) and higher concentrations in Northern and Western counties.

Changes in the location of cattle aged over one year from 1945 to 1990, gives an indication of the counties used for fattening cattle. This is illustrated in maps 4a and 4b and shows that the highest concentration in 1945 were found in the East Midlands, Shropshire and Cornwall. By 1990 the distribution had changed, particularly in Nottinghamshire, Northamptonshire, and Northumberland which went from relatively

³To illustrate changes in livestock location and movement, data on livestock were converted to density per hectare of agricultural land. On the maps, for ease of comparison between years, the same scale has been used unless stated otherwise.

high density in 1945 to low density in 1990. Other falls occurred in the arable counties of the East. The highest concentrations in 1990 were in the South Western Counties with increases in Dorset, Cornwall, Devon, Cumbria and Staffordshire.

A significant change from 1945 to 1990 was the drop in cattle (excluding breeding cows) over the age of two to 40% of their level in 1945. This is not surprising as it reflects the change in production systems over the period with the development of cereal based systems and 18 month grass based beef production. The most significant fall in this type of cattle was found in the North East, East Anglia, and Bedfordshire and Kent. The only counties with numbers of cattle over 2 years remotely similar to that in 1945 were Cornwall, Devon, Dorset and Wiltshire.

The number of cattle aged between one and two years rose by 26% from 1945 to 1990. The largest increase was in Dorset with a two and a half times increase. Other counties with growth of over 70% included Cornwall, Cumbria, Staffordshire, and Surrey. The largest falls in number were in East Anglia and surrounding counties, to between one half and two thirds of their level in 1945.

The number of cattle under one year increased by 60% from 1945 to 1990. The number more than tripled in Dorset, and more than doubled in Cornwall, Cumbria, Devon, Greater London, Northumberland, Somerset, Surrey, West Sussex, Wiltshire and parts of Yorkshire. These increases reflect the development of feeding techniques enabling the fattening of calves from the dairy herd. The only counties with a reduction in number of cattle under one year old were Cambridgeshire and Lincolnshire.

Location and Movement of Sheep

The number of ewes more than doubled in England between 1945 and 1990. The distribution of this change across counties was uneven. Although, with the exception of Suffolk, all counties experienced increased ewe numbers, the most dramatic gains were an eight fold increase in Lincolnshire, almost a six fold increase in Cheshire, between a four and five fold increase in Staffordshire, East and West Sussex, and Derbyshire, and over a three fold increase in Gloucestershire, Leicestershire, Oxfordshire, Bedfordshire and Buckinghamshire.

Maps 5a to 5g express ewe numbers in terms of head per hectare of agricultural land, converting total numbers to a measure of density. Map 5a shows that in 1945 only two English counties, Northumberland and Cumbria had a concentration greater than one breeding ewes per hectare with Wales having 1.3 ewes per hectare. The lowest

concentrations of sheep were in the counties of East Anglia, Cheshire, and Surrey with under 0.1 ewe per hectare⁴.

Some increase in ewe numbers occurred by 1955 with further rises from 1955 to 1965 apart from the North. However, numbers in some midland counties fell back again in 1975. The greatest change in ewe numbers took place between 1975 and 1980, with a rise in stocking particularly in the South, followed by a further increase from 1985 to 1990.

Cheshire, Surrey and East Anglia still had lowest concentration of ewes in 1990, but all had risen to above 0.1 ewes per hectare. Counties with the highest concentration of ewes were those with large areas of hill land such as Cumbria and Northumberland, although it is interesting to note that in both 1945 and 1990 Kent and Hereford and Worcester had relatively high concentrations of ewes.

The number of lambs increased nationally by 2.68 times over the period 1945 to 1990. The change in number of lambs by county generally reflects the increase in the ewe numbers, although increased lambing rates also play a part, particularly for counties such as Berkshire, Cumbria, Derbyshire, Dorset, Durham, Hampshire, Northumberland, West and East Sussex where the increase in lambs was greater than that for ewes. However, unlike cows and calves, the distribution of lambs under one year is little different to that of breeding ewes. The highest concentrations of lambs were in the upland counties, plus Hereford and Worcester, generally matching the distribution of ewes. The fact that there are no major differences between the location of ewes and lambs suggests little change in the movement of store lambs between counties. By June, when the census is taken, most store lambs have been sold for fattening. Thus it should be possible to determine differences in location of lambs and ewes which would indicate the extent to which stock is moved away for fattening. Of course, movement within counties can not be revealed using the census data at this level.

Livestock Density

The change in all livestock is summarised by livestock units (LU) per hectare of agricultural land, illustrated by maps 6a to 6d. This shows the fall in LU per hectare in the East and the rise in the LU in the West, most of the changes having occurred by 1980. In 1945, Cambridgeshire had the lowest LU per hectare at 0.3 with six other counties having between 0.3 and 0.4 LU per hectare. By 1990, Cambridgeshire still the lowest LU

⁴In the case of Cheshire and Surrey this reflects the high proportion of breeding cows in these counties.

per hectare but it had fallen to under 0.1 LU per hectare, followed by Essex, Suffolk, and Lincolnshire with between 0.17 and 0.19 LU per hectare, then by nine other counties with between 0.2 and 0.4 LU per hectare. On the other hand, in 1945 only Cheshire had over 1.0 LU per hectare whereas by 1990 12 counties achieved this density.

The relative distribution of LU changed little from 1945 to 1990 with East Anglia tending to have the lowest intensity (apart from isolated dense concentrations in East Sussex and Surrey) and Western counties the highest. Interestingly the LU per hectare in Norfolk and Humberside rose in 1980 but then fell again by 1985. Some change in ranking of counties by LU has occurred between 1945 and 1990 with, for example, counties in the Midlands becoming relatively less important.

Livestock units per adjusted grass hectare, as an indicator of intensity of grass use, is illustrated in maps 7a to 7d. There have been some major changes in the ranking for counties from 1945 to 1990, for example the relative fall in LU per adjusted hectares in a band across the middle of England, particularly in Cambridgeshire and Surrey, and the rise in Dorset which had the lowest LU per hectare in 1945 but one of the highest in 1990. Most of this change occurred between 1945 and 1980. There has been a tendency for stocking rates to increase in the West and fall in the South East. The metropolitan counties tend to have low stocking rates which may reflect the use of other stock in these areas, such as horses for recreation.

Hill Livestock

Census data are supplemented by various other sources. With respect to livestock location and movement, statistics on the number of claimants for the Hill Livestock Compensatory Amount (HLCA) is most relevant. This provides information on numbers of breeding cows and ewes in the Less Favoured Area (LFA) of England since 1980. Unfortunately, due to the manner in which the data are collected, only limited inferences can be drawn.

An analysis of the data on LU per hectare in 1980, 1985 and 1990 shows that, unlike the census data, there has not been an overall increase in stocking rate from 0.345 in 1980 to 0.354 in 1990. On the disadvantaged area, an area on the periphery of the existing boundary designated in 1984, the stocking rate has increased from 0.115 in 1985 to 0.170 in 1990. Changes varied between counties with the South West experiencing a fall in stocking, whereas increases were found in Yorkshire, Derbyshire, Staffordshire, Cheshire, Shropshire, and Hereford and Worcester.

Summary

There have been considerable changes in the location and movement of livestock over the post war period. There has been an increase in concentration of production in the West with a reduction in the East. This is particularly true in the case of dairy cows and beef production. So, whilst the total number of dairy cows has declined, reflecting the rise in milk production per cow, they have declined by a greater amount in the East. In the case of cattle over one year of age, there has been a major change in location away from the East Midlands, and to a lesser extent East Anglia, to the dairy producing regions. This is due to change in technology enabling dairy calves to be reared for beef, and the reduction in importance of store for fattening.

(iii) The environmental effects of recent changes in the movement and location of livestock in England

Introduction

Although few of the wildlife habitats associated with agricultural land use can be described as natural, many managed covers do support native flora and fauna within a similar structure to natural conditions. Prime examples include, in the uplands, heather moorland and blanket mires, and, in the lowlands, heathland and grazing marshes. Changes in agricultural management and technology during the post-war period have led to loss of plant species diversity, shifts in vegetation types and fragmentation of habitats in many of these areas. Consequently, remaining semi-natural plant communities form an important part of the national nature conservation and landscape resource and are considered to be priority targets for protection and expansion (NCC 1990; Cook and Moorby 1993). Agricultural land use changes affecting these areas may be considered under three inter-related headings.

Agricultural Cover Types

Following the census definitions, agricultural cover types may be split broadly into arable, sown grassland and rough grazing. Of these, arable is the most productive in an agricultural sense but also the least valuable as a wildlife habitat since it is essentially an intensively managed monoculture. Consequently, except possibly around field margins and boundaries, there is little scope for native flora to become established. By contrast, grassland and rough grazing swards are typically managed at low intensity and support a mix of vegetation types.

During the post war period, agricultural intensification has caused areas of rough grazing to be improved to permanent pasture and existing permanent pasture converted to leys and arable crops (as outlined in the previous section). Furthermore, on-farm specialisation has led to the demise of mixed farming and reductions in the complexity of cover mosaics, particularly in lowland areas. This change in the mix and location of agricultural cover types has led to the destruction of semi-natural habitats in many areas (NCC 1990). Moreover, since much of the intensification has been achieved through drainage and ploughing up of land, it is to some extent irreversible. This perhaps underlines the importance of protecting remaining semi-natural areas.

Grazing Pressure

Although much habitat loss is attributable to wholesale removal of permanent pasture and rough grazing, more subtle, within cover type changes have also occurred. Agricultural grassland and rough grazing are generic terms that mask considerable ecological heterogeneity, as indicated by the large number of NVC classes that they encompass (Wyatt *et al* 1993). Consequently there is considerable scope for management practices to influence the vegetation mix present. One significant factor is grazing pressure.

Both the direction and rate of succession between vegetation types can be influenced by grazing management (Rawes & Hobbs 1979; Gibson *et al* 1987). Perhaps the most obvious example is (ecological) overgrazing. This can lead to loss of species diversity, especially tall grasses and herbs, which in turn affects many invertebrate, amphibian, reptile, bird and mammal populations. Taking birds as a high profile example, species such as chough, corncrake, curlew and lapwing rely on low intensity semi-natural cover for nesting and feeding sites, (NCC 1990; Green 1988). Increased stocking rates on shrubby heaths can adversely affect species such as heather, leading to a rough pasture cover type. High stocking rates on improved pasture can lead to dominance of tolerant species such as italian ryegrass and, in some cases, poaching and soil degradation. The increase in stocking rates in many areas, particularly Northern and Western counties, during the post war period indicates that overgrazing may be a common problem.

At the other extreme, under grazing can also cause habitat change (Gordon & Duncan 1988; Steven and Biron 1993). Many semi-natural communities represent a vegetation cover maintained by low level grazing that prevents development of a climax community. If grazing pressure is reduced or removed below historical levels, grassland may be invaded by, for example, tall grasses, herbs, scrub and trees. Improved pastures (e.g. ryegrass) can degrade relatively rapidly to rough pastures (e.g. bent-fescue with rushes).

However, vestiges of drainage and altered soil nutrient status may delay degradation to grassy heaths (e.g. mat-grass, purple-moor grass) and then to shrubby heaths (e.g. heather) quite considerably (Ball *et al* 1982). In the absence of burning undertaken as part of moor management, shrubby heaths may in turn revert to woodland (Grant & Armstrong 1993).

Stocking rates leading to over and under grazing are difficult to specify. To some extent, the susceptibility of a habitat to change depends on the existing species mix and site conditions, such as soils and climate, and proximity to other vegetation types (Gray *et al* 1987). Livestock grazing pressure also needs to be viewed in the context of wild grazing (eg. deer, rabbits) and public access and tourism (Williams *et al* 1974; Coulson *et al*, 1992). The situation is complicated further by the fact that neither grazing pressure nor susceptibility to grazing are uniform throughout the year: livestock numbers fluctuate and vegetation passes through lifecycles. This may mean that livestock have to be kept off (or on) the land at specific times of year to achieve the desired ecological effect. Moreover, different livestock exhibit different grazing habits. For example, sheep tend to graze very selectively and, unless shepherded well, promote different vegetation types to those that would develop under similar cattle stocking rates (Ellett 1984)

Chemical Inputs

Another aspect of management that has altered significantly in the post war period is the use of chemical inputs. In particular, the use of inorganic nitrogen fertilisers on permanent pasture has increased, on average, from approximately 4 kg/ha in 1945 to approximately 118 kg/ha in 1990. There is also some evidence that small areas of rough grazing are now receiving low nitrogen inputs (Spedding 1983; Survey of Fertiliser Practice 1990). This has a direct effect on sward species and can permanently alter vegetation types, even if nitrogen inputs later cease (Lee *et al* 1983). The problem is exacerbated by the fact that approximately 90% of nutrient intake is recycled by livestock and, since nutrients are removed (approximately) uniformly from a field but returned at discrete points, localised 'hot spots' can develop where only certain species will survive. The problem can be particularly acute around sites of supplementary feeding.

Pesticides are another important chemical input that is generally regarded as ecologically harmful, affecting flora and fauna both directly and indirectly through the food chain and habitat change. Although less than 10% of permanent pasture and less than 1% of rough grazing are sprayed (Davis *et al* 1989), this is in addition to extensive spraying of arable crops and leys, and cumulative impacts on invertebrate and larger animals may be

significant. Moreover, certain pesticides, for example gamma-HCH, applied to grassland are considered to be particularly potent (Ivens 1991).

In addition to influencing species composition on-site, chemical usage (including sheep dip) may contribute also to off-site environmental damage through water pollution. The susceptibility of chemicals to surface runoff and leaching is dependent upon site characteristics (such as soil, topography and rainfall patterns), the chemical used, and management practices, particularly dates and rates of application (Russel and Shogren 1993). Pollution can also arise through organic inputs, notably manure and slurry. Indeed, slurry from intensive cattle enterprises is a major concern of the National Rivers Authority.

Directing Land Use

The diverse nature of semi-natural habitats and geographical variation in ecological conditions and conservation targets makes generalisations about appropriate land use difficult. Nevertheless, it is apparent that the general reduction in lowland permanent pasture and upland rough grazing, together with altered livestock pressure, has led to habitat losses in many areas. Protecting remaining habitats and reversing some losses will require changes in agricultural cover types and judicious use of livestock (Gordon & Duncan 1988). Supplementary management such as heather burning and control of water levels may also be necessary (Coulson *et al* 1992; Burgess *et al* 1990). Although core habitats can be protected through, for example, SSSIs, wider protection and expansion will require a general shift in land use (NCC 1990). Designing policy measures to achieve desired changes in land use will entail understanding of the factors that have shaped agricultural land use historically and the opportunities and constraints likely to be encountered in the future.

(iv) Causes of changes in the movement and location of livestock in England

Introduction

The location of livestock production is influenced by numerous factors including market conditions and agricultural policy. Due to the level and type of government intervention in the main agricultural sectors, market conditions have been determined primarily by public policy rather than market forces⁵. Thus much of the historical change described in section (ii) is attributable to the policy environment within which farmers' operated during the post-war period. However, policy changes were accompanied by significant technological advances that, in many cases, enhanced the responsiveness of agriculture to incentives. Indeed policy reforms were (and continue to be) often shaped by continuing technical change leading to spiralling budgetary costs and pressure for structural change.

Post war agricultural policy up to entry into the EC

Post-war agricultural policy in the UK prior to entry into the European Community (EC), and the introduction of the Common Agricultural Policy (CAP), can be divided into three phases. The first of these was from the end of the war to the mid 1950's and was characterised by continuing controls on agricultural markets with the emphasis on the expansion of production; the second phase was from the mid 1950's to 1960 and saw a gradual switch from unlimited guarantees of market support to capital grants and subsidies, mainly in response to gluts appearing on world markets; and the third phase was from 1960 to 1973 which, in response to growing levels of production and rising support costs, saw the introduction of structural policy and a movement away from free trade towards import quotas and the system in operation under the CAP.

Agricultural policy 1945 - mid 1950's

Post war agricultural policy was embodied in the 1947 Agricultural Act which emphasised the government's commitment to supporting farmers. This was implemented through guaranteeing markets and prices. In addition, farmers were encouraged to intensify production through capital grants and subsidies for drainage, fertiliser, and for conversion from grass to arable land. The target was to increase production by 20% from 1945 to 1952, but was raised to 60% in 1952 (with exception of milk and pigmeat). Farmers in the hills and uplands were given subsidies on their breeding stock and grants

⁵ Exceptions to this include the change in demand for leaner carcasses which may partially explain the reduction in beef cattle over two years of age.

for improvement to their land under the Hill Farming Act 1946 and Livestock Rearing Act 1951. Every encouragement was thus given to increase production and in particular to expand cereal production and switch from pasture farming to arable.

Agricultural Policy 1954 - 1960

In 1954 government controls on agricultural markets and rationing were removed and replaced largely by a free market. However, to protect producers' incomes, deficiency payments calculated as the difference between an annually fixed guaranteed price and the average market price were re-introduced and the marketing boards were reconvened. The Milk Marketing Board (MMB) was the most powerful with a monopoly on the liquid milk market and raising returns to producers by fixing liquid milk prices. More selective expansion was also sought through capital grants, with the emphasis on cereal intensification accounting for the decline of grassland in Eastern counties.

Agricultural Policy 1960 - 1973

The late 1950s saw surpluses appearing on world markets. Consequently the UK, as one of the few importing countries with little or no restriction on imports, soon found prices falling on domestic markets and the cost of support rising. This led to political concern over the public exchequer cost of open ended support offered by the deficiency payments system, and ultimately paved the way for a fundamental shift in agricultural policy. Although support for hill farmers was widened under the Hill Land Improvement Scheme of 1967, in general structural policy was targeted at rationalising the industry through measures such as the farm amalgamation scheme. Perhaps most significantly, import quotas were also introduced. This latter measure switched the burden of support from taxpayers to consumers and moved UK policy towards the CAP.

The Common Agricultural Policy

The basis of the CAP was agreed in 1962 on the three policy cornerstones of; community preference; common prices; and financial solidarity. The first regimes were established in 1962 and included cereals and pigmeat, with regimes for beef and dairy being established the following year.

CAP Cereal Regime

The CAP was and still is based upon price support, with the cereal regime effectively forming the blueprint for other sectors. The policy involved the setting each year of institutional support prices, a target price, (the ideal price for producers); an intervention price, (the price at which supplies will be removed from the market); and a threshold price, (the price at which imports are allowed in the EC) usually set between the target and intervention price and maintained by import levies.

The community set these institutional or support prices relatively high compared to prices in the rest of the world, thereby encouraging rapid expansion of domestic production. This process was aided by continuing technological advances in, for example, new varieties and chemical inputs.

CAP Dairy regime

The dairy regime was similar to that for cereals with an intervention price and restrictions on imports. However in the dairy sector production expanded rapidly and the EC was soon self-sufficient in milk products and faced the problem of subsidising exports onto the world market. It is this which led to the dairy sector being the most costly regime under the CAP.

Various schemes were introduced in the 1970's to try to reduce production. These included subsidies to convert to beef and coresponsibility levies, but it was the introduction of milk quotas in 1984 which had the most profound effect. In the UK the quota meant production had to fall by around 9% of the previous years level. Apart from the first year, production in the UK has tended to be above quota. This has led to further reductions in quota, for example by 1% in 1985/6, 2% the following year and 1% the year after that.

The impact of the introduction of milk quota on livestock production was profound with a large increase in the slaughter of dairy cows, up by 17% in 1984, as well as a larger number of heifers being slaughtered. Beef production peaked in 1984 and 1985, fell back in 1986, but rose again in 1987 as quotas were cut again. However in 1988 and 1989 cattle prices rose as the number of dairy cows stabilised and beef cows rose in number by 9% in 1989, the first time since they had been in decline since 1975. Much of this rise was in the lowland traditionally used for dairy production and represented a change with dairy farmers diversifying into beef rearing.

CAP Sheepmeat regime

The sheepmeat regime, introduced in 1980, was one of the last to be implemented under the CAP. The regime is based upon the fixing of an annual support price, the Basic Price. Although the over supply problems of other regimes did not appear in the sheep sector, budgetary pressure led to the imposition of a Budgetary Stabiliser in 1987. This effectively reduces the support price: in 1993 the proposed reduction is 7%.

Up to the end of 1991, two separate systems were operated to maintain the market price. The first of these, which operated in all member states with the exception of Great Britain, was the intervention system. The alternative operated in Great Britain was the variable premium scheme, similar to the deficiency payment scheme operating in Great Britain prior to the establishment of the common sheepmeat regime. To prevent the undermining of the market in other member states operating the intervention scheme, intra-EC exports from Great Britain were subject to a 'clawback', that is an intra-EC export tax. In addition to these market support systems, an annual ewe premium, calculated as the difference between the representative market price and basic price, was paid to producers to compensate for any loss in income caused by the establishment of the sheepmeat regime. In 1992, the variable premium system was phased out and the ewe premium is now the main support mechanism for sheep. This change represents a reduction in support to Great Britain, which had previously been the main beneficiary of the sheepmeat regime.

CAP Beef regime

The beef regime is also based upon an intervention system supported by import levies and export refunds. When, in 1973, there was a shortage on world markets, intervention prices were set high to encourage expansion of the beef sector. However, although world prices soon fell, the EC maintained institutional prices well above world price levels (for example, from 1974-77 prices rose by an average of 15% per year), thereby supporting continued expansion of the beef sector. As EC self-sufficiency rose, the cost of the regime increased and pressure for reform mounted. These pressures became most acute after dairy quotas were introduced and the supply of beef rose as dairy cows were culled and dairy replacements switched to the beef herd. Some changes were introduced in 1986 to redress the imbalance but these were not effective. Subsequent changes in 1989 were more fundamental, attempting to restore the original function of the intervention system.

Under the 1989 reforms, the intervention price no longer forms the floor price to the market but is used in conjunction with market prices to trigger intervention. For sales to intervention, sellers must tender and fix buying-in prices and quantity under certain restrictive conditions such as a minimum quantity of 10 tonnes and payment of security. Up to June 1991 there was also a 220,000 tonne ceiling on intervention, although there was a safety net to prevent a downward spiral of prices. These factors make intervention much more restrictive: few farmers can meet the conditions, and most selling to intervention is by middle men and marketing agencies.

Compensation for these changes was offered to producers through a number of other schemes such as subsidies for private storage, and premia for beef animals and suckler cows. The special beef premium scheme came into operation in 1989 in the UK and is a flat-rate payment per animal which was, until the current reforms, a payment once in its lifetime of 40 ECU. The suckler cow premia was introduced in 1980/1 as support for beef producers without aiding dairy producers. In 1992, the higher rate for Less Favoured Areas (LFA) was £59.64, and the lower rate for elsewhere was £55.38.

Hill Livestock Compensatory Allowances

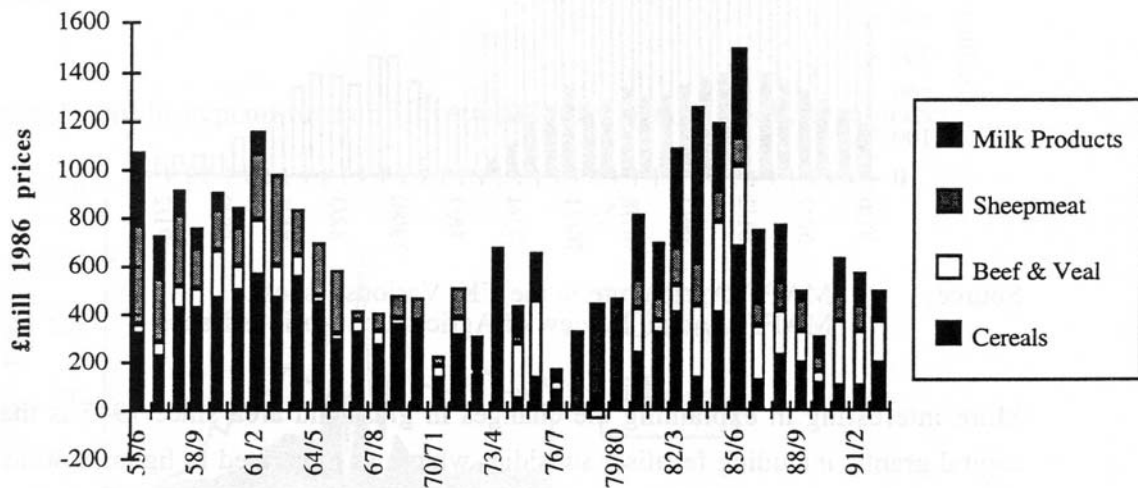
Over most of the post war period suckler cows and ewes in the LFA of Britain have been eligible for headage payments; now called Hill Livestock Compensatory Allowances (HLCA). These are an annual payment varying, since 1984, with the type of LFA. The maximum allowance in the severely disadvantaged LFA (SDA) was £8.75 per hardy breed ewe, and £2.45 per ewe in the Disadvantaged LFA (DA), up to a maximum of six ewes per hectare in the SDA and nine ewes per hectare in the DA. This was reduced in 1992 to £6.50 in the SDA and raised to £2.86 in the DA. The payments for cows is £63.3 in the SDA and £31.65 in the DA area, up to a maximum of £62.48 per hectare in the SDA and £46.86 in the DA. A maximum stocking rate of 1.4 LU per hectare and a financial limit of £81.13 per hectare in SDA and £60.85 in DA exists.

Public exchequer support cost

The relative importance of policy changes is reflected partially in their cost which is described below. The cost of market support schemes as shown in figure 2 would be expected therefore to reveal the relative changes in support by sector. However, it must be remembered that since the 1960's, and in particular after 1973, the cost of policy fell more on consumers in the form of higher market prices due to restrictions on trade and therefore the degree of support will not be reflected in these data. In addition the fluctuations in cost reflect the dependence on price as a mechanism for support: years

with relatively low world market prices show high support costs. These factors reduce the usefulness of these data in explaining changes in livestock location and movement and as such should be used cautiously.

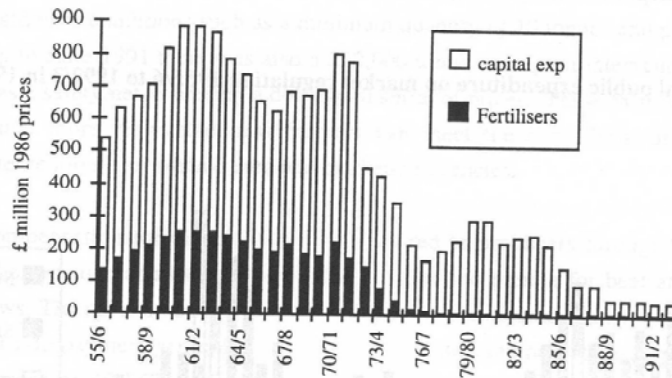
Figure 2: Total public expenditure on market regulation 1955/6 to 1992/3 in 1986 prices



Source: MAFF: Agriculture in the UK. Various Issues
MAFF: Annual Review of Agriculture. Various issues

The cost of policies rose during the late 1950's and early 1960's but fell as import restrictions became a more widely used policy tool. The cost began to rise again during the 1980's, peaking in 1985 as the cost of exporting surpluses rose. The fall in the cost of policies since then is due largely to the introduction of milk quotas but also to rises in cereal prices on world markets and restrictions in intervention buying for beef.

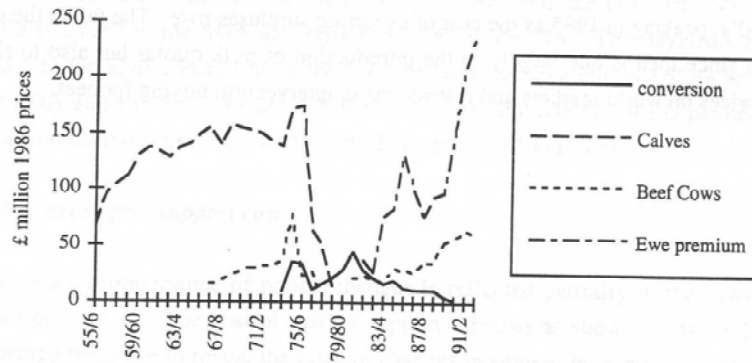
Figure 3: Public expenditure on capital grants including fertiliser subsidies 1986 prices



Source: MAFF: Agriculture in the UK. Various Issues
MAFF: Annual Review of Agriculture. Various issues

More interesting in explaining the changes in grassland area since 1945 is the rise capital grants, including fertiliser subsidies which, as illustrated in figure 3, were at the highest level during the 1950's and 1960's. As stated earlier, these included grants for drainage and grass conversion and were a major reason behind the reduction in grass area in the East of the country as well as the intensification of grass use in the West.

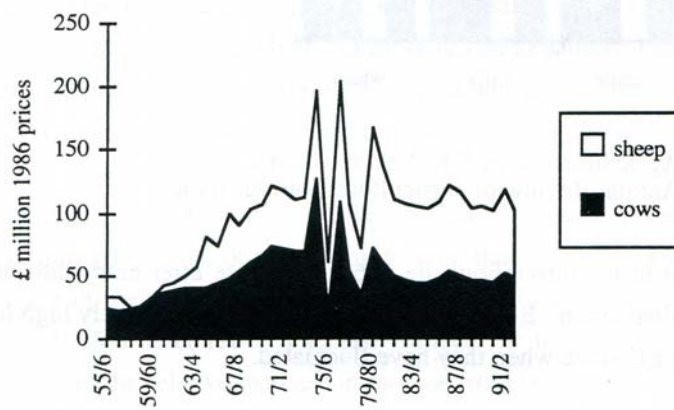
Figure 4: Public expenditure on subsidies for livestock



Source: MAFF: Agriculture in the UK. Various Issues
MAFF: Annual Review of Agriculture. Various issues

Figure 4 shows the cost of other schemes supporting livestock in general. The high cost item was the calf subsidy, in operation up to the adoption of the CAP beef regime. The main cost item since then is the ewe premium which, as expected, has risen considerably since 1990 when it became the main support mechanism for the sheep sector. Finally the cost of the hill subsidy to cows and ewes is illustrated in figure 5 which shows a rise from 1960 to the mid 1970's since when it has stabilised, in real terms. The fluctuations in the mid 1970's were caused largely by transitional problems between the pre and post CAP systems.

Figure 5: Public expenditure on Hill subsidies by type of stock, 1986 prices

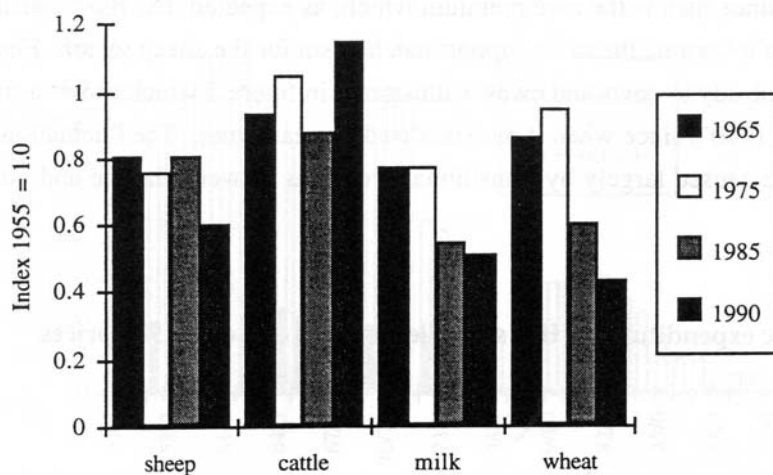


Source: MAFF: Agriculture in the UK. Various Issues
 MAFF: Annual Review of Agriculture. Various issues

Agricultural Prices and Incomes

Some indication of the incentives behind the changes in livestock and location can be assessed by examining changes in prices. These are summarised for selected years in figure 6 and show the prices of the main products, including wheat for reference, in relation to their 1955 level. In the case of sheep the price fell from 1955 to 1973, then rose slightly, and has fluctuated since.

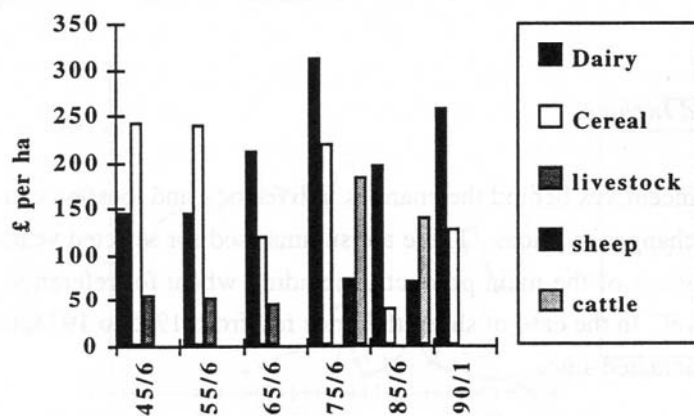
Figure 6: Relative real prices of main agricultural products



Source: MAFF: Agriculture in the UK. Various Issues
MAFF: Annual Review of Agriculture. Various issues

Milk returns fell in real terms throughout the 1960's but rose after entry into the EC, since when they have fallen again. Beef prices also fell from their relatively high level in 1955 until entry into the EC since when they have fluctuated.

Figure 7: Real Net Farm Incomes by sector 1945/6 to 1990/1, 1986 prices



NB: From 1975/6 onwards livestock incomes were broken down into cattle and sheep

Source: MAFF: Farm Incomes in the UK. Various issues

More revealing in terms of livestock movement and location is Net Farm Income per hectare across the farm types since 1945/6, illustrated in figure 7. This shows that dairy farm incomes rose in real terms from 1945/6 to a high in 1975/6. They then fell back in 1985/6, to recover in 1990/1. Cereal incomes were similar in real terms in 1945/6 and 1955/6, falling in 1965/6 to recover in 1975/6, before falling to low levels in 1985/6. Livestock incomes were similar for 1945/6, 1955/6 and 1965/6. From 1975/6, income was broken down by type of stock and this shows the relative lower incomes of sheep compared to cattle farms in both 1975/6 and 1985/6.

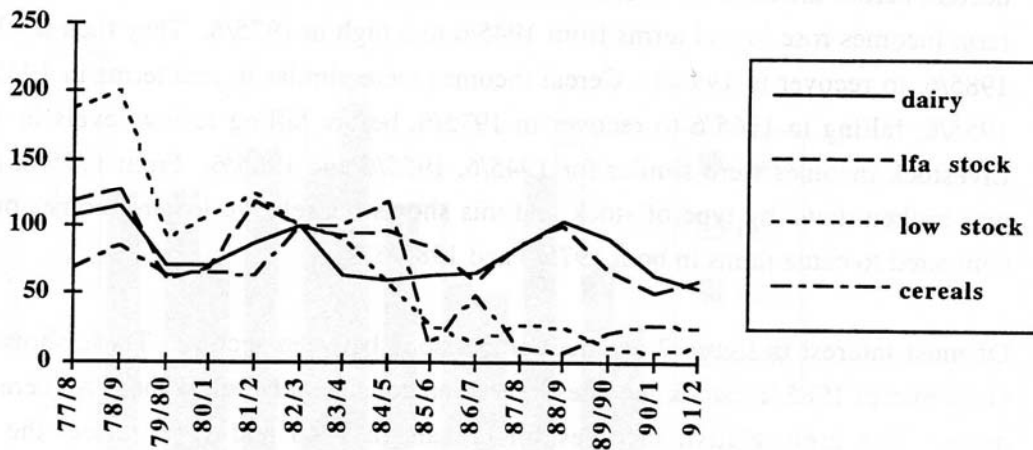
Of most interest in figure 7 are the comparisons between sectors. These show for all years except 1985 livestock incomes have been considerably below those for cereals and dairy. The high relative incomes for cereals in 1945 and 1955 reflect the policy incentives in this period which concentrated on expanding cereal production in particular. However, the main reduction in grass area was not in this period but between 1955 and 1965 with more specialisation of grass production in the west over the next ten years.

In the case of the dairy sector, relative incomes increased the most since 1965 and after entry into the EC. It is interesting to note that, in keeping with the timing of the main increase in the grass area in the West, no significant changes in cow numbers occurred before 1975 or after 1980. This also reflects the increase in beef cow herd at this time in response to the relative increase in income from beef.

The relatively low level of livestock incomes is also reflected by the small rise in ewe numbers from 1945 to 1965. These fell back by 1975, (probably due to the relatively high support for other sectors), but increased rapidly in 1980's largely as a consequence of the introduction of the sheepmeat regime which raised relative incomes in this sector

The more recent changes can be seen in detail in figure 8 which shows the change in real farm income (1982/3 =100). This reveals that dairy and hill livestock farmers have maintained their real incomes compared to the other groups. For dairy farms this was due to the introduction of milk quotas, which allowed support prices to be maintained in real terms without the threat of further surpluses and for hill farmers the existence of HLCA. Incomes of cereal farmers fluctuated over the late 1970's and early 1980's and then declined after 1984/5 to a low of 7% of their 1982/3 level recovering in 1991/2 to 25% of this level. Lowland livestock farmers incomes fell consistently over the period to one tenth of their 1982/3 level.

Figure 8: Real incomes in the UK 1982/3 =100



Source: MAFF: Agriculture in the UK. Various Issues
MAFF: Annual Review of Agriculture. Various issues

Technological change and livestock location and movement

The role of technological change in the evolution of patterns of livestock production across England should not be understated. Improved cereal varieties and chemical inputs have, to some extent, weakened rotational links between arable and livestock activities thereby contributing to on-farm specialisation and the displacement of livestock from Eastern counties. Similarly, new rye grass varieties and improved inorganic fertilisers, together with advanced feeding management (eg. silage), have resulted in widespread change in livestock production permitting for example, the use of calves from the dairy herd for fattening, shorter fattening periods and intensive beef production. Developments in farm machinery have also contributed to specialisation and increased enterprise sizes, a prime example being the herringbone milking parlour. Dominant livestock breeds have also changed, resulting in faster growing animals with better confirmation. To some extent these technical advances were induced by policy reforms, but it is difficult to say whether or not they would have occurred without high support prices and capital grants. Certainly they enhanced the ability of agriculture to respond to policy signals, contributing partially to subsequent policy problems. Continuing technical change, for example in the area of biotechnology, raises interesting possibilities for future livestock production systems.

Phase two

Constraints and opportunities

(i) Existing and potential constraints in the location and movement of livestock in England

Introduction

The main driving force behind current reform of the CAP is the rising cost of market support through export refunds. Prior to the imposition of milk quotas, the support of the dairy sector was the most expensive but cereals are currently the most costly, followed by dairy and then beef. Pressure for reform is also being exerted on policy makers via concerns over GATT, declining relative farm incomes, and falling rural populations. Environmental issues, such as nitrate pollution, loss in biological diversity and landscape quality, are also increasingly prominent.

Current CAP Reform

The reform package agreed in 1992, the so-called MacSharry proposals, marks a major shift in policy. Attention has focused on reducing support prices with farmers being compensated by payments based upon historic production patterns. The main sector affected by the reforms is the arable sector, particularly cereals.

Arable

The reform of the cereal regime entails a fall in the support prices closer to world market levels, as illustrated in table 1. Producers are compensated for the fall in cereal prices by arable area payments, given the condition that they set aside 15% of arable land. Small farmers, producing less than 92 tonnes of cereals per year, are exempt from set aside. The compensation farmers will receive is derived from the fixed tonnage payments, as illustrated in table 1, converted to hectare payments on the basis of regional yields. The compensation for set-aside is linked to the price compensation (45 ecu per tonne) for cereals with no transitional period.

Table 1 Support price and compensation payments for cereals (ECU/tonne)

	1992/3	1993/4	1994/5	1995/6
Threshold	200	175	165	155
Target	155	130	120	110
Intervention	140	117	108	100
Compensation		25	35	45

Source: Toepfer (1993)

In the arable sector the introduction of set-aside will obviously reduce production, but by how much? There are many indications that the reduction in output from cereals will be less than the 15% of set-aside for a variety of reasons. Firstly, the number of small arable farmers in the community producing under 92 tonnes, and therefore exempt from set-aside, is considerable. Estimates of the impact of this suggest that more than 90% of holdings, and 40% of the cereal area, is exempt from set-aside (Allanson 1992). So only 9% of the arable area would be set-aside; that is an estimated drop in output of 9.4% in the EC(12). This is important because if the policy does not significantly reduce output it is less likely to be maintained.

In fact these estimates seem high given recent studies which predict a fall in area of only 6.9% or 2.6 million hectares (Agra Europe 1993). The greatest reduction would be in France followed by Spain, then Germany, Italy, the UK and Denmark. Preliminary figures for the UK indicate a fall of over 3 million hectares (MAFF 1993).

Another unknown is the impact of non-rotational set-aside to be introduced in 1993/4. This will apply to 18% of the arable area to allow for the fact that farmers will set-aside their most unproductive land. It is unknown how attractive farmers will find this option.

Although the change in the cereal regime does not affect livestock production directly it will have a number of important indirect effects. Also the success, however measured, of these changes will be used as a model for other sectors. The change in the cereal regime has effectively fixed the area and location of cereal production, thus any incentive to switch back to grass based production, extensify, diversify or otherwise change farming practice has been removed. Lower cereal prices may encourage cereal based feeding of stock, for example intensive beef production, but this will be counteracted by changes to the beef regime outlined below.

Dairy

The milk regime has been left largely untouched, with the quota system to remain in place until the year 2000. The main change is the removal of the Milk Marketing Boards monopoly, the implications of which are discussed later.

Beef

The changes to the beef regime include a 15% reduction in the intervention price over three years. Two-thirds of the price reduction is supposed to reflect the fall in input costs as cereal prices fall and the remaining third is to make beef more competitive. The ceiling on intervention is 750,000 tonnes in 1993 which will fall to 350,000 in 1997, with a new safety net of 60% of the intervention price.

Table 2 Changes to the Beef regime

	1993	1994	1995	1996	1997
Ceiling on intervention (000 tonnes)	750	650	550	400	350
Special Beef Premium (£ per head)	60	75	90	90	90
Suckler Cow Premium * (£ per head)	70	95	120	120	120
Stocking density (lu/hectare)**	3.5	3.0	2.5	2.0	2.0

* National government may pay an additional 25 ecu/head

** The special beef premia and the suckler cow premia are subject to a stocking density which includes other stock on the farm.

Source: Meat and Livestock Commission (1993)

To compensate farmers for these changes, headage payments on beef animals and suckler cows have been increased. The Special Beef Premium is not only raised, as illustrated in table 2, but is to be paid twice in the animals' lifetime, at the ages of 10 and 22 months. The payment is subject to a maximum of 90 animals per holding and a stocking restriction. There are, however, regional reference ceilings based upon claims in 1991, and the level for the UK is expected to be 1,418,000 (940,000 in England). Individual regions can set their own reference herds if they so wish. These changes are to compensate grass based beef systems which do not benefit from lower cereal prices. The two payments for the premia allow also for the encouragement of extensive systems.

The Suckler Cow Premium has also been increased, as illustrated in table 2. Under the reforms to the beef regime, the suckler cow premium is subject to a system of rights with producers' rights for premia limited to the number claimed in 1992, minus three percent for the national reserve. Eligibility can be transferred but a donation of 15% to the national pool must be made if the holding is not transferred. The national reserve is to be distributed to, among others, small producers and new entrants.

The beef and suckler cow premiums will, from 1993, be subject to a maximum stocking density of 3.5 LU per forage hectare falling over four years to 2 LU per forage hectare in 1996. In calculating the stocking density, all animals eligible for premium are included, that is ewes and suckler cows. There is an additional payment of 30 ecu per head if the stocking rate is below 1.4 per hectare. As stocking densities are just calculated using forage area, intensive beef producers lose their right to premia beyond 1992 unless, of course, they have spare forage area.

Sheep

The main impact of the current reform of the sheep sector is the introduction of rights (sometimes referred to as quota) to ewe premia. The full ewe premium is payable on the first 1000 ewes in the LFA and 500 in other areas, with 50% paid on any ewes above this number. A producer therefore claims the right to receive his annual ewe premia up to these maximum.

The first allocation of producer rights for premia under the reforms were based upon their claims for ewe premia in 1991. The second allocation of quota include producers who were in such schemes as the ESA or the pilot extensification scheme in 1991 or who had numbers reduced in 1991 through natural circumstances (among other reasons). The number of right allocations are expected to be 19.5 million head in 1993. Stocking rates do not apply to ewe premia, but ewes are considered in calculating stocking rates for beef premia.

Producers can transfer, or temporarily lease, their rights to ewe premia, when they sell their holding or pass it on to a successor. They can also sell their rights without transferring the holding but must pass some of these rights, up to a maximum of 15%, to the national reserve free of charge. Except under special circumstances rights are not allowed to be removed from LFA areas. Each nation has to create a national reserve of between 1 and 3% of the reference flock. In Great Britain this is 450,000 ewes; 320,000 in the lowland and 130,000 in the LFA. Distribution of this reserve will take place after initial allocations are made.

Implications of the reforms

The main change in the current CAP reform is the movement away from market support to support based upon area or headage payments which, in theory, decouple income support from production levels. As stated earlier, the reforms will tend to freeze current production patterns both through set-aside in the arable sector and through rights to premia for breeding stock in the livestock sector.

The main change to the dairy sector is not really a consequence of the current reform package but rather due to the removal of the Milk Marketing Board monopoly. This means that there will no longer be cross-subsidisation between dairy producers close to market centres and more remote producers with higher transport costs. This is likely to have the effect of increasing profitability of herds close to centres of population or, in the case of manufactured milk products, close to processing plants. This may lead to an increase in the smaller remote farms and an increase in the larger dairy farms with larger herds concentrated in certain areas.

The reform of the beef regime reduces market support both through the reduction in intervention price and also the limit on intervention buying. The compensation for this drop in market support encourages extensive production. The double payment of special beef premia with the second payment at 20 months will encourage farmers to retain stock on the farm instead of marketing them earlier. However the extent to which extensive production actually increases is difficult to predict and depends upon the relative market prices of cereals, beef and its substitutes in relation to the level of subsidy.

The impact of the stocking rate restrictions will be gradual as they are introduced over the next three years. These will further encourage the production of beef from extensive systems which presumably will require less fertiliser. Moreover the stocking limit will discourage intensive beef production as little or no premia will be paid on these animals.

The implications of changes to the sheep regime are the freezing of the breeding herd in numbers and location. However, there are market developments in sheep compared to the other sectors due to the fact that the EC is not self-sufficient in sheepmeat and that Great Britain exports sheepmeat to the rest of the EC. The removal of clawback on sheep exports has had a positive effect on this market.

Other factors affecting the location of livestock

Although policy incentives and constraints will influence livestock production patterns, other factors also need to be considered. In particular, the relocation of livestock as a tool to manage habitats will rely upon farming skills, labour availability, capital, marketing and processing.

The skills required for all types of agricultural production have grown more specialised with arable farmers and workers likely to be more adept at operating and maintaining machinery than managing stock. Such livestock production as currently exists in the arable East tends to be in self contained specialist intensive cereal based units with their own staff having different skills than those required by outdoor units. The possible exception to this is sheep flocks which will again tend to be self-contained units. This reflects growing specialisation in livestock farming, the increase in the scale of operation and labour saving technology.

Thus lack of suitable skills may well be a constraint to the reintroduction of livestock in the East. Whilst this skill can be hired, the economies of scale in production do mean that the size of enterprise needed to support a full-time worker may be larger than required for habitat management. Thus abandoned areas in the lowlands which would benefit from stocking would typically be too small to carry the number of stock necessary to justify the employment of a specialist worker. A possible solution is the use of existing roving flocks owned by landless producers who rent land from farmers. This would also overcome the difficulty of producers raising capital to purchase livestock and, if applicable, quota. However, no data exists on the number of stock farmed in this manner and whether it is increasing or not.

Other problems restricting livestock movement and location the East is the capital required not just to purchase stock but for equipment as well. Costs would include reducing fields which have grown in size over the post war to accommodate new machinery and cut costs of production. Few of these fields are stock proof and many are too large for the easy management of stock. In addition, in some cases there would also be the need for conversion or construction of new farm buildings.

The availability of markets is also a potential constraint. The location of livestock markets in England is illustrated in map 8. This shows that the highest numbers are concentrated in the West. However, with the exception of Cambridgeshire, all counties have at least one market. In any case, due to concentration on fattening livestock, livestock marketing in the East will depend on auction markets less since selling directly

to abattoirs, often under contract agreement, will be prevalent. Thus, whilst there appear to be fewer outlets for livestock produce in the East, this excludes direct sales and therefore may not be a major constraint.

(ii) Existing and potential opportunities for livestock movement and location in England

Introduction

The previous section focused upon the CAP reform and the generally negative effects on the redistribution of livestock in England. However, there are positive elements of the CAP reform. In particular, the introduction of a stocking limit on payment of livestock premia for cattle discussed in phase I section (iv), and measures under the agri-environment programme. Whilst the latter programme is considerably underfunded compared to the other areas, it does represent an important change in policy direction which will affect livestock location and movement.

Agri-Environmental Policy Measures

A range of policy measures has been developed over recent years to provide for the conservation of identified areas, including the designation of Sites of Special Scientific Interest (SSSI), Environmentally Sensitive Areas (ESAs), Countryside Stewardship, tax concessions for the management of "Heritage Landscapes", covenants and public purchase. All except the last of these work through management agreements between landowners and other parties, usually involving some form of reward in return for following prescribed farming practices. The essence of the management agreement as used in this context is that primary producers undertake to modify their production activities in ways beneficial to the environment and are reimbursed for the costs they may incur in so doing. Most of the modifications involved imply a reduction in the intensity of production, including the conversion of arable to grass.

The use of management agreements goes back at least to the 1949 National Parks and Access to the Countryside Act, which introduced them (under Section 16) to regulate the management of nature reserves. Agreements under the 1968 Countryside Act (Section 15) now apply in SSSIs. These arrangements have been reviewed recently by Whitby et al (1990) and Withrington and Jones (1992). A major addition to the list of possible management agreements were the Environmentally Sensitive Areas embodied in Section

18 of the Agriculture Act 1986. ESAs are areas of landscape, conservation and/or archaeological interest within which farmers are offered financial incentives to comply with a package of management practices designed to secure conservation goals. Each ESA has a separate management package; some are comparatively simple specifying only one level of practices to be followed, others are more complex, allowing for two or more "tiers" of incentives for particular practices.

The "first round" of ESAs began in 1987 and, by 1992, they covered some 0.8 million hectares, containing agreements with 6,000 farmers which related to 285,000 hectares in the UK. Participation is voluntary and agreements were taken up rapidly by farmers, which may partly be explained by the comparatively slight constraint they impose on the practices of many participants. Several workers (Colman *et al* 1992, Hodge *et al* 1992) have commented on the limited extent to which ESA management packages have changed the practices of participants in these arrangements; although such comments require the qualification that they should be based on a comparison of the behaviour of farmers *with* agreements and those on similar land but who were outside ESAs and therefore ineligible for agreements. A series of flat rate payments, varying according to tier or severity of environmental constraint, is set individually for each ESA by MAFF.

As ESA only apply to designated areas their impact is limited, but in a number of areas they have been instrumental in maintaining traditional forms of livestock production where it otherwise might have been lost. For example, the prevention of some areas either being abandoned or intensified, either to arable or grass, as in the Brecklands or the South Downs. Some ESAs were renegotiated in 1992, expanding many of the areas and tightening the environmental constraints. In addition, six new ESAs were designated covering 426,000 hectares in total (MAFF 1993), as well as a further six under the agri-environment programme as discussed later.

The most recent addition to policies based upon management agreements is the Countryside Stewardship scheme which offers incentives to enhance, protect and recreate landscapes and wildlife habitats. The scheme is not confined to designated areas, as ESA or SSSI, but it targets landscapes rather than wildlife. The scheme is voluntary, with farmers proposing a management plan to the Countryside Commission in return for fixed payments. The relevant landscape types include lowland heath, chalk and Limestone grassland, historic landscapes, old orchards, waterside and coastal areas, uplands, and old meadows and pastures, all of which require the use of livestock

The current agri-environment package was agreed in general at the same time as the CAP reforms. The package includes an extra payment of 30 ECU per head on Beef Special

Premium claims if their density is below 1.4 LU per forage hectare. Other elements under this package have been left largely in the hands of the individual member states. In the case of the UK, this involved the introduction of seven new environmental measures announced in August 1993 (MAFF 1993):

- The designation of six new ESAs increasing the total ESA area by 300,000 hectares to over a million hectares or 10 per cent of agricultural land. In the newly designated ESAs many agreements include arable conversion schemes as well as polices to reduce intensity of grass use.

- A new Moorland Scheme rewarding farmers for restricting stocking on heather and shrub moorland outside the already protected ESAs.

- a Habitat Scheme to create and improve habitats by taking land out of production for a twenty year period. This includes intertidal habitats, water fringe habitats and the continuing management of habitats created from set-aside scheme. It is also proposed to create lowland heath from arable land if this land can be counted as set-aside.

- a new Organic Aid Scheme

- the introduction of 30 new nitrate sensitive areas under which farmers can obtain reward for a number of options including low nitrogen arable cropping, conversion of arable to grass or conversion of intensive to extensive grass

- and (perhaps of less relevance here) two schemes to improve access on both ESAs and set-aside land.

Most of the agri-environment schemes present opportunities for the relocation of livestock coupled with the existing schemes such as ESAs and Countryside Stewardship (itself now under the agri-environment programme). However, it has yet to be seen how effective these will be. Reports of the monitoring of first round of ESAs generally indicate that the period is too short to discern any major changes. This is not unexpected given that these areas tend to protect the existing pattern of production and methods rather than concentrate on altering practice as perhaps the newer policies will do.

Future Considerations

Agricultural and environmental policy is entering a new phase of development. Although the current CAP reform package is radical in its coverage and movement towards decoupling support from production, there are indications that it is not sustainable either financially or politically. The European Commission itself predicts that costs of support will rise by an extra 40% (Agra Europe 1993) whilst public reaction to set-aside is uncertain. Moreover, policy makers are also conscious of increasing awareness of environmental issues and the possibility of a GATT agreement. The manner in which policies will respond to these pressures is open to debate. However, consideration of existing mechanisms and possible future targets gives scope for speculative suggestions.

In the short term, in order to meet GATT requirements (assuming that the existing EC/US accord is agreed) and to relieve internal budgetary pressure, price reductions and increases in setaside areas seem likely, primarily because they fall within existing policy mechanisms. With respect to livestock, the Commission is already suggesting the introduction of area payments to replace headage payments, although this change is not likely before 1996. Given that the mechanisms for reducing stocking rates are in existence, it would be relatively easy to increase payments for lower stocking rates as under the agri-environment package. Other constraints could be placed upon headage payments such as a minimum stocking rate to prevent under stocking or abandonment in some areas. This would overcome a potential problem where farmers include all their fodder area in claiming for subsidies to obtain the maximum amount, but only stock the more productive areas, leading to some areas being abandoned and others being overstocked. Introducing minimum stocking rates would ensure areas not currently farmed or areas under threat of being abandoned would be stocked.

In the longer term, opportunities for tying environmental compliance to agricultural support payments seem ripe for exploitation, not least as a way of deflecting public criticism of paying farmers for doing nothing (setaside). Indeed, the recent change in definition of overgrazing in HLCA regulations from being based upon the condition of the ewes to being based upon the condition of the sward is a move in this direction. Furthermore, the Commission has stated that setaside should be linked to environmental criteria. If policy makers adopt this principle of cross-compliance, it may lead to wider acceptance of the notion of paying farmers to produce public (ie. environmental) goods rather than food. Consequently, policy could develop in any number of directions, as reviewed in a number of publications such as Whitby *et al* (1990), and Colman (1991).

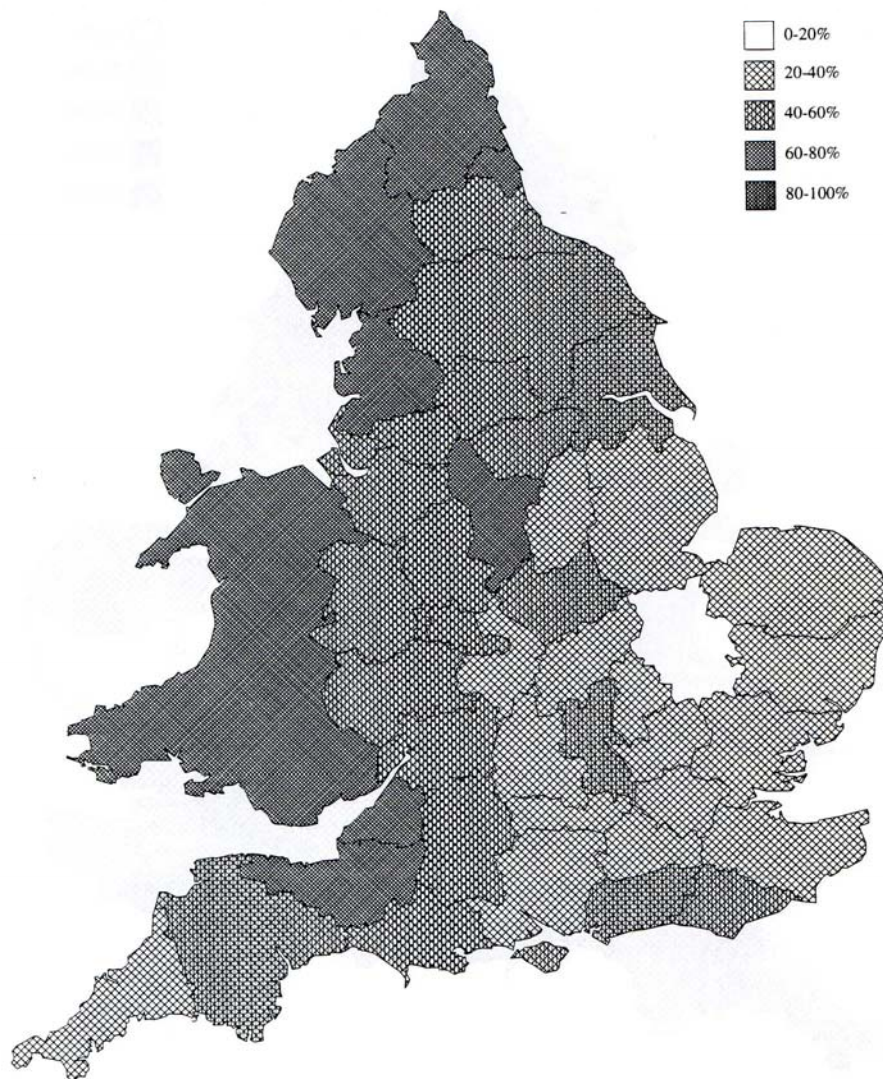
At present, cross-compliance mechanisms concentrate upon voluntary and compulsory management agreements which modify property rights with compensation. However, there is ample scope for modifying such arrangements by, for example, varying the level of compensation and degree of compulsion. It is interesting to note that work at Newcastle (as yet unpublished) suggests that individually negotiated management agreements under section 15 of the Wildlife and Countryside Act 1981 have tended to result in lower cost per hectare protected in SSSIs than the flat-rate payments in ESAs due to the ability to negotiate with farmers at an informal level. This is despite the fact that a few management agreements under section 15 are relatively costly in terms of compensation for producers. This has important messages for the use of advice and consultation as a mechanism for securing conservation benefits with producers frequently willing to cooperate for no or nominal returns. Elaborating along the line of management agreements, a flexible package offering a menu of items with appropriate rewards from which the most relevant could be selected could be useful. Such a package might include a base level prescription, similar to tier one in the ESAs, to which all producers comply.

A more radical option is to drop the cross-compliance element of agricultural support, switching completely from production based support to support solely through management agreements. This has been rejected previously on a number of grounds, including cost. However a study at Newcastle found that, with current levels of public expenditure on agriculture in the UK, there were sufficient funds to reward farmers for farming in a more environmentally friendly manner and still maintain farm incomes, even at world market prices (Cain *et al* 1991). Another radical solution would be for policy to develop along a more regulatory line, extending planning controls and regulations into agriculture. Such a move would mark a break from the traditional principle of incentive based mechanisms but could be construed as offering a more positive approach to the provision of public goods.

MAP 1a

1945

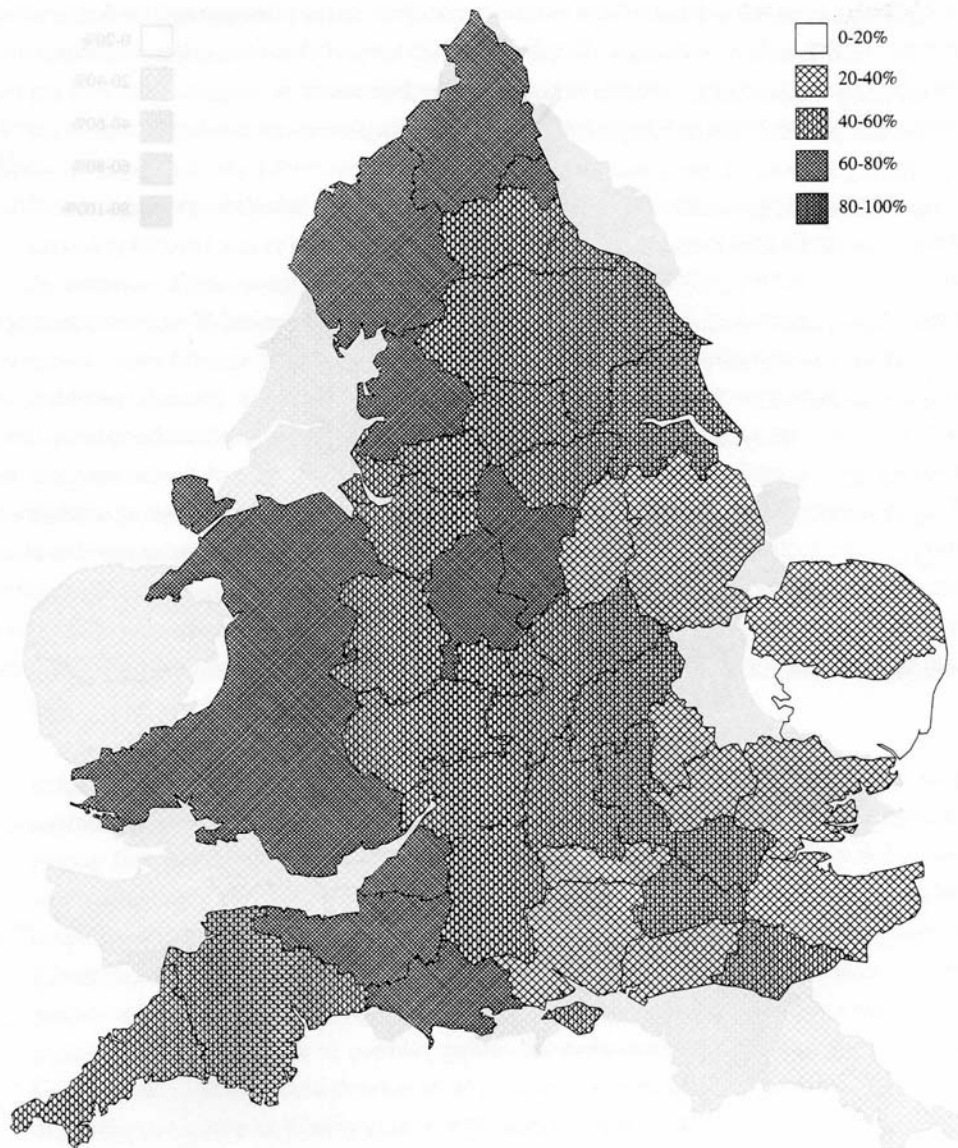
GRASSLAND AS PERCENTAGE OF AGRICULTURAL LAND COVER



MAP 1b

1955

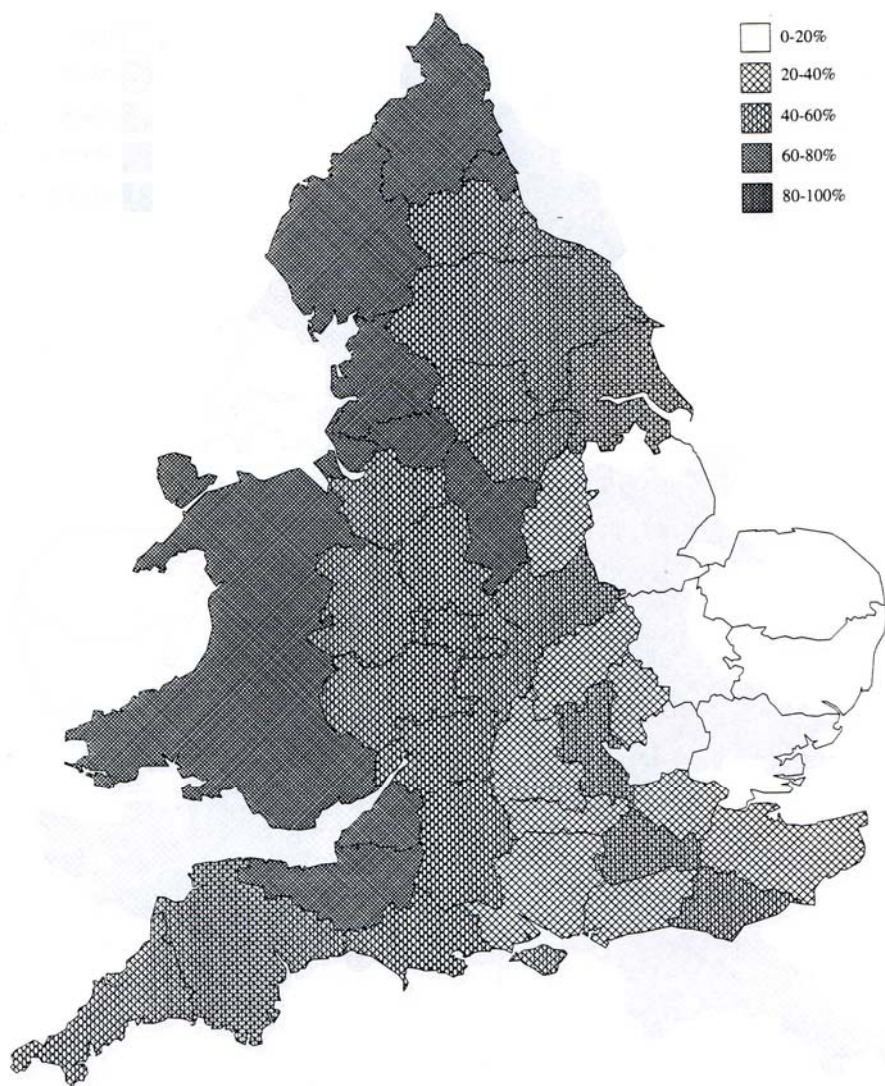
GRASSLAND AS PERCENTAGE OF AGRICULTURAL LAND COVER



MAP 1c

1965

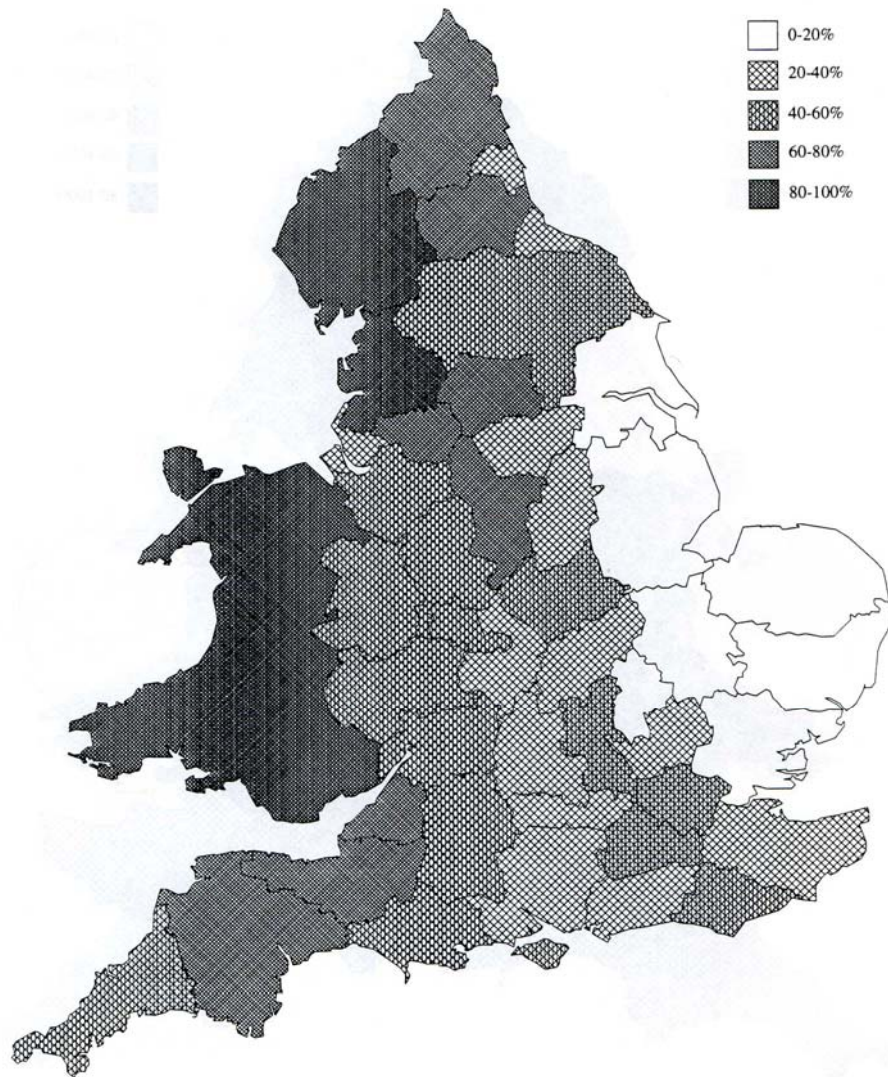
GRASSLAND AS PERCENTAGE OF AGRICULTURAL LAND COVER



MAP 1d

1975

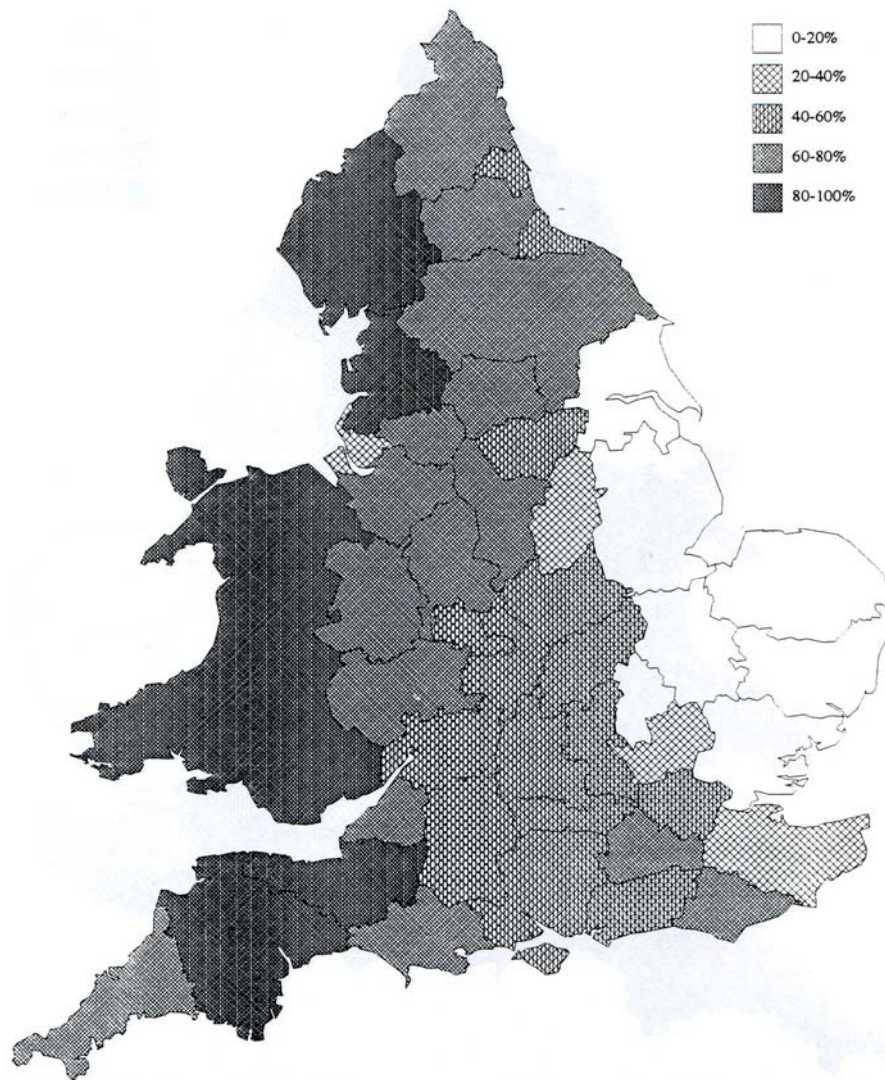
GRASSLAND AS PERCENTAGE OF AGRICULTURAL LAND COVER



MAP 1e

1980

GRASSLAND AS PERCENTAGE OF AGRICULTURAL LAND COVER



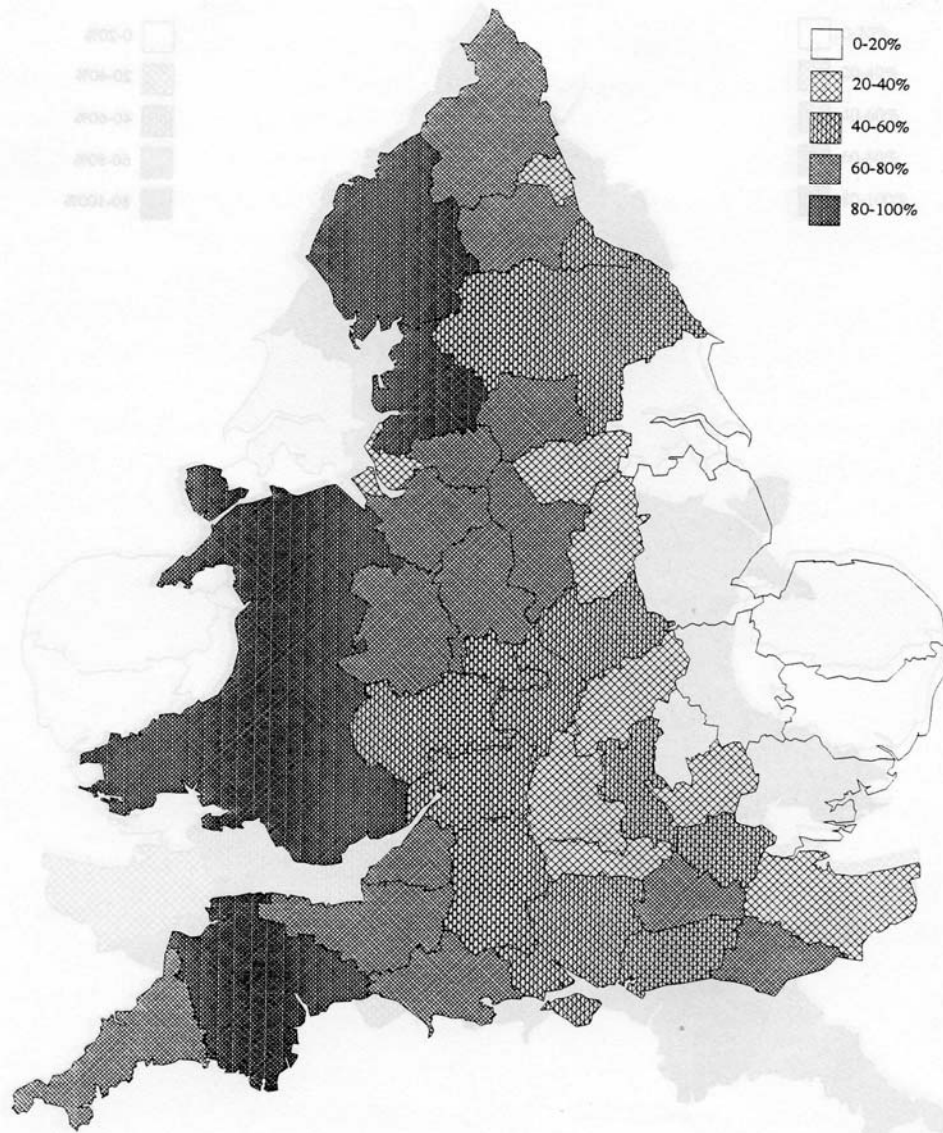
MAP 1f

1985

of 9AM

1981

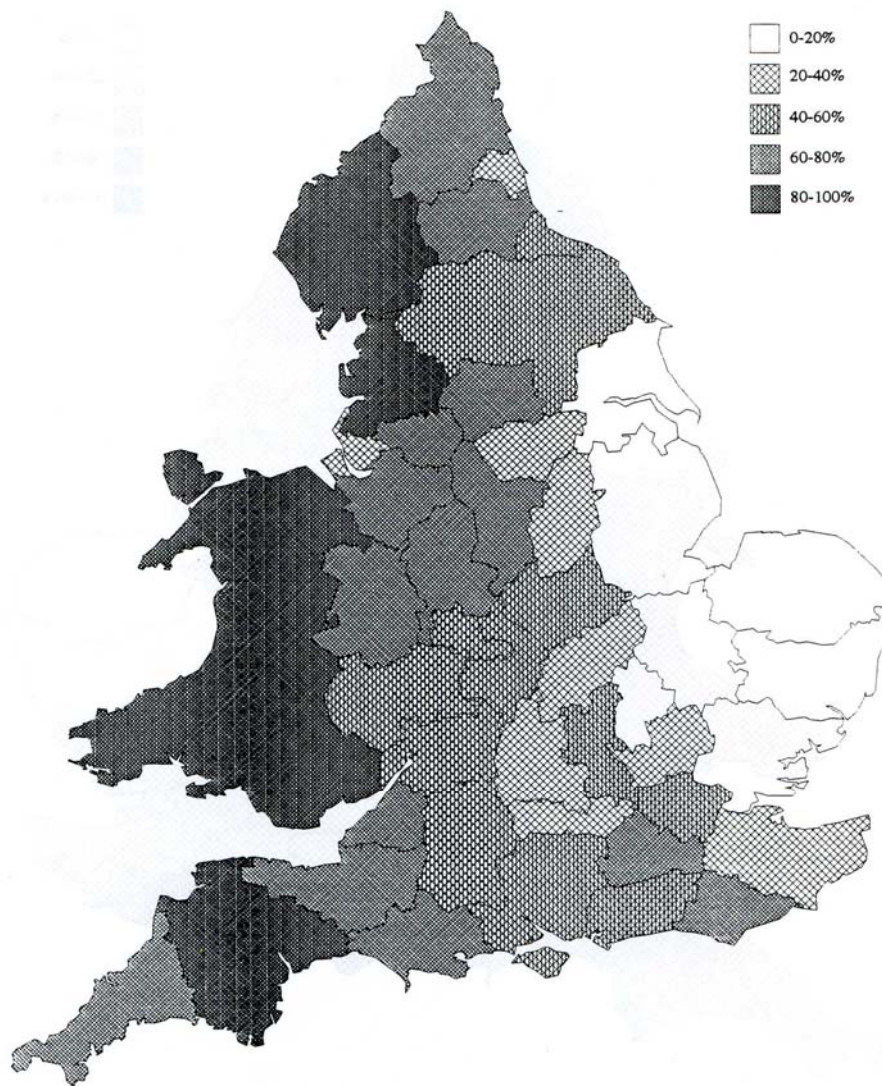
GRASSLAND AS PERCENTAGE OF AGRICULTURAL LAND COVER



MAP 1g

1990

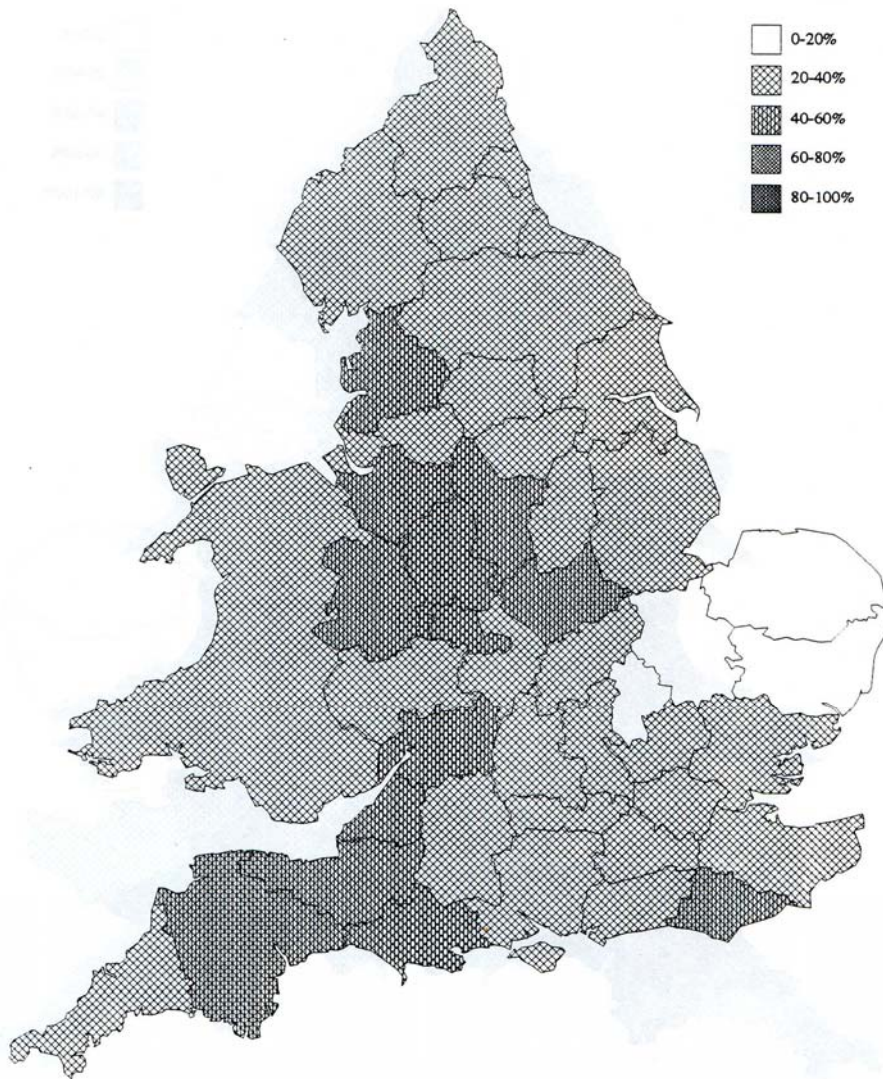
GRASSLAND AS PERCENTAGE OF AGRICULTURAL LAND COVER



MAP 2a

1945

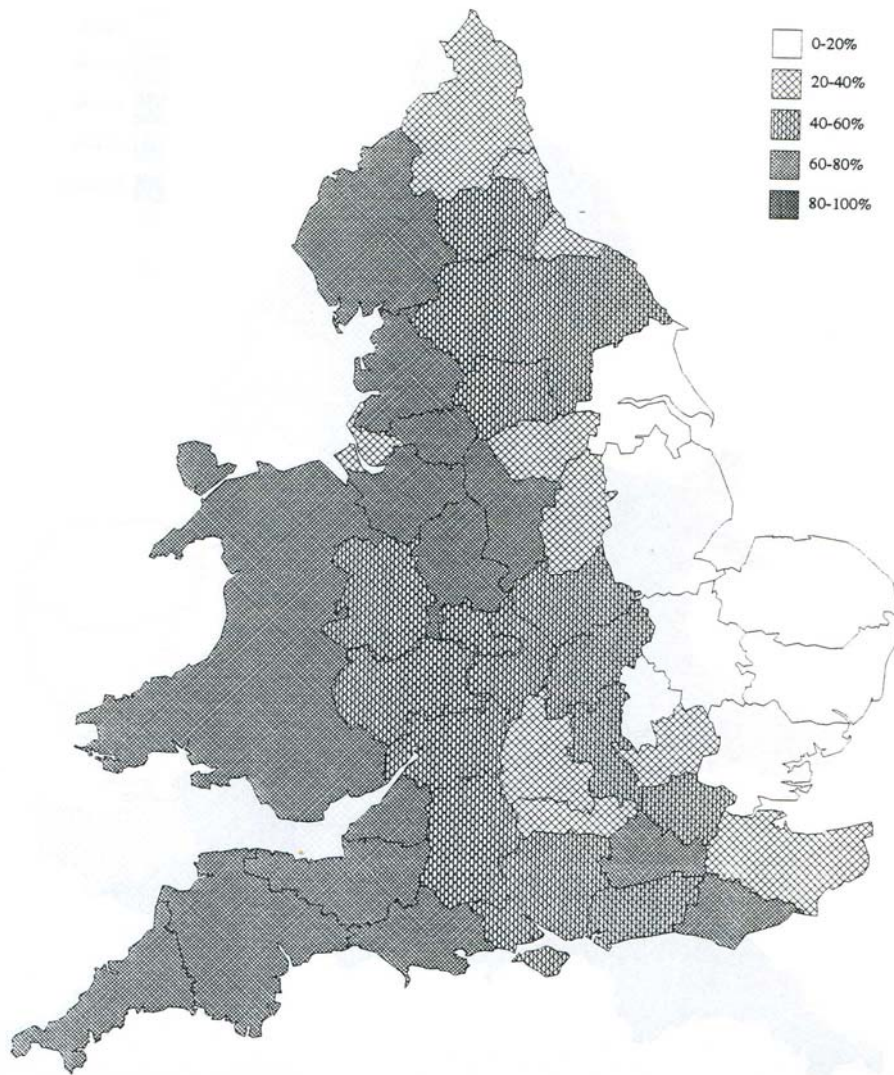
SOWN GRASS AS PERCENTAGE OF AGRICULTURAL LAND COVER



MAP 2b

1980

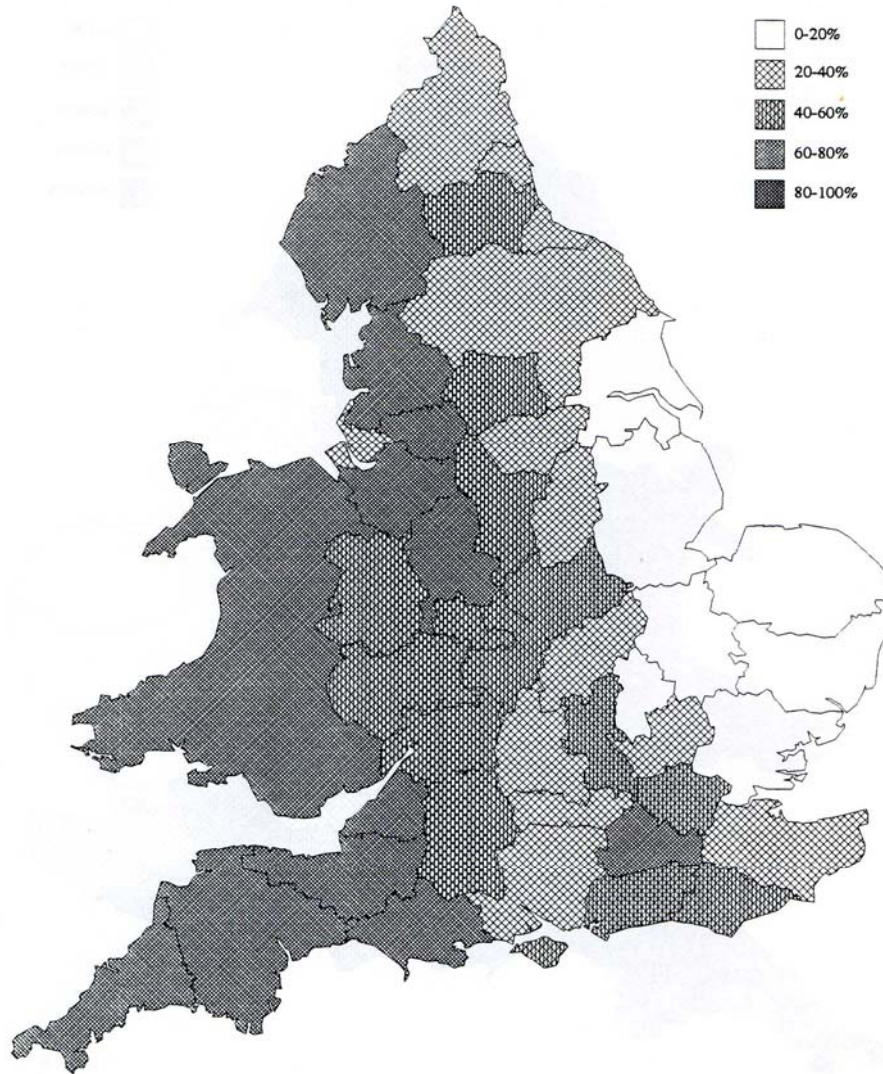
SOWN GRASS AS PERCENTAGE OF AGRICULTURAL LAND COVER



MAP 2c

1985

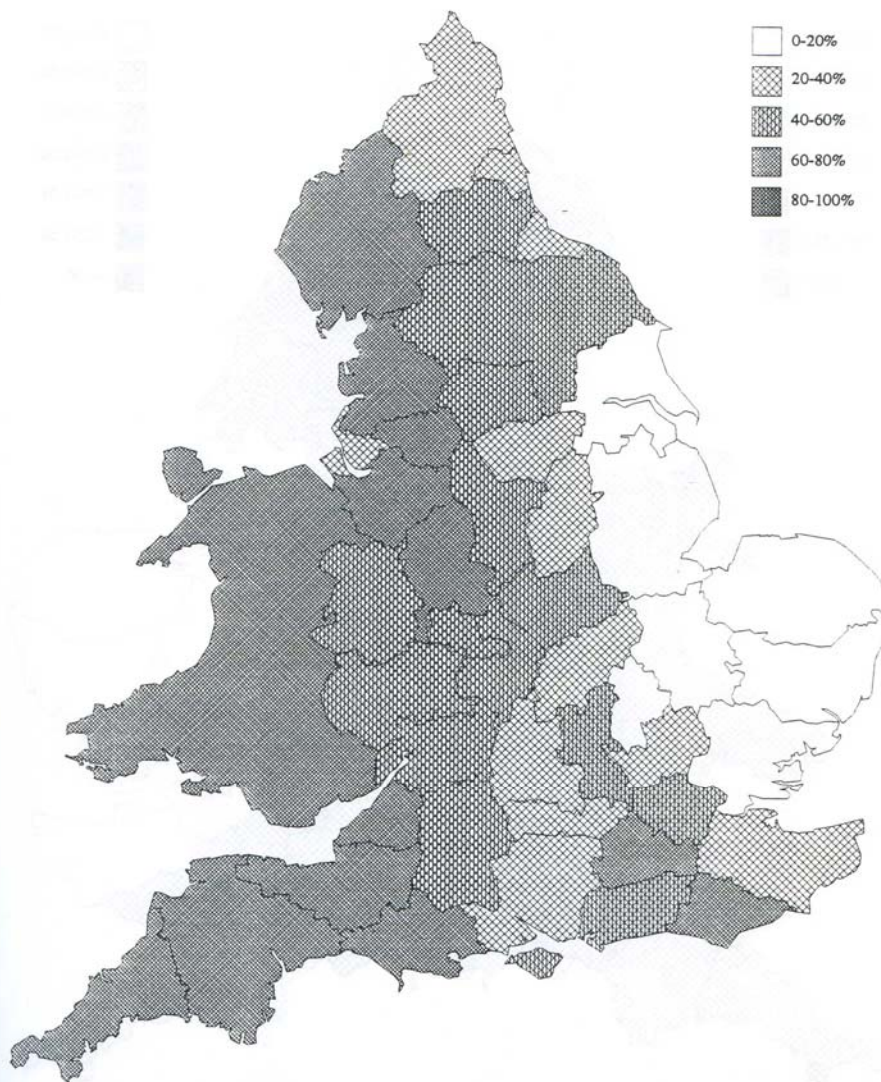
SOWN GRASS AS PERCENTAGE OF AGRICULTURAL LAND COVER



MAP 2d

1990

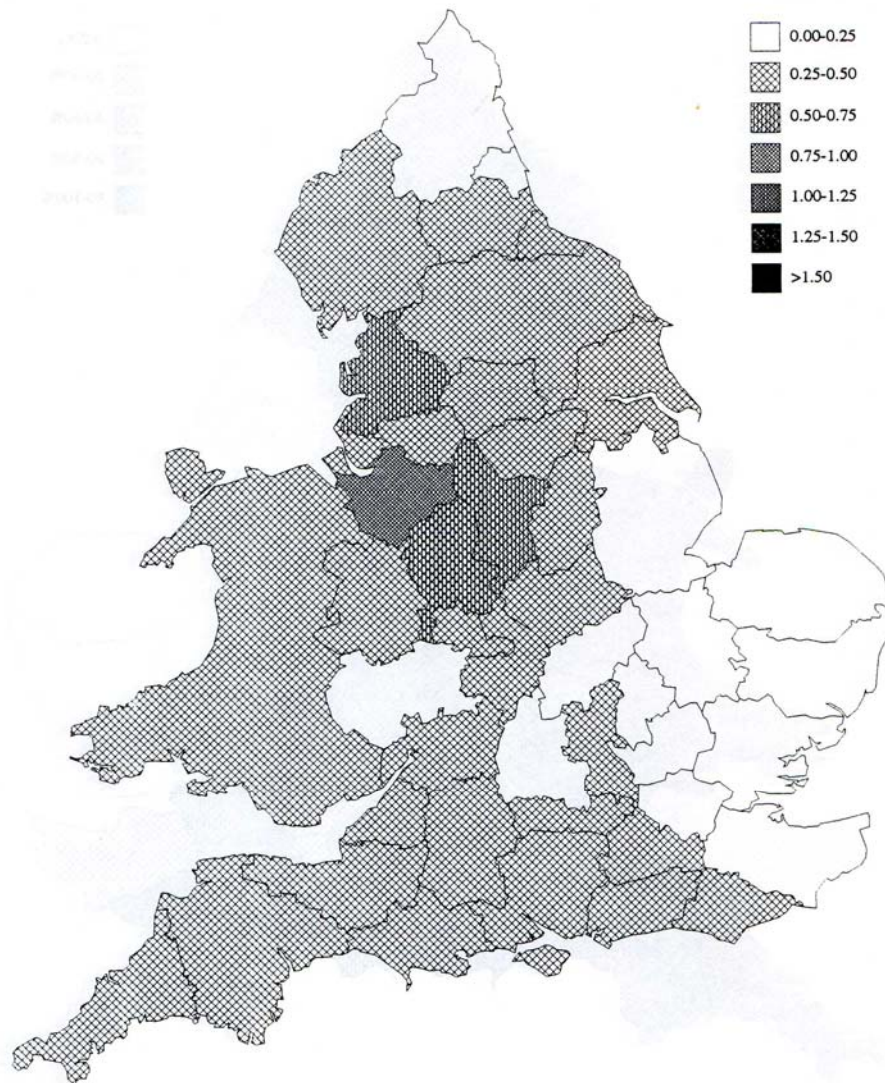
SOWN GRASS AS PERCENTAGE OF AGRICULTURAL LAND COVER



MAP 3a

1945

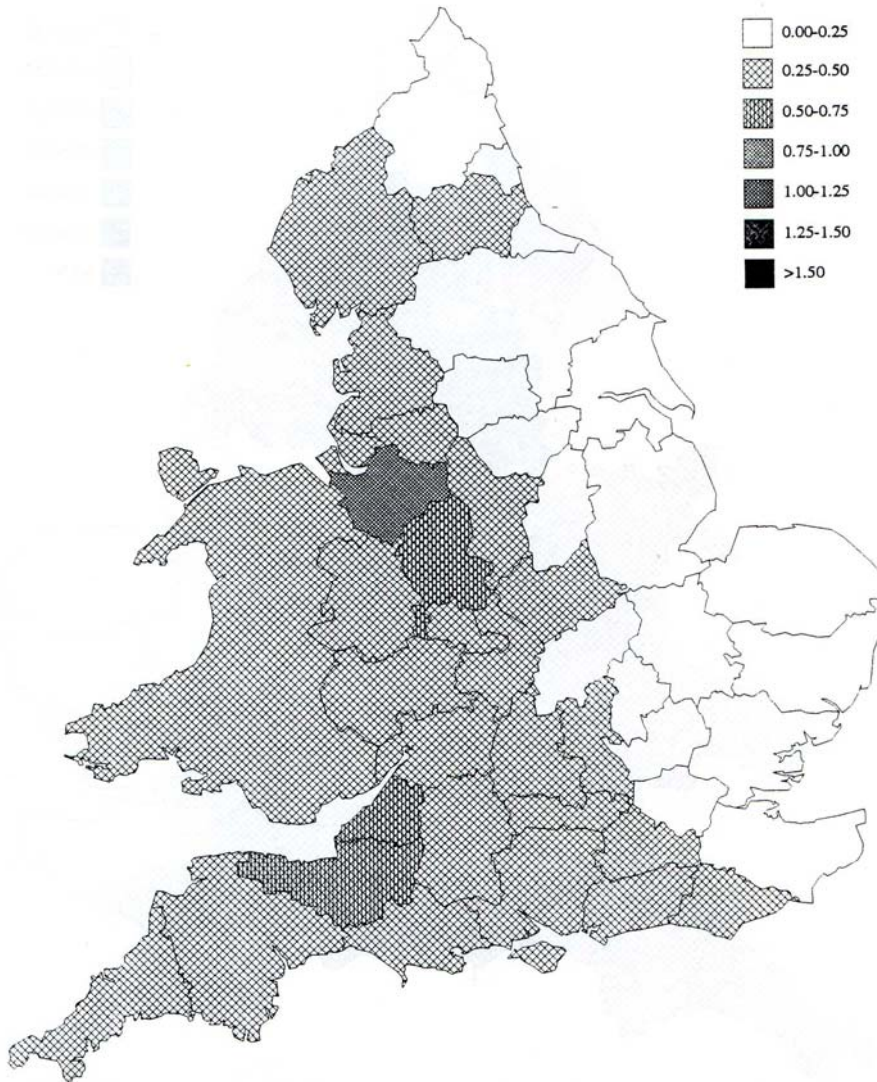
No. BREEDING CATTLE PER HECTARE OF AGRICULTURAL LAND



MAP 3b

1955

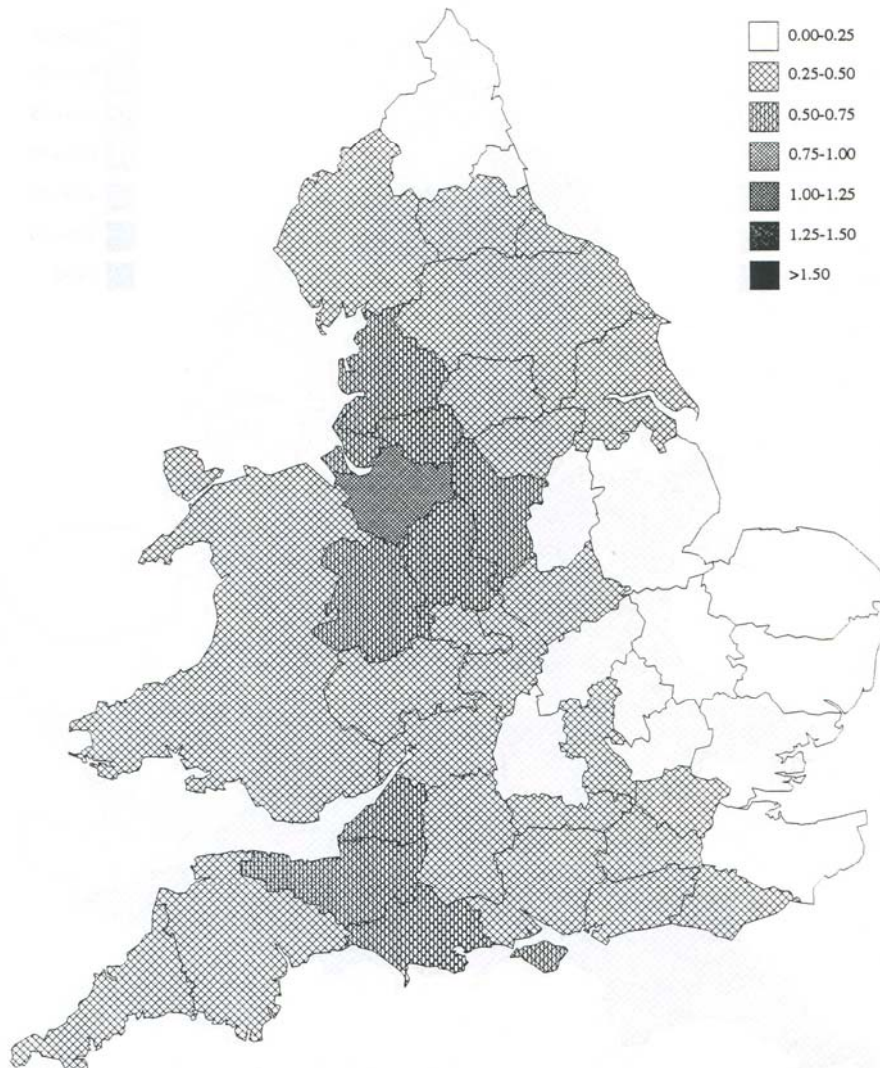
No. BREEDING CATTLE PER HECTARE OF AGRICULTURAL LAND



MAP 3c

1965

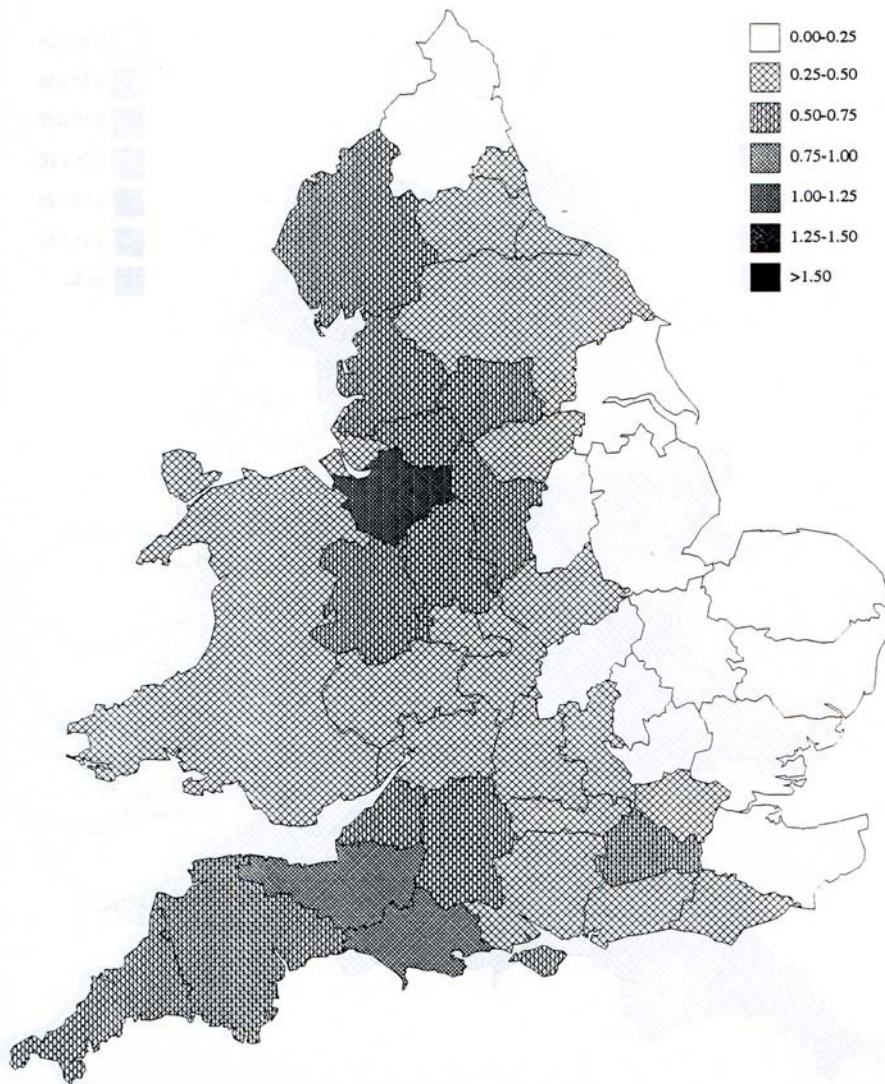
No. BREEDING CATTLE PER HECTARE OF AGRICULTURAL LAND



MAP 3d

1975

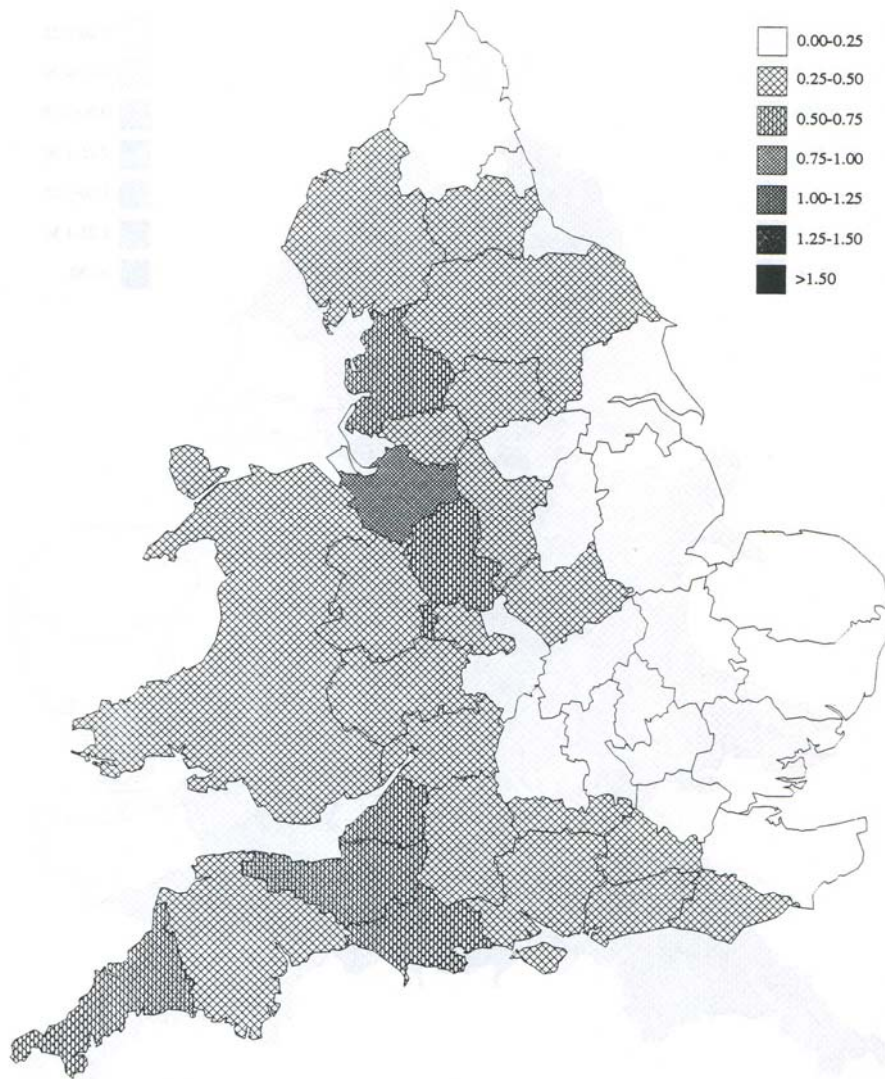
No. BREEDING CATTLE PER HECTARE OF AGRICULTURAL LAND



MAP 3e

1980

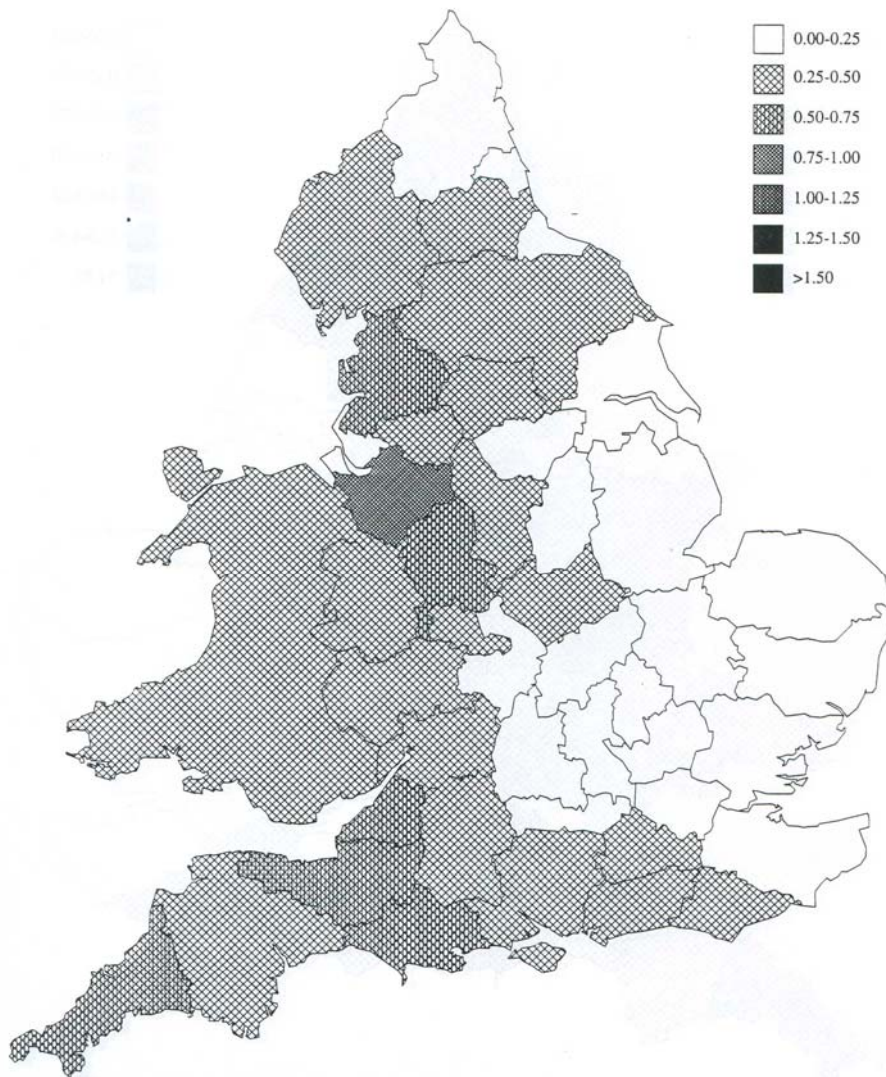
No. BREEDING CATTLE PER HECTARE OF AGRICULTURAL LAND



MAP 3F

1985

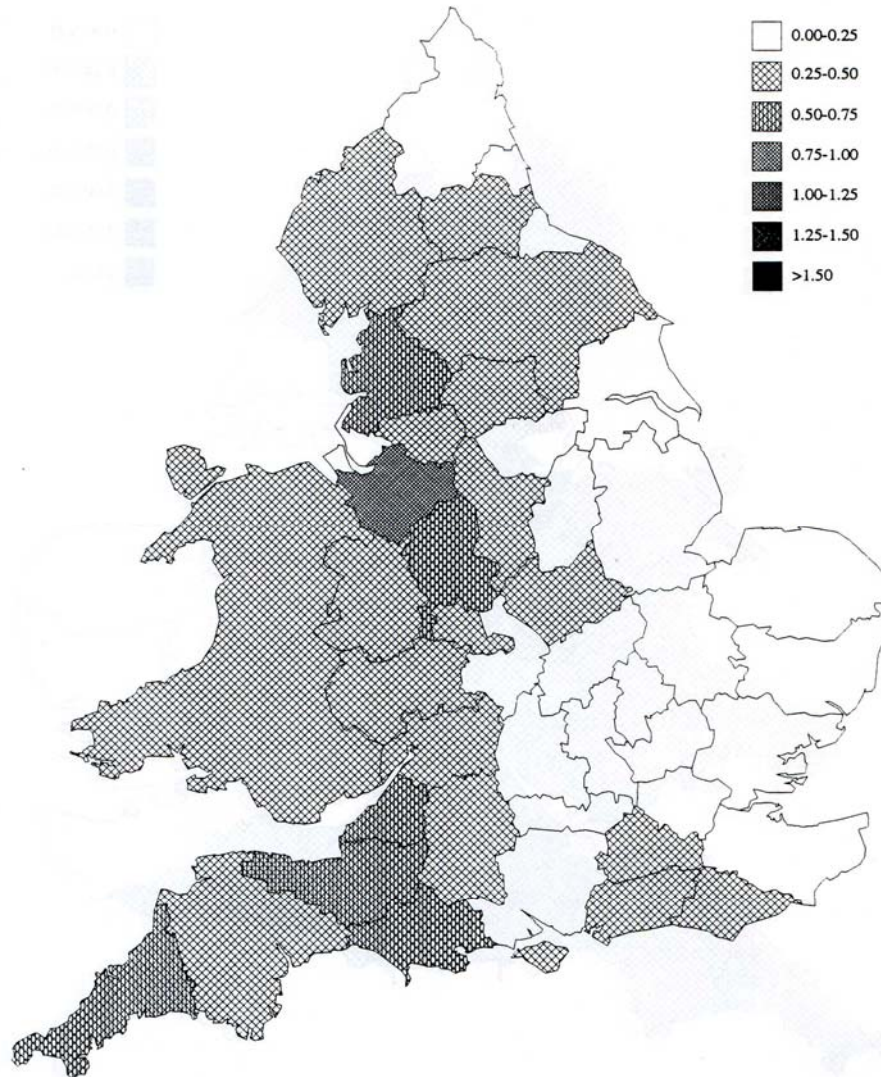
No. BREEDING CATTLE PER HECTARE OF AGRICULTURAL LAND



MAP 3g

1990

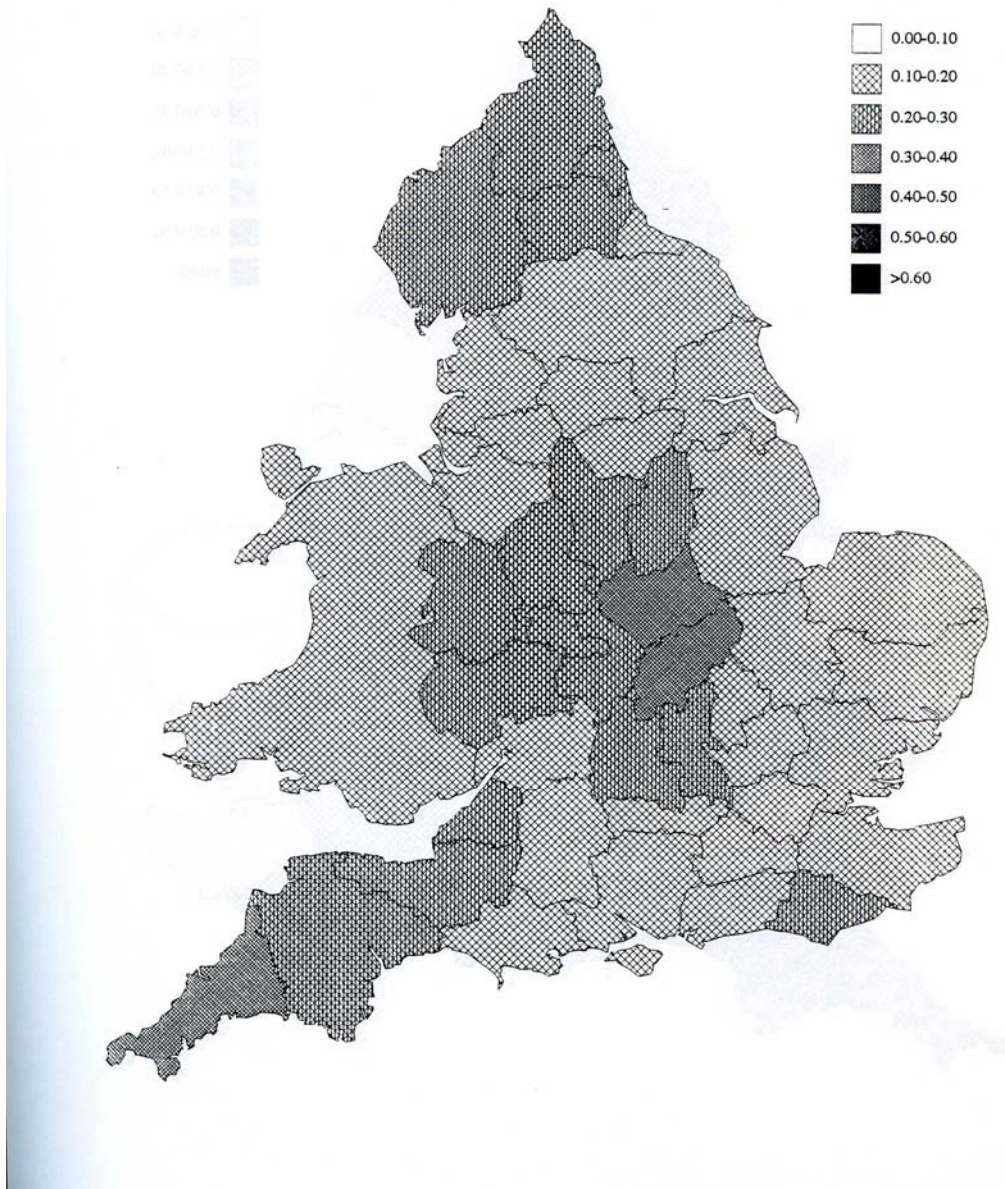
No. BREEDING CATTLE PER HECTARE OF AGRICULTURAL LAND



MAP 4a

1945

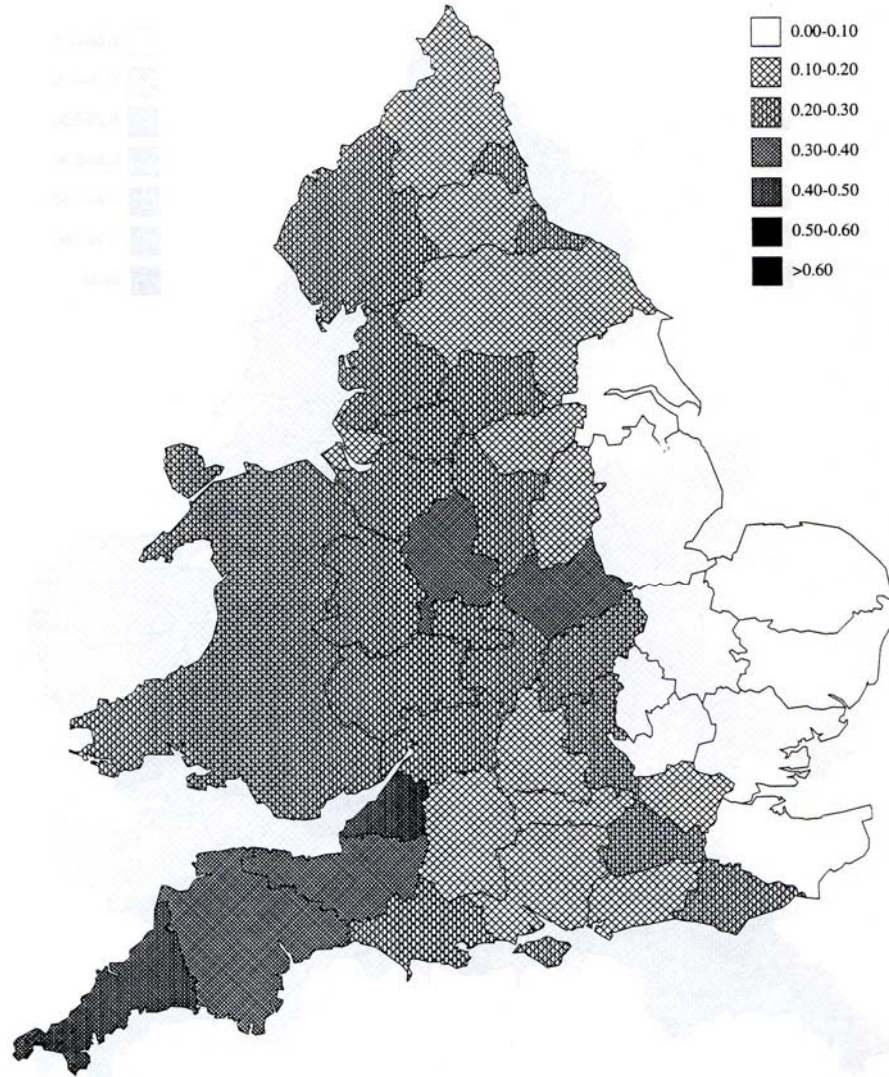
No. CATTLE >1 YEAR OLD PER HECTARE OF AGRICULTURAL LAND



MAP 4b

1990

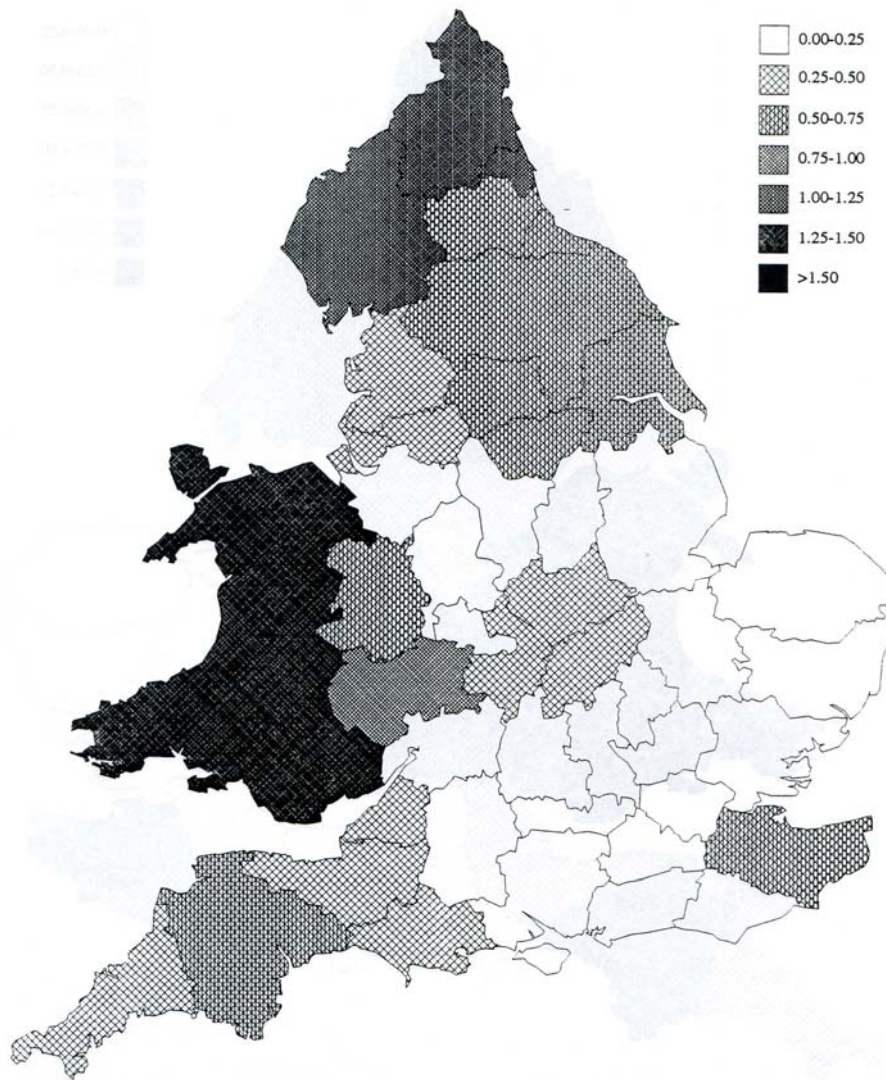
No. CATTLE >1 YEAR PER HECTARE OF AGRICULTURAL LAND



MAP 5a

1945

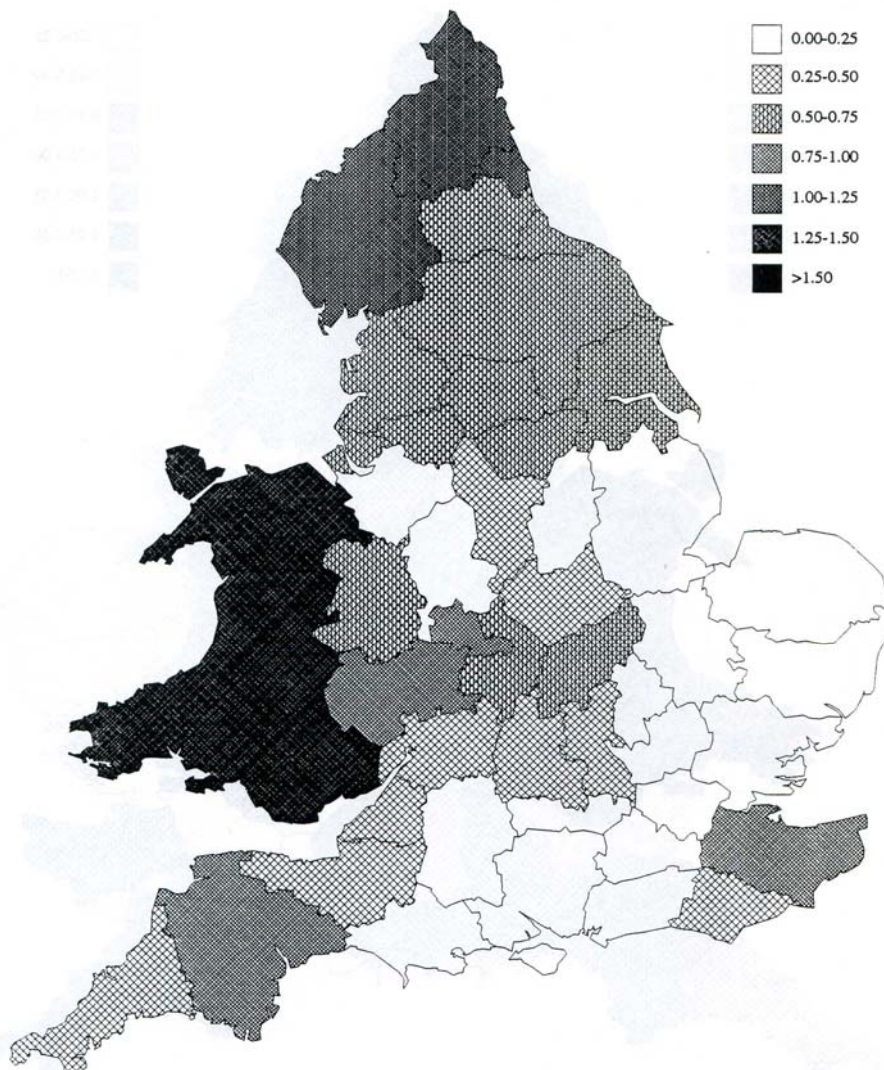
No. BREEDING SHEEP PER HECTARE OF AGRICULTURAL LAND



MAP 5b

1955

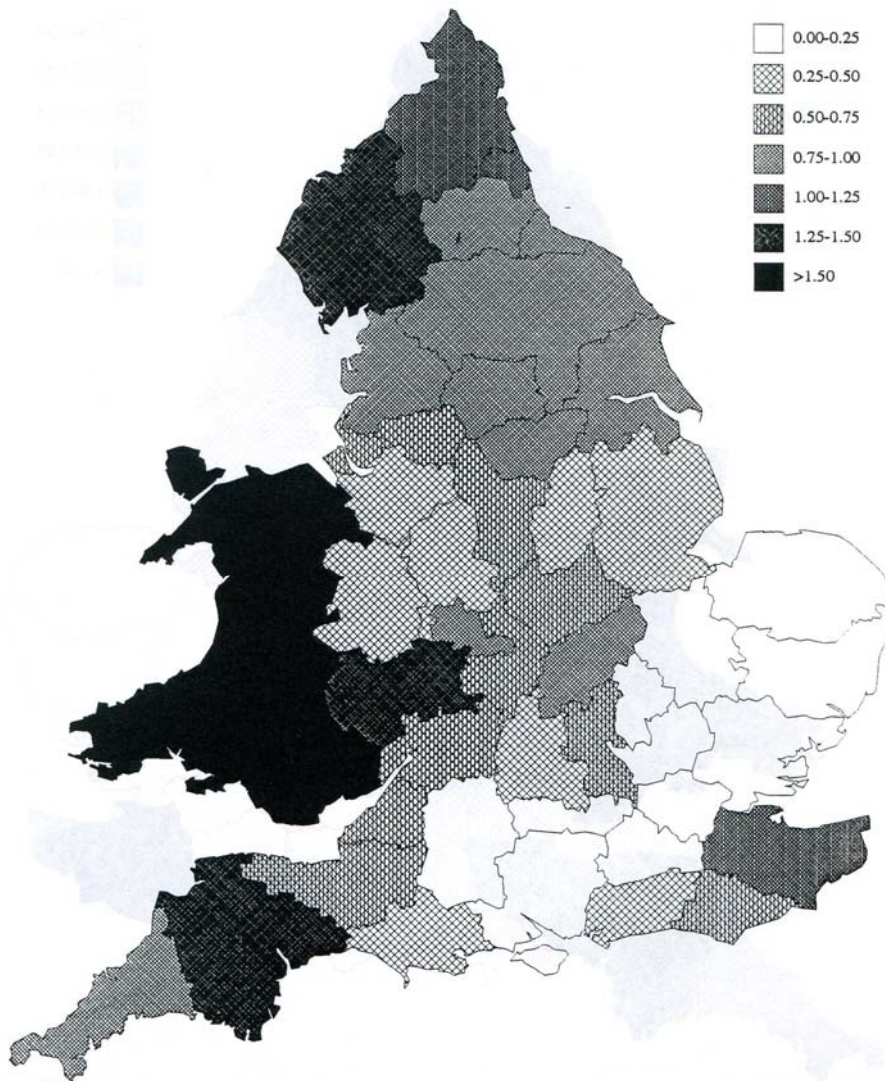
No. BREEDING SHEEP PER HECTARE OF AGRICULTURAL LAND



MAP 5c

1965

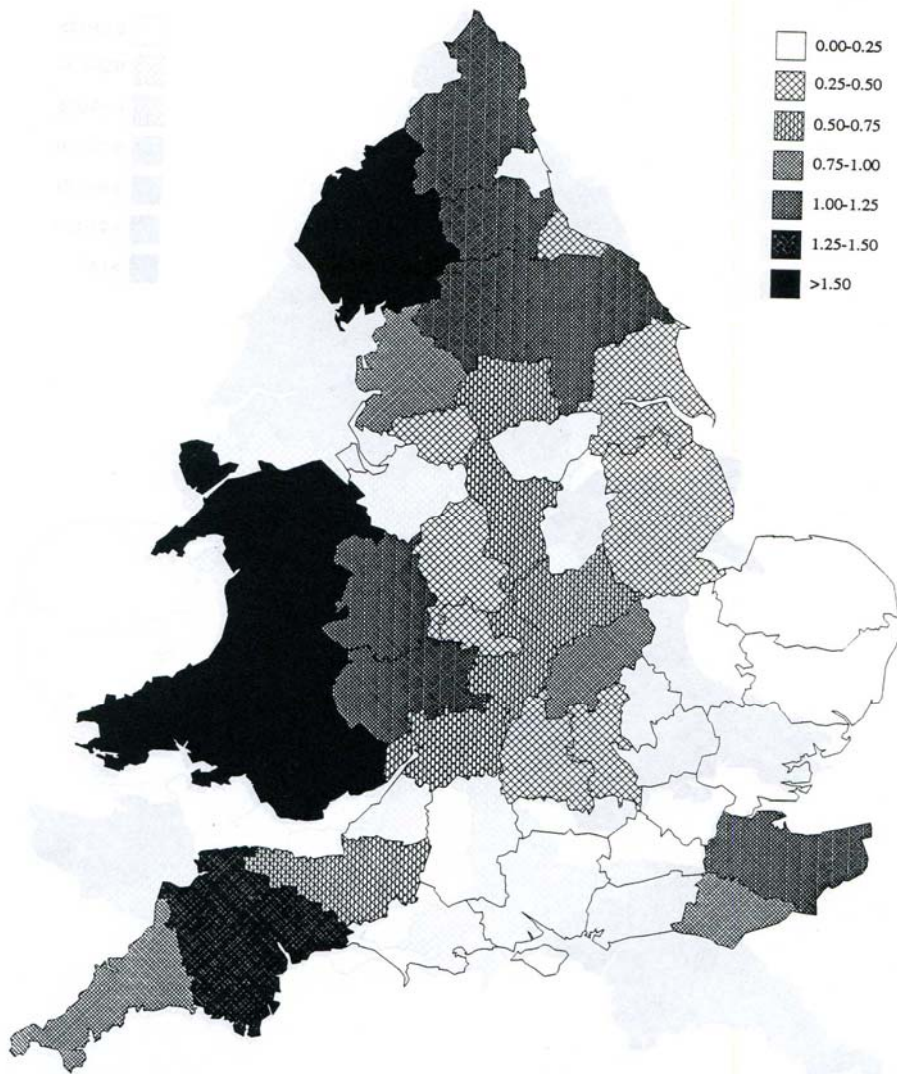
No. BREEDING SHEEP PER HECTARE OF AGRICULTURAL LAND



MAP 5d

1975

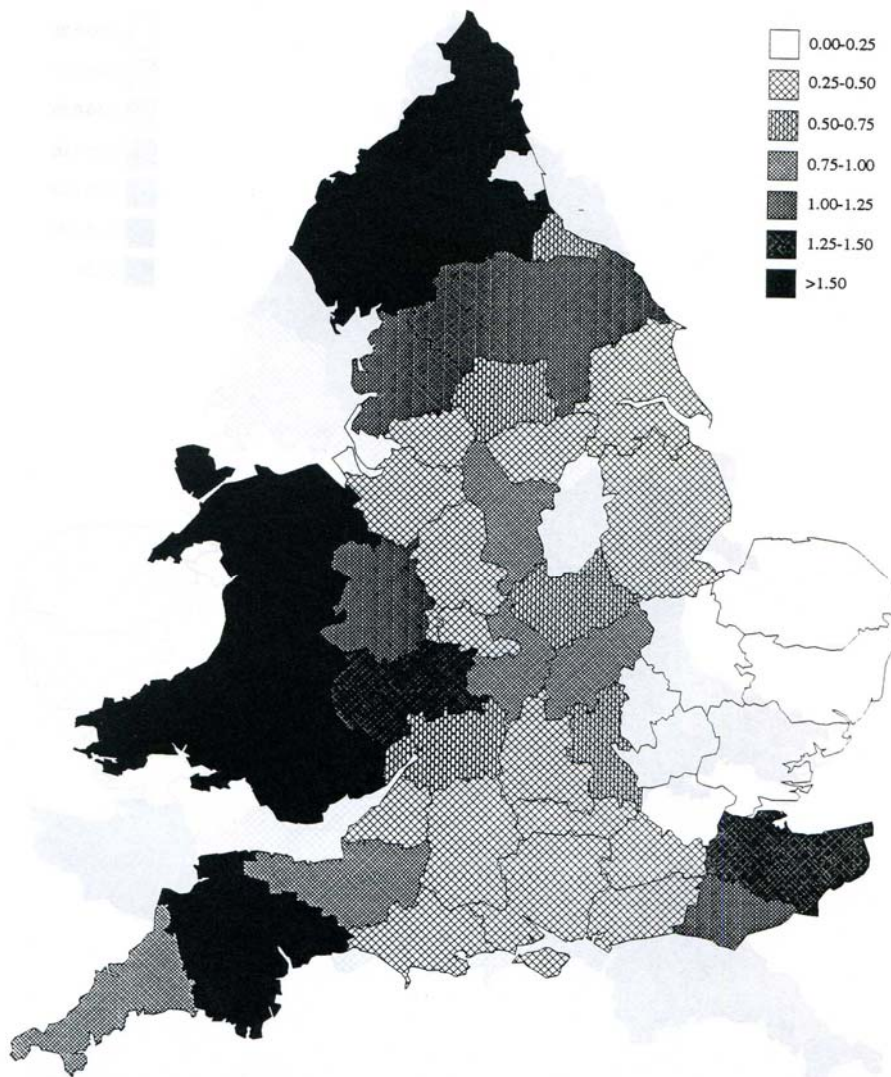
No. BREEDING SHEEP PER HECTARE OF AGRICULTURAL LAND



MAP 5e

1980

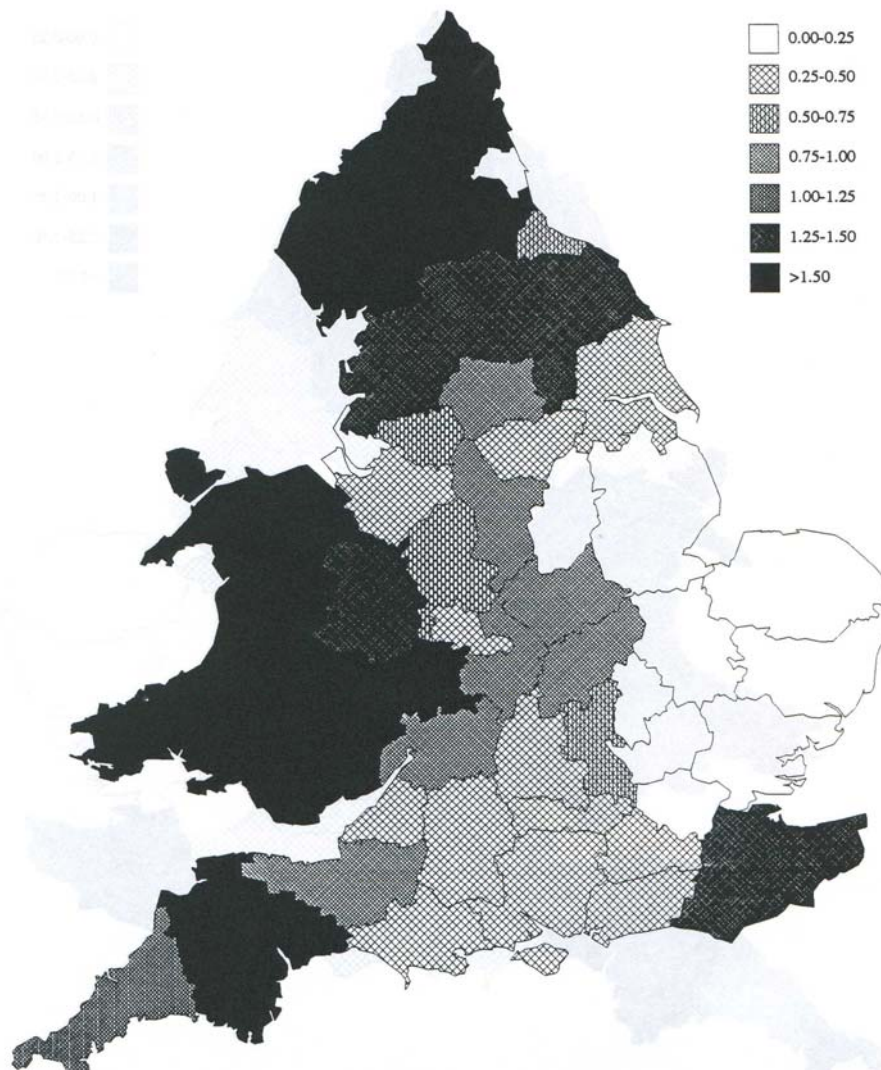
No. BREEDING SHEEP PER HECTARE OF AGRICULTURAL LAND



MAP 5f

1985

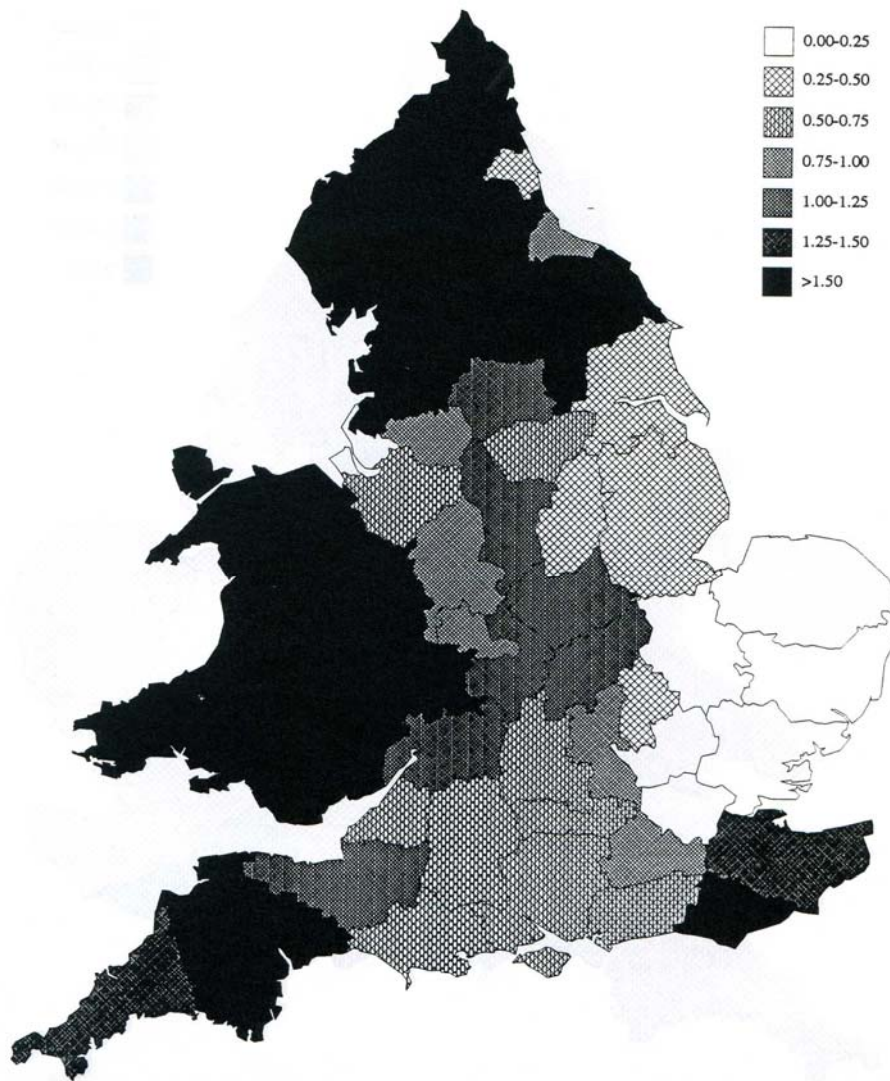
No. BREEDING SHEEP PER HECTARE OF AGRICULTURAL LAND



MAP 5g

1990

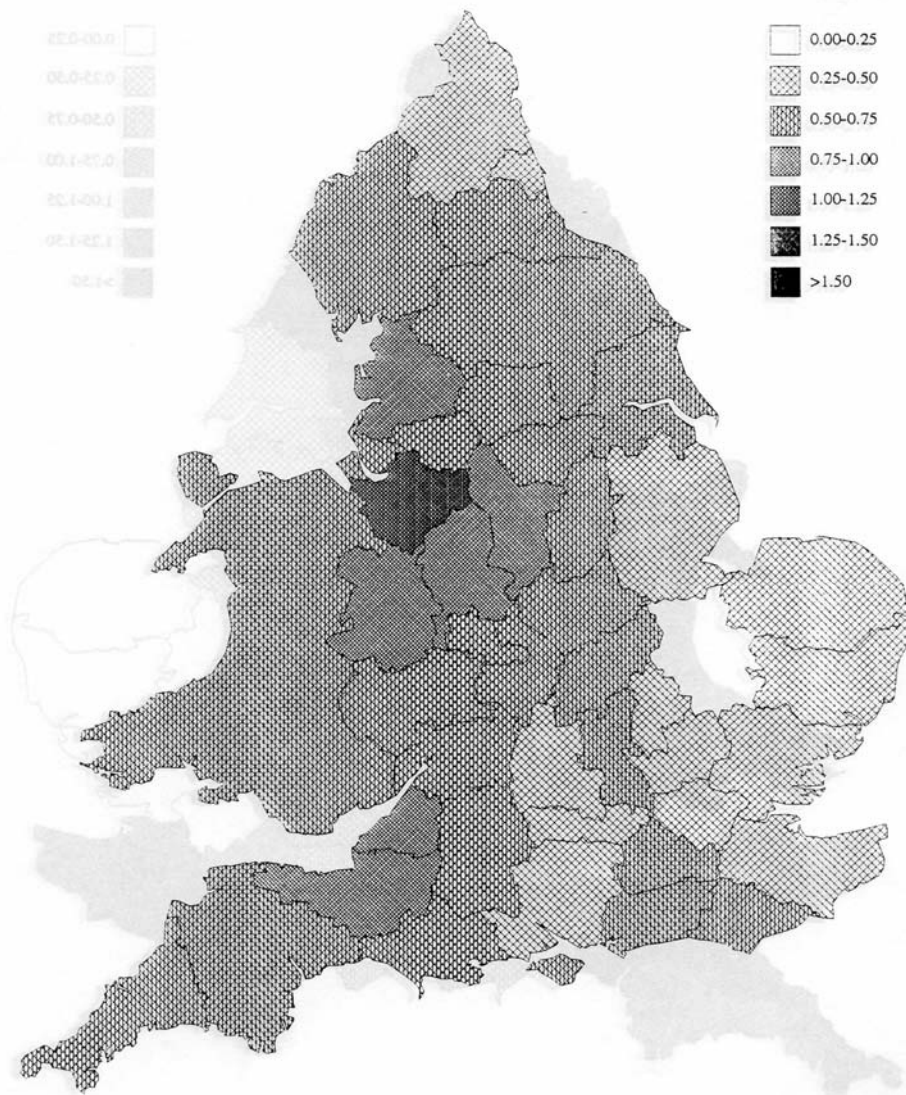
No. BREEDING SHEEP PER HECTARE OF AGRICULTURAL LAND



Map 6a

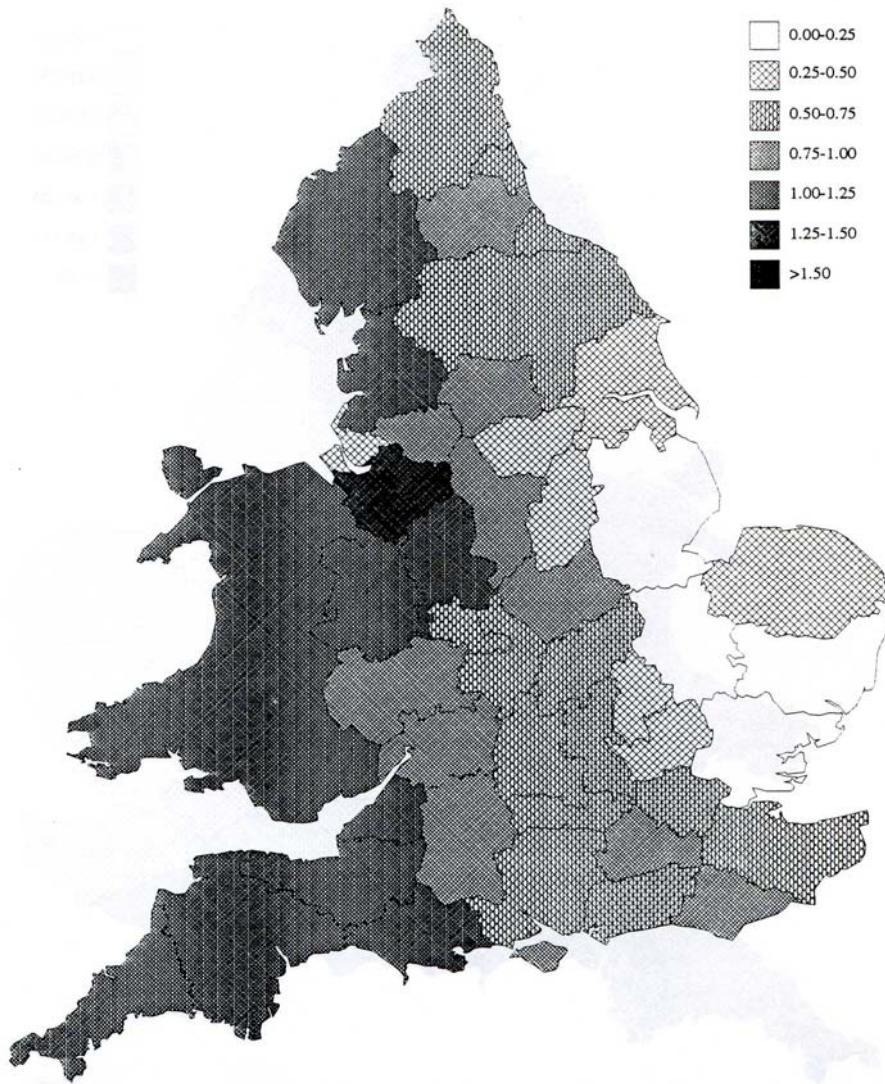
1945

GLU PER HECTARE OF AGRICULTURAL LAND



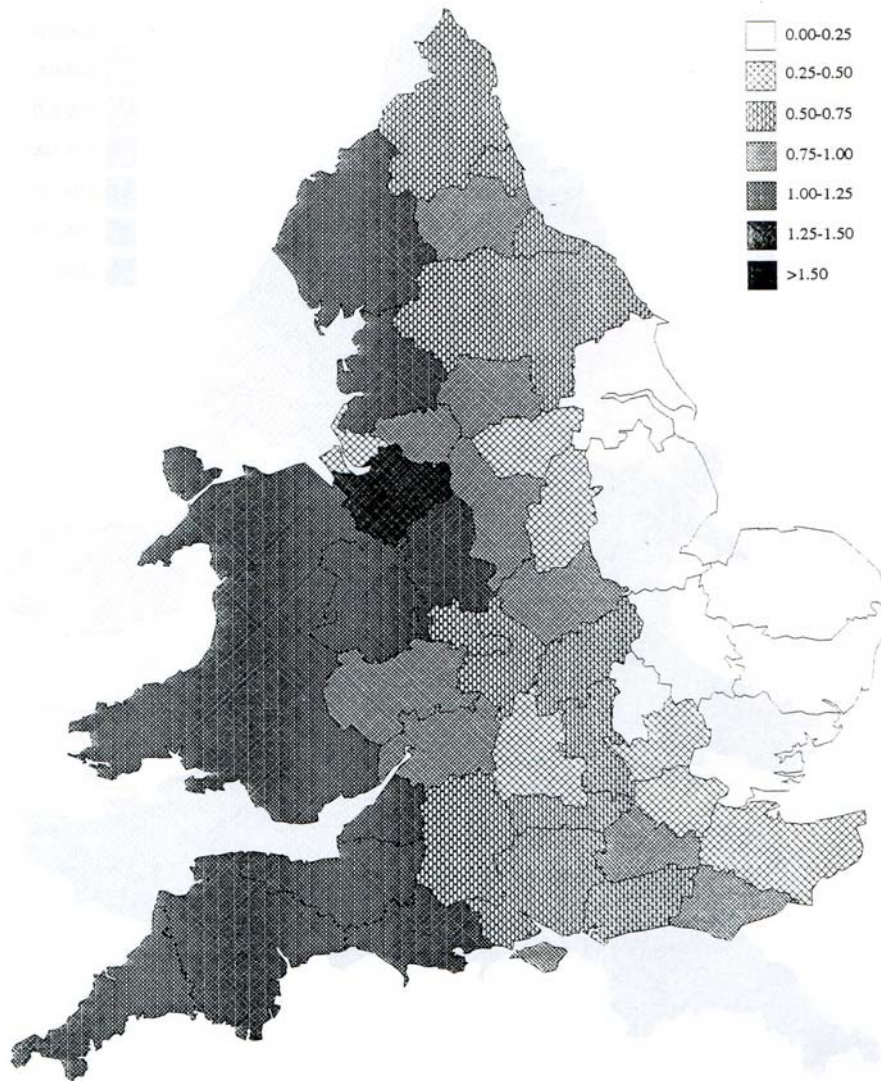
1980

GLU PER HECTARE OF AGRICULTURAL LAND



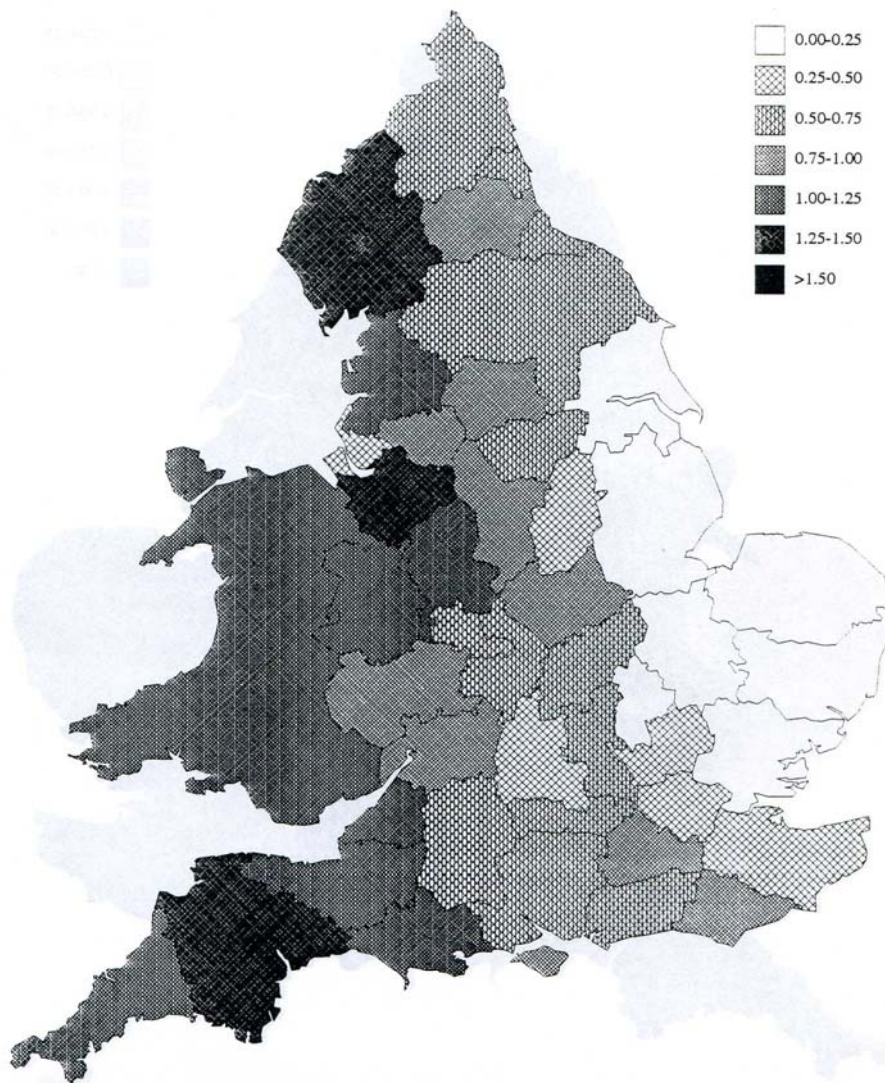
1985

GLU PER HECTARE OF AGRICULTURAL LAND



1990

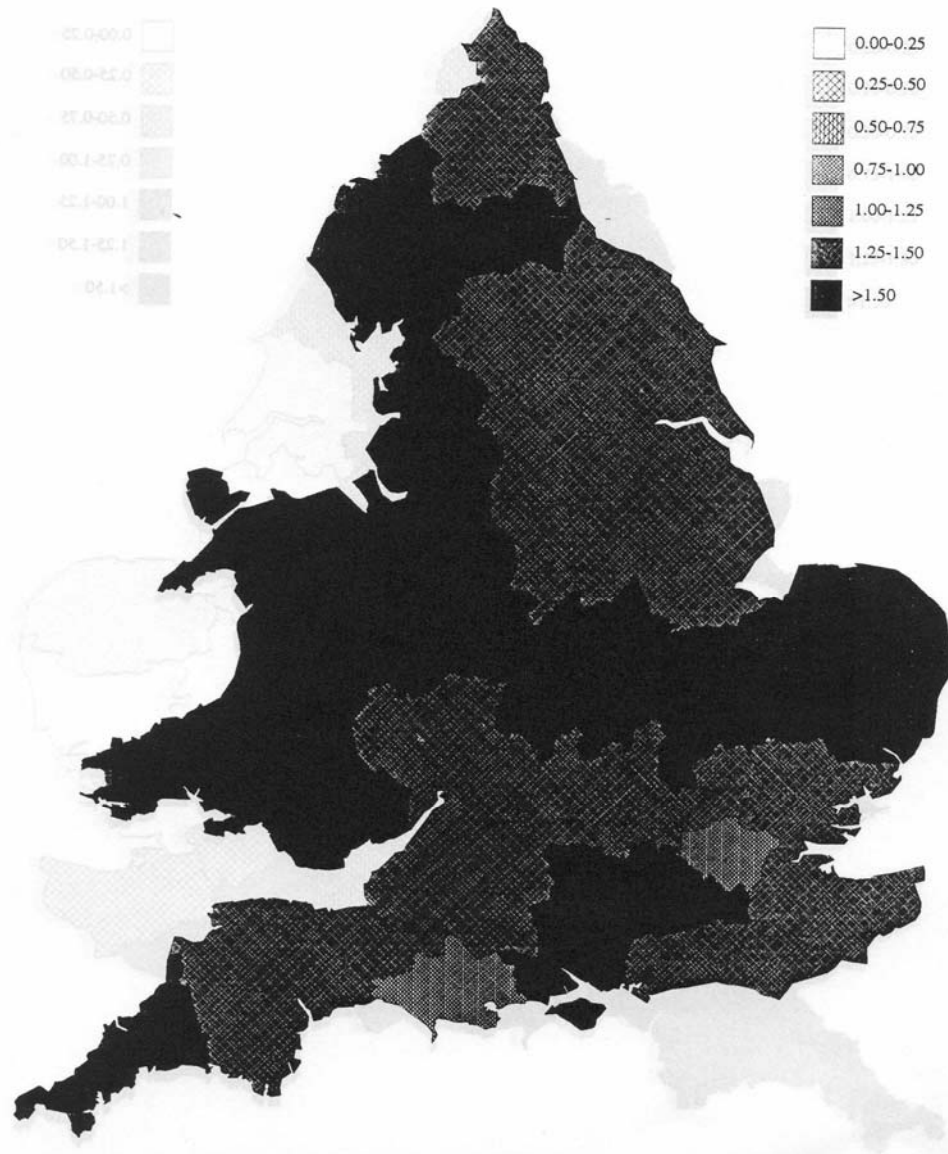
GLU PER HECTARE OF AGRICULTURAL LAND



1945

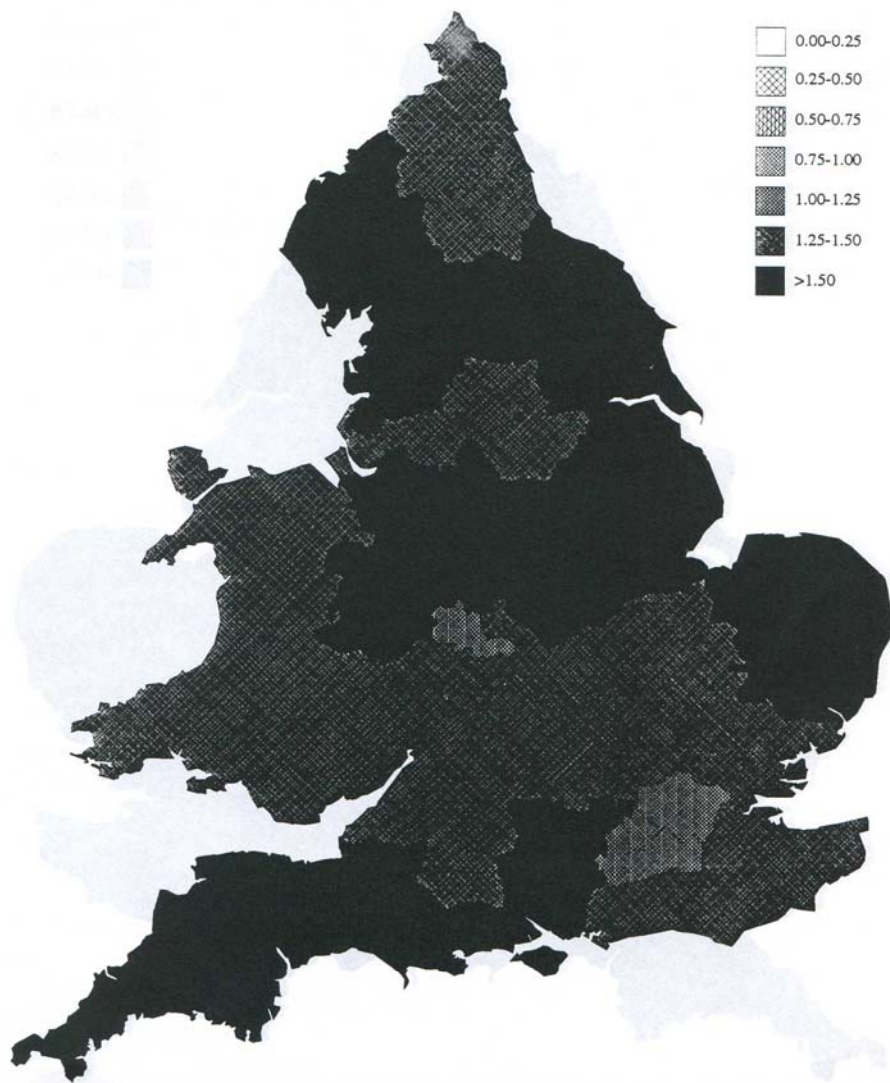
1990

GLU PER ADJUSTED HECTARE OF GRASSLAND



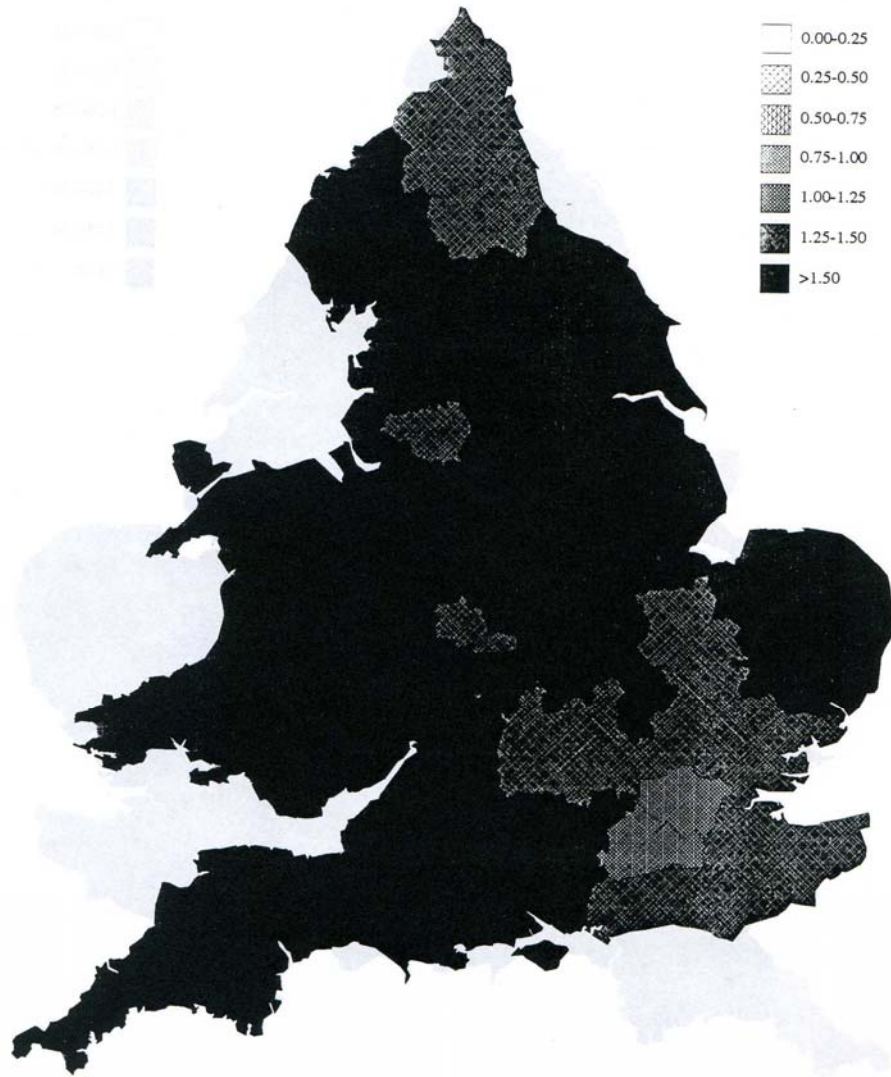
1980

GLU PER HECTARE OF ADJUSTED GRASSLAND



1985

GLU PER HECTARE OF ADJUSTED GRASSLAND



1990

GLU PER HECTARE OF ADJUSTED GRASSLAND

Agra Europe London Various Issues

Allanson, P. (1993): The impact of the modernisation proposal in the MacSherry Plan for Reform of the cereals regime. *European Review of Agricultural Economics* 20, pp 99-109.

Anon (1990): *Survey of Fertiliser Practice 1989*. Rothamsted: ADAS

Ball, D.P., Dale, I., Sheail J & Hogg (1982) *Vegetation Change and Landscape*. NERC/ITE

Burgess, N.D., Evans, C.E. (1984) *Vegetation change in the Washes wetland, England: their conservation and Biological Conservation*

Cain, P., Saunders, J.M. (1985) *Effects of the removal of CAP support on farm alliance*. Department of Agriculture Central Statistical Office, London

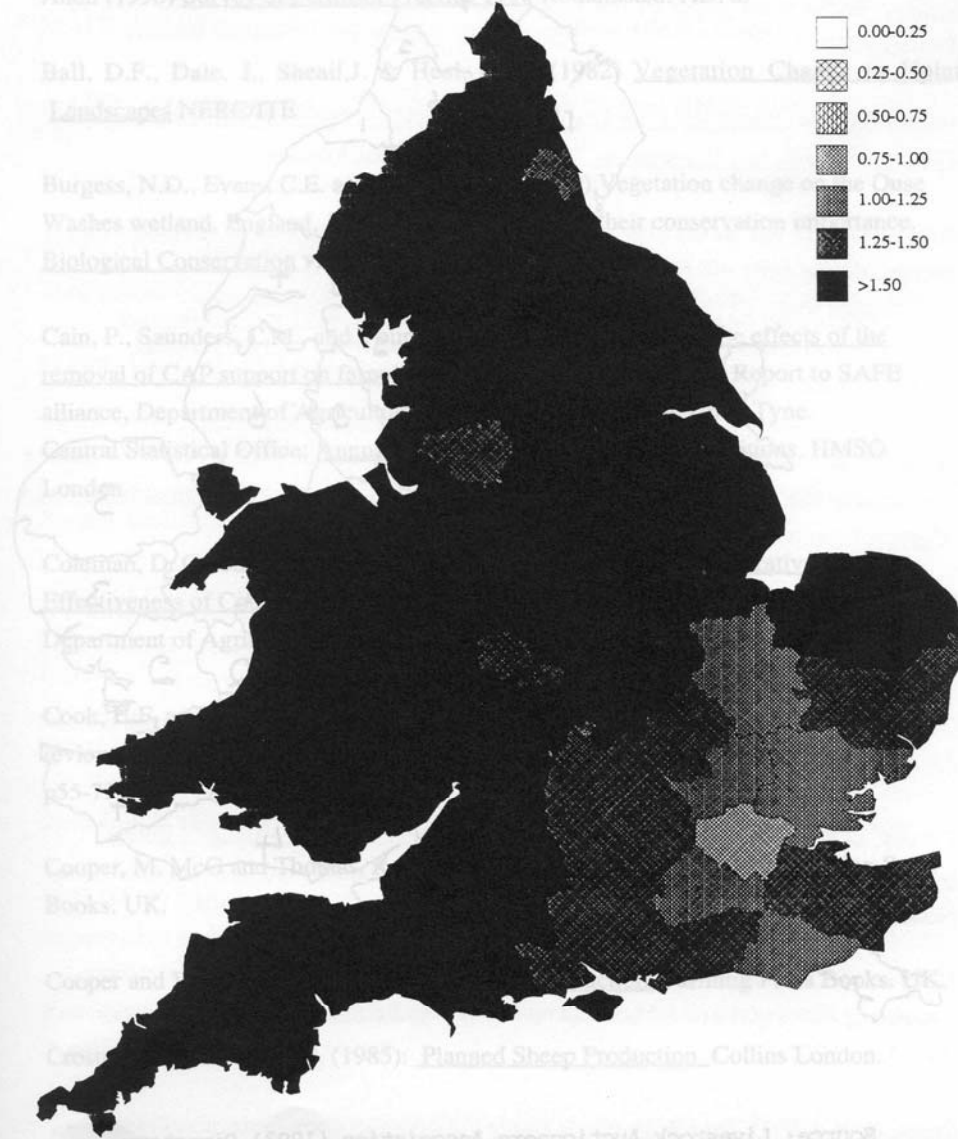
Conman, D. (1985) *Efficiency of Grazing*. Department of Agriculture

Cook, T.E. (1985) *Grassland Survey*

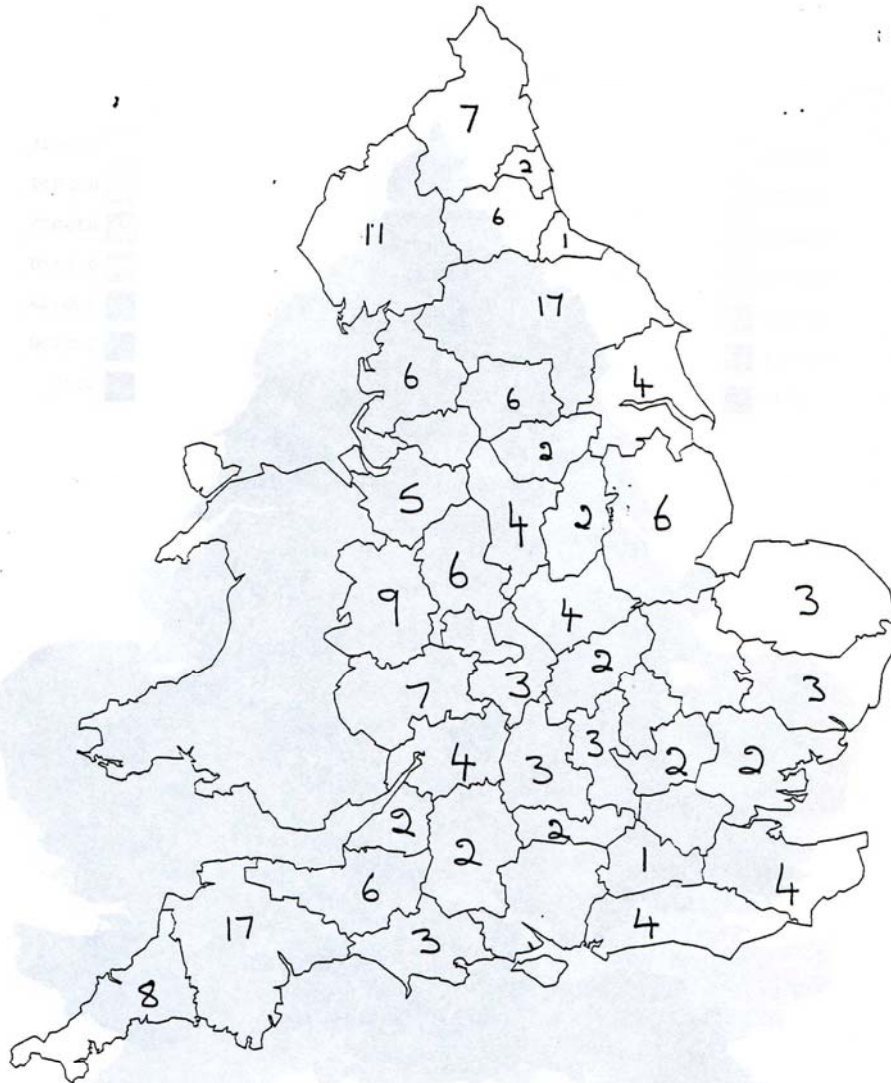
Cooper, M. McGinnis (1985) *Grassland*. Books, UK.

Cooper and (1985) *Grassland*

Cox (1985): *Planned Sheep Production*. Collins London



Map 8: Location of Auction Markets 1993



Source: Livestock Auctioneers Association (1993) Directory of Livestock Auction Markets 8th Ed, Coventry

References

Agra Europe London. Various Issues.

Allanson, P. (1993): The impact of the modularisation proposal in the MacSharry Plan for Reform of the cereals regime, European Review of Agricultural Economics v20, pp 99-109.

Anon (1990) Survey of Fertiliser Practice 1990 Rothamsted: ADAS

Ball, D.F., Dale, J., Sheail, J. & Heal, O.W. (1982) Vegetation Change in Upland Landscapes NERC/ITE

Burgess, N.D., Evans, C.E. and Thomas, G.J. (1990) Vegetation change on the Ouse Washes wetland, England, 1972-1988 and effects on their conservation importance. Biological Conservation v53, 173-189

Cain, P., Saunders, C.M., and Younger, A. (1991) Estimation of the effects of the removal of CAP support on farm incomes and public expenditure. Report to SAFE alliance, Department of Agriculture, University of Newcastle Upon Tyne.

Central Statistical Office: Annual Abstract of Statistics. various editions. HMSO London

Coleman, D. Crabtree, B., Froud, J. and O'Carroll, L. (1991): Comparative Effectiveness of Conservation Mechanisms. Report to the Countryside Commission, Department of Agricultural economics, University of Manchester.

Cook, H.F. and Moorby, H. (1993) English marshlands reclaimed for grazing: a review of the physical environment. Journal of Environmental Management, v38, p55-72

Cooper, M. McG and Thomas, R.J. (1991): Profitable Sheep Farming. Farming Press Books. UK.

Cooper and Willis, M. (1989): Profitable Beef Production. Farming Press Books. UK.

Croston, D. and Pollott, G. (1985): Planned Sheep Production. Collins London.

Coulson, J.C and others (1992) The management of moorland areas to enhance their nature conservation interest. Joint Nature Conservation Committee and Durham University

Davis, R.P., Thomas, M.R. and Garthwaite, D.G (1989) Pesticide Usage Survey Report 79: Grassland and Fodder Crops 1989 MAFF, Harpenden

EC Commission: Agricultural Situation in the Community. Various issues.

EC Commission (1991): The Development and Future of the Common Agricultural Policy. Reflections paper of the Commission (COM(91) 100 final, Brussels, 1st February 1991)

Ellett, J.S. (1984) Sheep stocking densities and vegetation change on the Long Mynd Common Unpublished Dissertation. Conservation Course, London.

Gibson, C.W.D. and others (1987) Spring grazing by sheep: effects on seasonal changes during early old field succession. Vegetation, **v70**, 33-43

Gordon, I. and Duncan, P. (1988) Pastures new for conservation New Scientist, 17/3/88, 54-59

Grant, S. & Armstrong, H. (1993) Grazing ecology and the conservation of heather moorland: the development of models as aids to management Biodiversity and Conservation, **v2**, 79-94

Gray, A.J., Crawley, M.J. and Edwards, P.J. (Eds, 1987) Colonisation, Succession and Stability 26th Symposium of the British Ecological Society, Blackwell, Oxford

Green, R.E. (1988) Stone-curlew conservation RSPB Conservation Review, **v2**, p30-33

Harvey, D.R. and Saunders, C.M. (1993): European Grassland Farming: Future prospects. Paper presented at the International Grassland Congress, Palmerston North, New Zealand, February 1993.

Hodge, I. D., Adams, W. M. and Bourn, N. A. D. (1992) The Cost of Conservation: comparing like with like - a comment on Brotherton Environment and Planning A **24** 1051 - 1054.

Ivens, G.W. (1991) The UK Pesticide Guide CAB/British Crop Protection Council

Lee, J.A. McNeill, S. and Rorison, I.H. (Eds, 1983) Nitrogen as an Ecological Factor 22nd Symposium of the British Ecological Society, Blackwell, Oxford

Livestock Auctioneers Association (1993): Directory of Livestock Auction Markets in England Wales and Scotland. Coventry 1993.

MAFF: Agriculture Statistics various editions HMSO London.

MAFF: Annual Review of Agriculture various editions HMSO London.

MAFF: Agriculture in the United Kingdom various editions HMSO London.

MAFF: Farm Incomes in the United Kingdom various editions HMSO London.

MAFF (1993) News Release. various.

MAFF (1989) Environmentally Sensitive Areas: a report under Section 18(8) of the Agriculture Act 1986 Ministry of Agriculture, Fisheries and Food, HMSO: London

MAFF (1990) UK ESA Statistics MAFF

MAFF (1991) Ministerial Information in MAFF (MINIM) 1990 Ministry of Agriculture Fisheries and Food

Marks, H.F. (1989): A Hundred years of British Food and Farming. A Statistical Survey. Ed Britton, D. Taylor and Francis. London.

Meat and Livestock Commission : European Handbook. Milton Keynes, UK.

Meat and Livestock Commission (1993): Meat Market Review. various issues. Milton Keynes.

Nix, J. : Farm Management Pocketbook. Farm Business Unit, Wye College, University of London.

Spedding, C. (Ed, 1983) Fream's Agriculture Sixteenth Edition London: John Murr

NCC (1990) Nature conservation and agricultural change Focus on nature conservation series No. 25, Peterborough: NCC

Rawes, M. & Hobbs, R (1979) Management of semi-natural blanket bog in the Northern Pennines J. Ecology, v67, 789-807

Russel, C.S. and Shogren, J.F. (Eds, 1993) Theory, Modelling, and Experience in the Management of Nonpoint-Source Pollution Kluwer Academic Publishers

Steven, G. and Biron, E.M. (1993) Oxfordshire chalk grassland botanical survey and evaluation 1991-1992 English Nature. South Region.

Toepfer International (1993): Grain and Feedstuffs Market Statistics. 1992/93 edition.

Whitby, M. C., Coggins, G. and Saunders, C. M. (1990) Alternative Payment Systems for Management Agreements Nature Conservancy Council

Williams, O.B., Wells, T.C.E. and Wells, D.A. (1974) Grazing management of Woodwalton Fen: seasonal changes in the diet of cattle and rabbits. Journal of Applied Ecology, v11, 499-516

Withrington, D. and Jones, W. (1992) The Enforcement of Conservation Legislation: protecting Sites of Special Scientific Interest in Howarth, W. and Rodgers, C. P. (eds.) Agriculture, Conservation and Land Use: Law and Policy Issues for Rural Areas University of Wales Press: Cardiff.

Wyatt, B.K., Greatorex, Davies N, Bunce, R.G.H, Fuller, R.M. and Kill, M.O. (1993) Comparisons of Land Cover Definitions, Final Report to DOE ITE Mnnkswood