A GIS-based Approach to Reconstructing Mid-20th Century Agricultural Land Use Around Lewes, East Sussex

by

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ABSTRACT

The main objective of this project has been to reconstruct agricultural land use around Lewes, East Sussex between 1931 and 1959. The key aims were to contribute to the debate around theories of productivism and to demonstrate the power of GIS as a tool for historical reconstruction.

The data for 1931 included the field sheets and one inch maps from the First Land Utilisation Survey, and significant differences were identified between these two sources. The data for the early 1940s included the maps and forms from the National Farm Survey along with a Luftwaffe aerial photograph. Using these, some farms were reconstructed successfully, although there were issues with the consistency of the data. The remaining datasets were aerial photographs from 1945/7 and 1959 along with the parish summaries of the 4th June agricultural census data.

In terms of the productivism debate, a fuller definition of pre-productivism was proposed as a result of examining the 1931 data. The shift towards productivism in this part of East Sussex was considered by looking at the snapshots of land use provided by the different datasets. A clear growth in arable land, an increase in farm size and intensification in terms of livestock farming was identified.

Finally the use of GIS allowed the integration of disparate datasets and the mapping of different types of land use in a way that has not previously been attempted for this area.

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In closing I would like to dedicate this piece of work to the memory of Harry and Valerie Taylor – I hope they would have been proud.

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CHAPTER 1: INTRODUCTION

The Second World War may be seen as a pivotal period for British agriculture. As a direct result of state intervention an "agricultural revolution" occurred which, arguably, changed forever both the attitudes of farmers and the context in which they operated (Short *et al* 2006, p15). This state intervention has continued in various forms ever since, and the result may have been an accelerated rate of change in the British landscape.

The key aim of this study is to reconstruct the agricultural landscape around Lewes, East Sussex between the early 1930s and 1959. This period spans the Second World War and should therefore mean that it is possible to trace the course of this agricultural revolution and see the immediate results from it. There are a number of objectives related to this primary aim.

The first objective is to provide a baseline against which subsequent changes can be measured. This baseline will be taken as the data from the First Land Utilisation Survey (LUS). The fieldwork for this was completed in East Sussex in 1931 although the results were not published until 1936.

The second objective is to contribute to the theoretical debate surrounding productivism. The period before the Second World War could be said to be pre-productivist. Whilst theories of productivism and post-productivism have been the subject of considerable debate, pre-productivism has been largely ignored. What, then, are the characteristics of the agricultural landscape of East Sussex in the early 1930s, and can these be said to be distinctively pre-productivist?

Thirdly, it has already been noted that the Second World War was a period of profound change in agriculture in Britain. The next objective, therefore, is to attempt to quantify the changes that took place over the period being studied. Does this represent a clear transition from pre-productivism into a productivist agricultural regime?

The final objective is methodological and is to demonstrate the power of GIS as a tool for historical reconstruction. The use of GIS allows the analysis and integration of disparate datasets in a way that would previously have been impossible or, at least, prohibitively time-consuming.

The study uses five datasets to allow a series of snapshots in time to be analysed and compared. The first of these is the LUS which has already been alluded to. The second is a Luftwaffe aerial photograph taken in 1940. The National Farm Survey (NFS) is a rich source of data and the maps and forms from this, including the 4th June 1941 census forms, are taken as the third dataset. The last two sources of data are both RAF aerial photographs. The first series of images was mainly taken in 1947, although one section of the study area was flown in 1945. The second set of images is from 1959. The datasets will be described in more detail in Chapters 4, 5 and 6 as will the steps taken to process and analyse them. In addition to these key datasets, the 4th June agricultural census summaries for the seven parishes which overlap the study area have been used to provide some additional material for 1931-1959.

Acres rather than hectares have been used as the units of area throughout this study. This is due to the fact that historic documents, such as the NFS, all record area in acres. Contemporary writing also discusses acreages and thus it was felt to be most appropriate to stay with the historic measures used. One acre is equivalent to 0.4047 hectares.

This project is particularly concerned with agricultural land use and it is important to distinguish land use from land cover. Stamp described the purpose of the LUS as "finding out exactly for what purpose the surface of the country is used" (Stamp 1964, p21). This seems reasonably straightforward, as does the distinction between land use and land cover made on the DEFRA website:

> "Land use refers to the main activity taking place on an area of land, for example, farming, forestry or housing. Land cover refers specifically to the make-up of the land surface, for example, whether it comprises arable crops, trees or buildings" (Department for Environment, Food and Rural Affairs 2006).

However, in terms of this study, an area of bare ground which was clearly used for agriculture would be classed as Arable land use, even though the land cover at the time was not actually crops.

In some cases, the distinction between land use and land cover may be harder to make. The category of Forest and Woodland, for example, has been adopted for this study, based on the classes used in the LUS. However, as Best notes:

> "All land covered with trees is not used for commercial forestry, and the content of this category can range from trees planted and managed for the production of timber right through to completely unused natural, or semi-natural forest vegetation" (Best 1981, p21).

Therefore the Forest and Woodland category actually includes both agricultural and non-agricultural land.

The thinking behind the choice of land use categories for this project is described more fully in Chapter 4. However it is recognised that some classes fit more comfortably into the broad category of "agricultural land use" than do others. Best comments that "the study of a subject has limitations imposed on it by its basic data" (Best 1981, p20) and this project has been constrained by the data available. It was simply not possible to make fine distinctions between different types of woodland and their uses based on the aerial photographs and so the final categories represent something of a compromise between land use and land cover.

Turning to the methodology employed to conduct the study, it was decided to concentrate on one larger area in detail rather than to look at small samples from a number of different areas. The reasons for this are discussed in more depth in Chapter 3. The study concentrates on a particular section of East Sussex, around the county town of Lewes. The next section will describe this area and explain why it was chosen.

The Study Area

The study area comprises some 21,700 acres of land in the county of East Sussex, England. Figure 1 shows the location of East Sussex in the South East region of England.

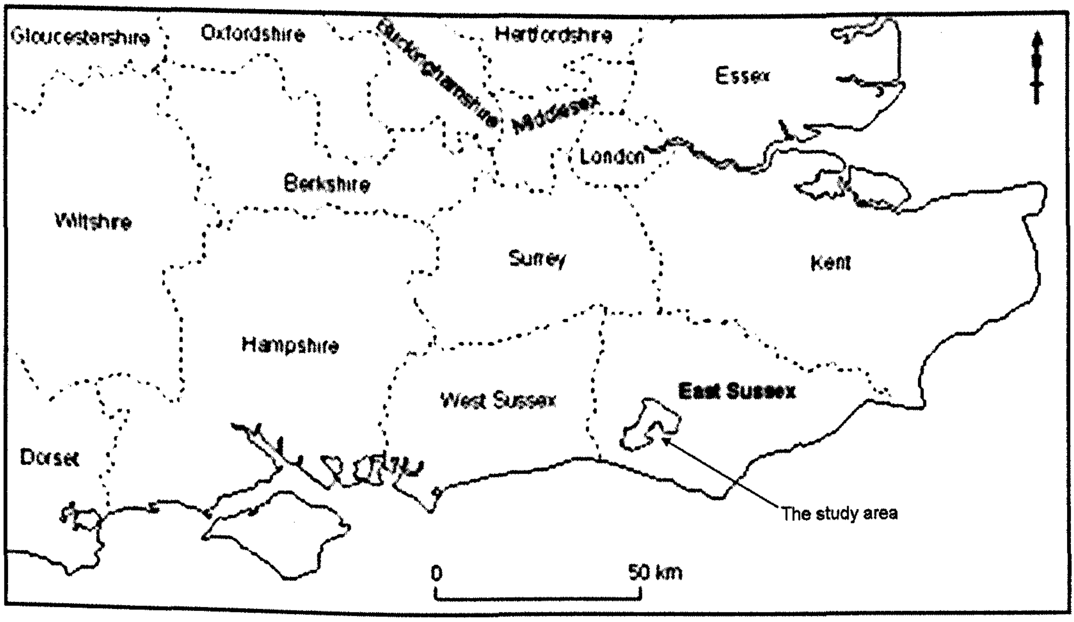

Figure 1: The location of East Sussex in South East England

Figure 2 shows the extent of the study area itself, depicted by the dotted blue line, with the seven parishes which overlap the chosen study area labelled. Names of three of the parishes have been abbreviated as the full titles are slightly cumbersome – throughout this study, Kingston near Lewes will be referred to as "Kingston"; (Lewes) St Anne Without will be called "St Anne" and (Lewes) St John Without simply "St John."

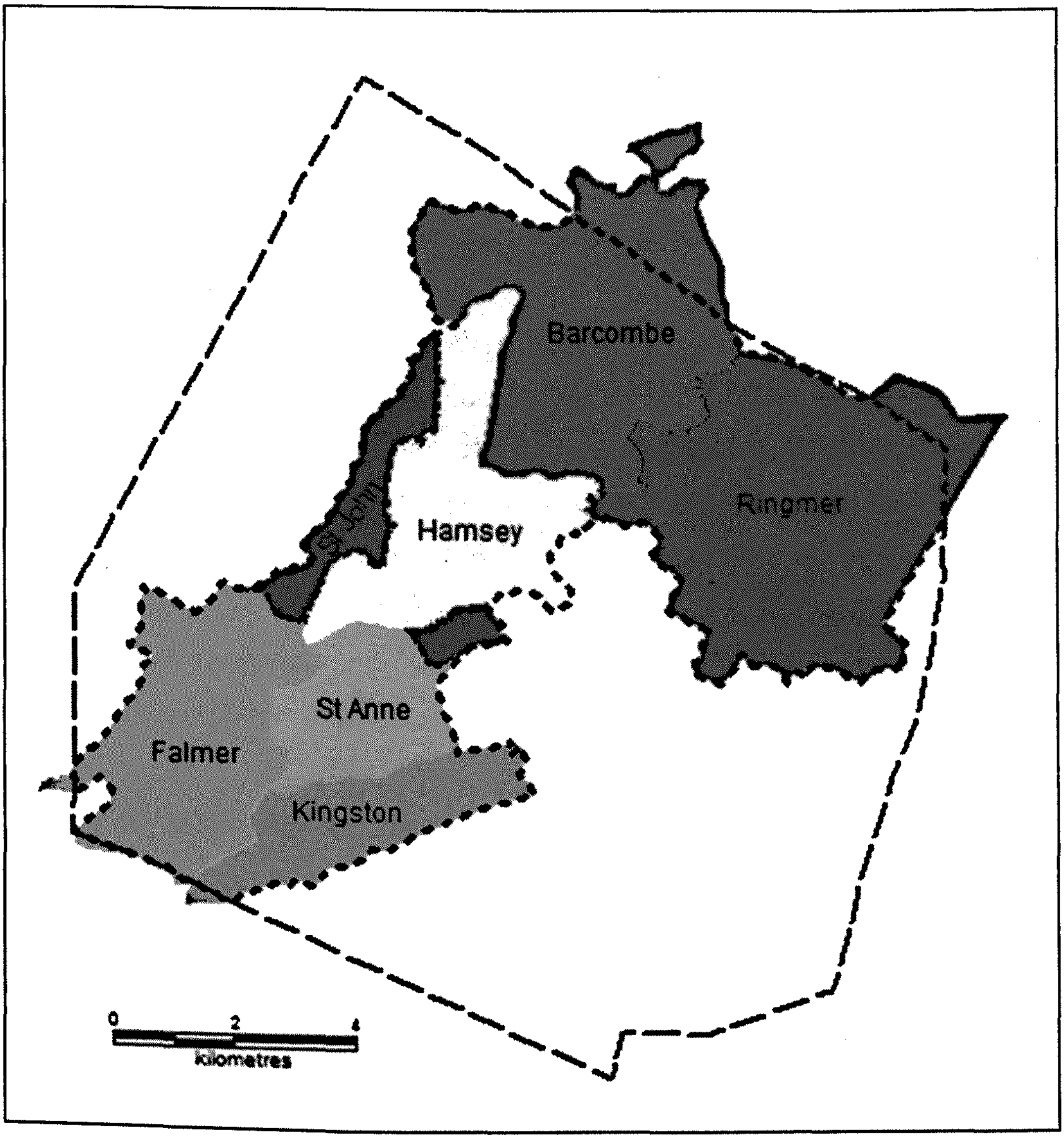

Figure 2: The parishes forming the study area
Source: Parish boundaries from UK Borders

It is clear from Figure 2 that parts of some parishes, such as Barcombe and Ringmer, are excluded from the study area. It has already been noted that one of the datasets is a 1940 Luftwaffe aerial photograph, centred on Lewes, which is held at the University of Sussex. The footprint of this image is shown as the red dotted line on Figure 2 – the shape is distorted due to variations in scale across the photograph. Parts of some parishes are excluded as they fall outside the area covered by this particular image. Whilst the RAF images are reasonably easy to come by and include much of the UK, Luftwaffe imagery tends to be centred on major towns and industrial centres (UK Aerial Photos) and much of the rest of the country is not covered. The original Luftwaffe images were held at the US National Archives, Maryland at the time this project was commenced, and they were difficult to access. Thus it was felt to be expedient to confine the study to the area covered by the image that was already available.

In terms of data availability, a further reason for the selection of East Sussex as the study area was that the quality of the NFS data was known to be good. Short *et al* (2000) had previously undertaken extensive research using the NFS records, and had analysed a "Sussex Sample" including "1200 holdings covering large areas of the South Downs and part of the Sussex Weald" (Short *et al* 2000, p10). They found that the NFS records for Sussex were relatively complete and that the maps were in good or very good condition (Short *et al* 2000, p145).

Whilst data availability and quality played some part in the selection of the study area, it must be emphasized that this was not the only reason for this choice of location. A particular advantage of this part of southern England is the variety of landscape types and geology which are found in a small area. Brandon and Short comment that:

> "The relationship between geology, farming, employment and landscape is by no means one of simple determinism. Nevertheless the soils have exerted a profound influence on agriculture, and it is impossible to divorce geology from any consideration of topography, rural settlement, agrarian history and vernacular architecture" (Brandon and Short 1990, p8).

Figure 3 shows a geological map of East Sussex. The area to the south of Lewes lies on Chalk as would be expected from the presence of the South Downs. To the north and north east of Lewes are beds of Gault Clay, Upper and Lower Greensand and then more (Weald) clay. The chosen study area therefore contains areas of both Weald and Downland which have quite different characteristics.

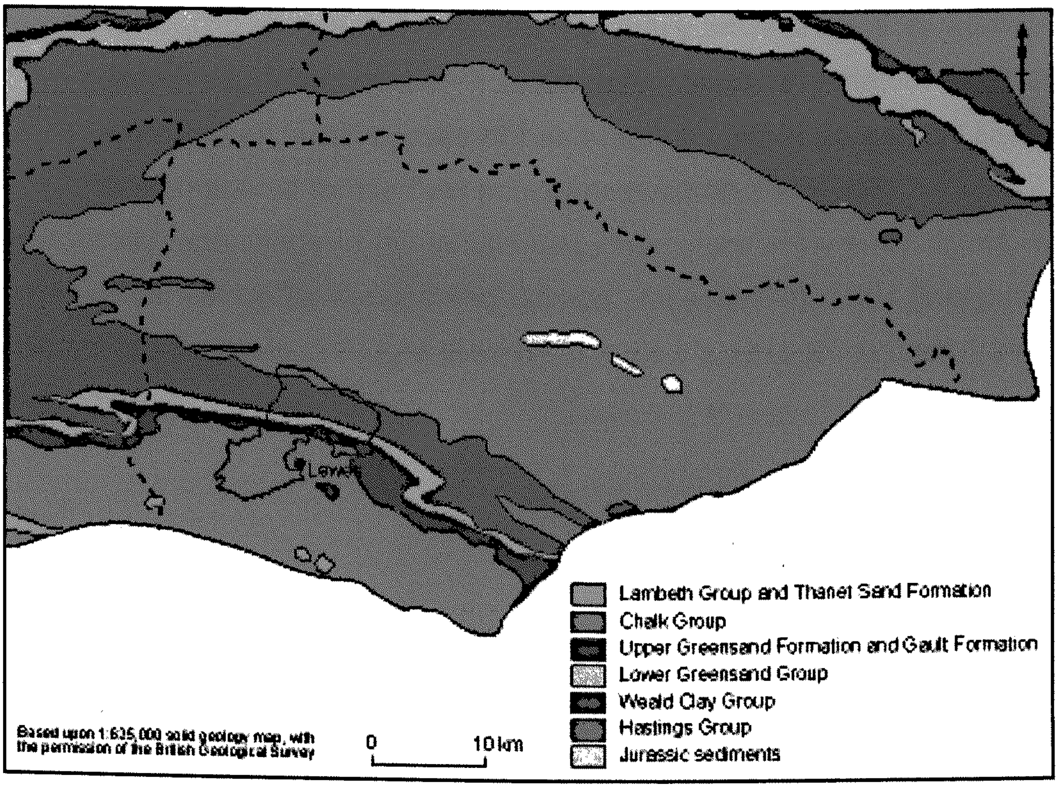

Figure 3: Geological map of East Sussex

Short comments that:

> "The contrast between open, chalk landscapes and wooded environments is one that echoes through much of Western Europe. Where these two environments are juxtaposed, each has been exploited by mankind for the different resources that they offer – the contrasts have been summarised as being that of different *pays*, regions of human and physical distinctiveness" (Short 2006, p52).

Jesse concurs that "The Chalk formations of Sussex are so very different from those of the Weald that it is not surprising that an entirely different type of farming has evolved on them" (Jesse 1960, p15).

The Weald

The northern section of the study area lies on the Low Weald. Short describes this as an

> "elongated horseshoe-shaped clay vale, bounded for much of its outer length by the Greensand. In this flat, low-lying and frequently

wet environment altitudes rarely exceed 40m and are often as low as 15m. The area is well-wooded, with many fields created by woodland clearance. Their species-rich shaws contain many mature trees and run between small copses of oak and birch, while occasional lines of trees mark out former field boundaries" (Short 2006, p53).

Historically, agriculture in the Weald was characterised by small farms with small fields, cut up by hedges and ditches (Jesse 1960). This field pattern can still be seen, as in Figure 4 which is a view across Knowlands Farm in Barcombe.

Figure 4: Knowlands Farm, Barcombe (January 2009)

The predominant type of land use was woodland or poor grass, ploughed up to produce corn "in times of exceptionally high prices" (Brandon and Short 1990, p10). In 1914 over 75% of wealden farmland was under grass (Brandon and Short 1990, p326) and by the 1930s this had increased to over 80% (Brandon and Short 1990, p330). Brandon and Short (1990, p8) quote Reid (1958) who says that "according to clay farmers, theirs is a man's land, compared with the boy's on the chalk."

Robinson and Williams explain some of the particular problems the farmers on the Low Weald have to contend with:

> "In very wet weather, water frequently lies on the surface, especially in the Low Weald where much of the land is flat or very gently sloping. In contrast, in dry periods during the summer, the soils dry out, become very hard, and extensive cracking tends to occur, especially in those soils developed on Gault Clay (Robinson and Williams 1983, p109).

Figure 5: View across the Weald towards the South Downs from Mount Pleasant Farm, Spithurst (January 2009)

Jesse notes that the timing of arable planting has to be carefully judged as a result of these problems: "If the land can be cultivated early and the crops well-established before the Winter commences, good crops can be expected. Late-sown crops are hopeless on the wealden clay, whether sown in Autumn or in Spring" (Jesse 1960, p20).

Before the advent of metalled roads, much of the area was inaccessible in poor weather due to its "wet, miry country" (Brandon 1974, p29). This had a knock-on effect for agriculture. As Brandon and Short comment, "there was little incentive to produce surpluses when the market was so hard to reach, except for animals which went to market on the hoof" (Brandon and Short 1990, p13). Settlements tended to be strung out along the edges of such roads as there were, and were often small and scattered.

By the 1930s, the beginning of the period covered by this study, dairying, poultry production, and pig farming had emerged as the main components of wealden farming, assisted, no doubt, by the establishment of marketing boards at this time. Brandon and Short comment that:

> "Many now turned to milk production from all-grass farms, using purchased concentrates. If the pre-war period [World War One] marked the beginnings of large-scale interest in dairying, it was the interwar period which established it as the lynch-pin of wealden agriculture" (Brandon and Short 1990, p330).

<u>The Downs</u>

The scarpfoot zone at the foot of the Downs is prime agricultural land, in stark contrast to the poor clay of the Weald. The Downs, themselves, however, are less promising, characterised by sticky clay on the summits and dry flinty soil on the upper slopes (Brandon and Short 1990, p10). Leonard describes three components of the landscape of the South Downs as they would have been in summer 1940:

> "*Woods, heaths and commons* on which the dominant vegetation and wildlife had derived from the wildwood and would have been recognized by the average Roman or Saxon. Most were used to produce fuel, fencing and fodder and formed part of the broad farming system.
>
> *Chalk downlands and rough grazings,* much modified by centuries of sheep-grazing, and a core part of the farming system.

> *Cultivated lands,* which were used for cereals, roots and short-term leys, which were the second core part of the farming system" (Leonard 2007, p92).

Brandon notes that "broadly speaking about one third of a downland farm in 1900 was downland, over one third arable and the rest meadow, parkland or woodland" (Brandon 2007, p7).

The type of agriculture practised on the Downs has often been referred to as 'sheep and corn.' Jesse describes farming on the Chalk as follows:

> "The Southdown flock would consist of some four hundred ewes with their followers. The rotations were always based on the needs of the flock. Each farm had its arable land but there was always a wide stretch of turf which never came under the plough. The flock was folded at night but roamed the hill by day. It was the main aim of the Chalk farmer to provide a succession of succulent crops for folding...The fertility of the arable land was kept up by folding the flock which gathered fertility from the hills and left it at the fold" (Jesse 1960, p15).

Brandon comments that the landscape of the Downs before the Second World War was "very much the creation of sheep, it being a 'sheep-adapted' community of plants which were capable of sustaining their constant cropping" (Brandon 2007, p9). Short notes that today "the soft, springy unimproved chalk grassland is again species-rich but has declined as a result of the decrease in sheep farming, changing patterns of land use and the invasion of scrub" (Short 2006, p50).

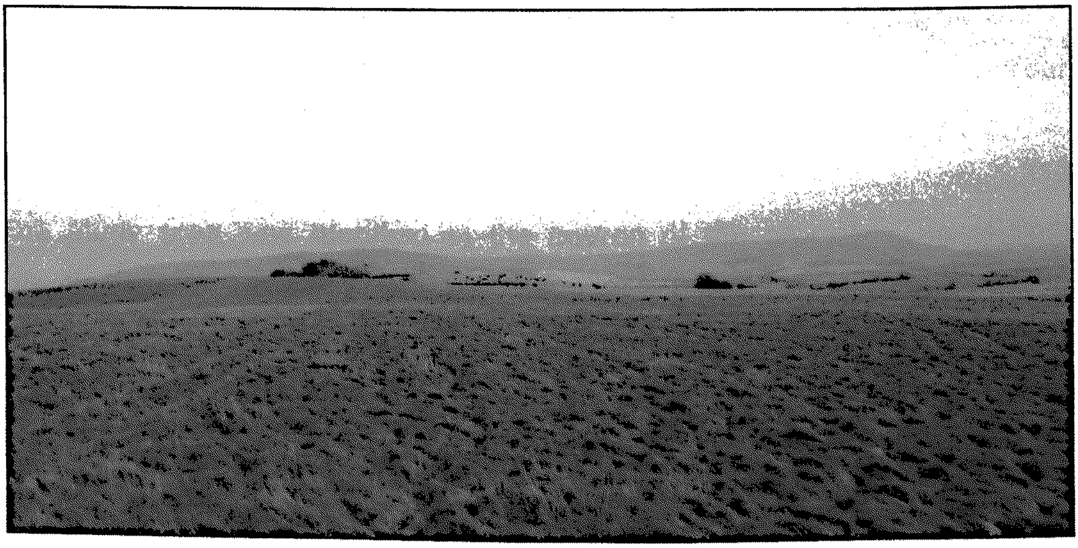

Figure 6: The South Downs near Kingston from Ashcombe (January 2009)

In terms of settlements, there are few on the Downs themselves, and Thornhill notes that "here and there on the Downs one meets with a lone barn more than a mile from its parent farmhouse" (Thornhill 1935, p81). Short comments that, "scattered villages, hamlets and isolated farms with traditional barns occur in the dry valleys of the dip slope, clustered along the scarp foot, or within the river valleys" (Short 2006, p51).

The character of the Weald to the north of the study area is therefore clearly different from the Downs to the south. They are both geologically and topographically different. This is apparent from even a cursory glance at the 1940 Luftwaffe aerial photograph (Figure 52) where the Weald is characterised by a patchwork of fields whereas the Downs appear much more open and featureless. Short notes that "Downland concentration and expansion contrasted with the proliferation of wealden smallholdings to produce very different farm structures" (Short 1983, p158).

As the focus for a study on agricultural land use, therefore, the area chosen includes two widely contrasting regions which have evolved very different farming styles over many hundreds of years. This means that many contrasts and comparisons can be drawn which would simply not be possible from a more homogeneous area. This diversity of landscape and farm types also means that any conclusions drawn may have wider application as they do not simply relate to one type of agriculture.

The study area was modified in the course of the project. The original intention had been to include the whole area covered by the 1940 Luftwaffe aerial photograph, but the volumes of data being generated became unmanageable. This description has therefore concentrated on the final study area and its characteristics.

Historical Overview

The previous section has explained the choice of the study area, and the importance of this particular period for British agriculture has also been emphasized. This section attempts to place the study in its wider historical context and to give some general background to agriculture in Britain at this time.

1914-1918

The First World War unsurprisingly had a major effect on Britain as a whole. In terms of agriculture at the beginning of the war, there was some government intervention, for example to secure a reserve of wheat and to control imports. Murray comments that:

> "Though little was done until 1917 drastically to increase home output, there were a few initial steps in 1914-16 which proved useful in view of subsequent developments. At the beginning of the war, the President of the Board of Agriculture and Fisheries established a consultative committee of experts to assist him in advising farmers on future production, and cautious advice was given in August 1914 on cropping for the 1915 harvest" (Murray 1955, p5).

County War Agricultural Committees were established to oversee the production of additional food at local level under the supervision of the Board of Agriculture. The term "Executive" was added to the Committee title in 1917 with the extension of their powers – Lord Ernle described the purpose of these Committees as "the improvement and extension of arable cultivation, with spade as well as plough; decentralization; and drastic powers of compulsion which could only be justifiable or tolerable in a war emergency" (Lord Ernle 1925, p107). These extended powers were tied in with the plough up campaign which was initiated in 1917 in order to increase the supply of home-grown wheat and potatoes. This was to be achieved in the main by ploughing up grassland which had been laid down since 1875. Ideally this would be done with the cooperation of the farmer but in some instances compulsion proved necessary. Lord Ernle comments that:

> "To meet the large war demands for increased corn and winter fodder, the existing area under the plough was inadequate, and it was impossible to 'keep off the grass,' because the release of its stored up fertility dispensed with the need of imported fertilizers" (Lord Ernle 1925, p107).

As a result of the efforts of the Committees the area under cultivation in England and Wales grew by 5.8% in 1917 and by a further 21.3% in 1918 (Crowe 2007, p209). By 1918 the area of tillage in the UK was 12.36 million acres, a rise of 18% on the pre-war area (Dewey 1997, p36).

1918-1939

After the First World War there was a growing desire for more precise information about land use in Britain. Urban land was beginning to encroach on agricultural land and there was a feeling that this should be managed and planned. However there was a lack of land use data for the country as a whole to enable this planning to be carried out. Stamp, writing about this period, commented:

> "That there has not been in the past the possibility of execution of comprehensive land use plans has been the excuse for the absence of data essential for proper planning, and it has been one of the

objects of the Land Utilisation Survey to provide at least some of these essential basic data" (Stamp 1964, p433).

The Ordnance Survey began publishing County series mapping of Great Britain in 1853-4 at 1:2500 scale. Between 1855 and the mid 1880s these maps were accompanied by "Books of Reference" giving the acreage of each parcel and its land use. However after October 1879 the land use information was omitted and the distinction between arable, grass and market gardens was lost (Oliver 2005, p54). By the time of the first revision maps the information available regarding land use was very limited. This can be seen from Figure 7 which shows an extract from the first revision of the 1:2500 County series map for Barcombe together with an extract from the legend. These maps were published between 1891 and 1912 (University of Edinburgh 2004). Woodland can be readily identified. However the land use for the open areas is not given.

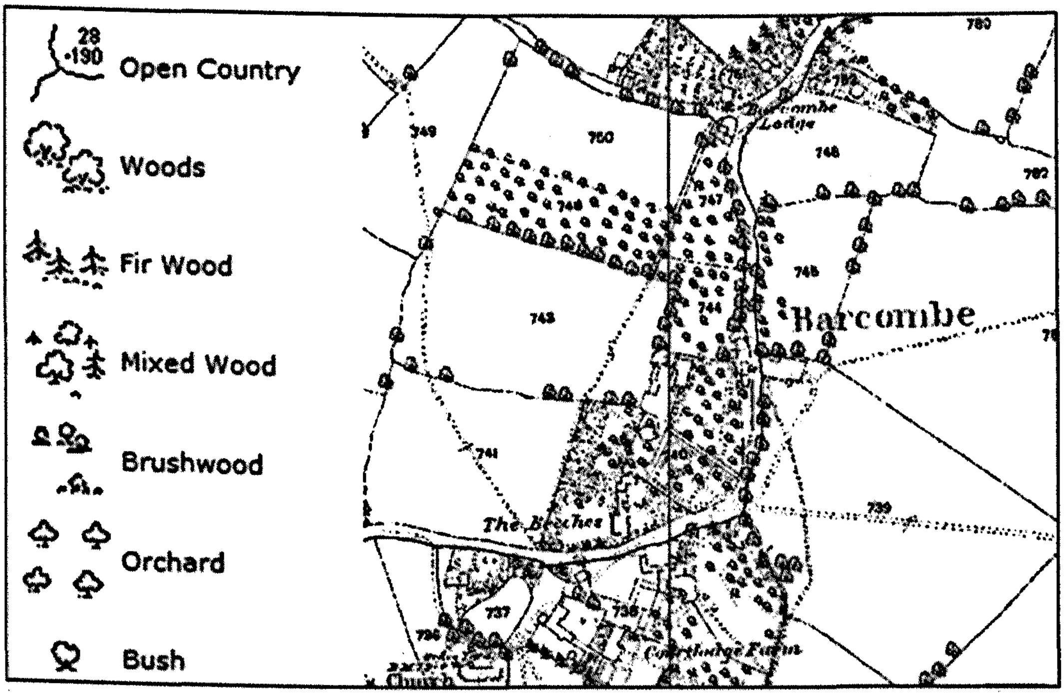

Figure 7: The village of Barcombe, East Sussex as represented on the first revision County series map (1:2500) © Landmark Information Group Ltd and Crown Copyright 2005

The idea of regional surveying to fill in these gaps in knowledge was being embraced by many geographers and in 1918 the Geographical Association set up a Regional Survey Standing Committee. As a result of this a number of small areas were surveyed and the results published (Stamp 1964, p3). Matless comments that "the regional survey movement was part of a much broader culture of landscape in inter-war Britain" (Matless 1992, p475) and argues that two of the key elements of that culture were the Scouting and Guiding movement, and the "broader upsurge in rambling in the twenties and thirties" (Matless 1992, p476). It is interesting to note that the South Downs became caught up in this culture of landscape. Brandon comments that "they became the object of a veritable popular cult which projected them as the halcyon image of a landscape embodying what was claimed to be the quintessence of English ideals" (Brandon 2007, p4).

Stamp attended an exhibition of Regional Survey work in January 1929, and commented afterwards that "This...revealed two things: what a small part of the country had been covered and what very different viewpoints were taken in the surveys so that scarcely two produced comparable data" (Stamp 1964, p4). Following this, Stamp began to consider the idea of a countrywide survey.

The first Land Utilisation Survey (LUS) was piloted in 1930 and the field work was mostly completed between 1931 and 1934. The process is described in more detail in Chapter 4. The LUS maps for East Sussex were published in 1936.

In addition to a growing interest in actually quantifying the land use of Great Britain, there were a number of other developments in the inter war years which accelerated the process of agricultural change. These are summarised in Table 1.

Year	Event	Consequence
1919	Royal Commission set up to examine the future of cereal prices	The 1920 Agriculture Act was passed to support the prices of wheat and oats
1921	Imports of wheat from overseas were resumed	Wheat prices plummeted in the UK and the government realised it could no longer afford to support prices
June 1921	The Agriculture Act was repealed	A return to a free market economy. Regarded by some farmers as "The Great Betrayal"
1925	British Sugar (subsidies) Act	Passed to encourage the cultivation of sugar beet in the UK and thus to reduce dependence on sugar imports
1929-1932	The impact of the depression peaked in Britain	Agricultural prices fell by one third between 1929 and 1932 (Robinson 1988, p147)
1931	Agricultural Marketing Act	Provided for the establishment of producer-controlled marketing boards to strengthen the buying power of producers and promote orderly marketing (Robinson 1988, p148)
1932	The Wheat Act	Subsidised wheat growing via a "standard guaranteed price" (Dewey 1997, p223)
1932	Introduction of a Hops Marketing Board	As above
1933	Second Agricultural Marketing Act	This authorised producers to control output as well as the prices of their products (Dewey 1997, p224)
1933	Milk Marketing scheme introduced	As above
1934	Potato Marketing scheme commenced	As above
1934	Bacon Pigs Marketing scheme introduced	As above

Table 1: Main events affecting British agriculture between the wars

One of the consequences of the depression in the 1920s was that many farms were sold off due to mounting debts. Before this in East Sussex, landownership had mainly been concentrated in the hands of a just a few individuals, whereas now for the first time in many hundreds of years the pattern of landownership began to undergo significant change. Brandon and Short estimate that "in Sussex as a whole between 1913 and 1927 the number of owner-occupiers tripled, and by 1941 43.5 percent of Sussex farms were owner-occupied" (Brandon and Short 1990, p330). A further consequence of the depression was the increase in agricultural land turned over to grass and even allowed to become derelict. Brandon and Short note that in the Weald "by the 1930s permanent pasture again covered over 80 per cent of the farmland" (Brandon and Short 1990, p330).

The free market policies of the 1920s increasingly gave way to government support for, and control of, agriculture during the 1930s. Self and Storing term this a "drastic change in public agricultural policy" and argue that "from this point can be dated the modern period of state intervention, assistance and control" (Self and Storing 1962, p18). This intervention began in earnest with the defeat of the Conservative government in May 1929 (Short *et al* 2000, p16) and continued with a succession of agricultural acts and marketing schemes designed to support and strengthen the industry. By 1939, there were "seventeen boards or associations of producers in active operation in Great Britain" (Murray 1955, p28). In addition, import duties were imposed on certain food imports from other countries, such as beef, mutton and lamb, bacon and ham, by the 1932 Import Duties Act which allowed "for the first time, for the quantitative regulation of imports, whereby definite import quotas were allocated to various supplying countries" (Murray 1955, p29).

However, despite increasing government intervention it was becoming clear that farming in the UK was in desperate decline. The area of land in England and Wales dedicated to arable cultivation fell by over six million acres between 1871 and 1938 as shown in Figure 8.

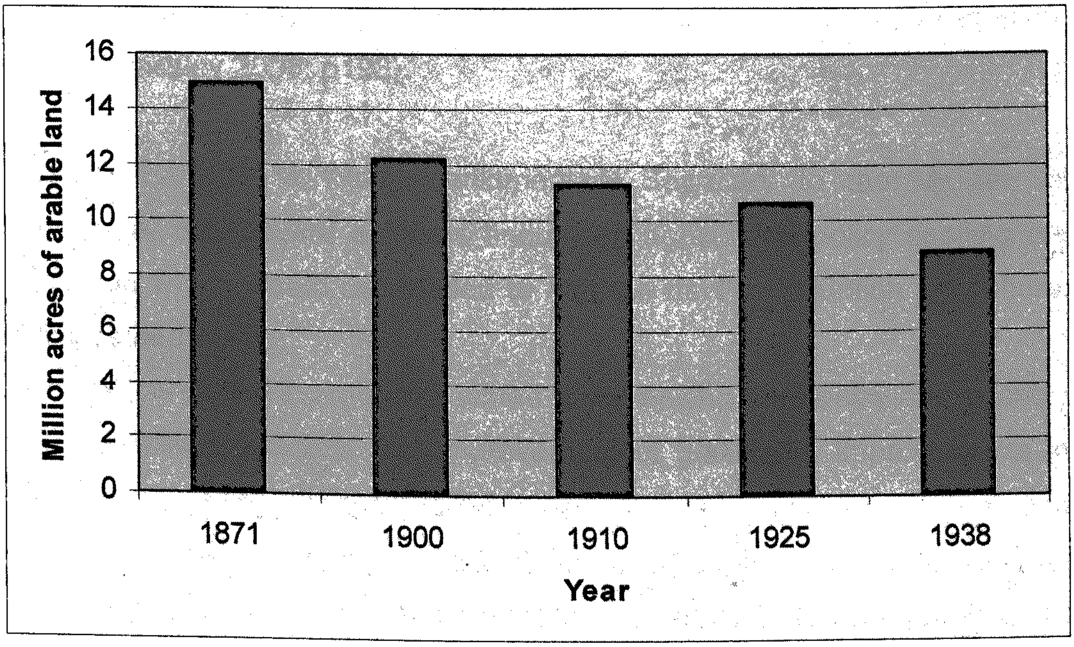

Figure 8: The decline in arable land in England and Wales 1871-1938 (Scott Report 1942, p14)

By 1932 more than 15.8 million acres of England and Wales were classified as permanent pasture and by 1938 almost one in five farmers derived their primary incomes from other sources (ie they were classed as part- or spare-time farmers (Martin 2006, p17). Murray notes that:

> "the agricultural area in the United Kingdom had fallen, during the twenty inter-war years by some 2½ million acres to just over 31½ million acres, of which only 9 million acres were under crops other than grass, 4 million under rotation grass and 18½ million under permanent grass. In addition there were some 16½ million acres of rough grazing of indeterminate agricultural value" (Murray 1955, p39).

However, Brassley challenges the idea that this was a period of unmitigated depression:

> "The interwar years were, for the farming industry, a mixture of decline and regeneration. There was increased emphasis on agricultural science...There were successful farmers introducing new techniques such as mechanisation and bail milking, and perhaps even overall productivity rose. But some farmers went bankrupt, workers left the land, farm incomes fluctuated a lot and there was a

feeling that dog and stick farming was not quite the proper farming" (Brassley 2006, p198).

In 1939 Earl de la Warr, Parliamentary Secretary to the Minister of Agriculture, put forward a memorandum on agricultural policy spelling out the action which would be needed to halt the decline in British agriculture. This included:

> "A concerted programme aimed at increasing the quality and quantity of milk production, the improvement of grassland, improvements in slaughtering of home-killed meat, the reorganisation of fruit and vegetable marketing, modifications to the agricultural credit scheme, re-equipment grants, the purchase and re-equipment of neglected or derelict land by the State, and the improvement of rural housing" (Short *et al* 2000, p17).

Thus the government was already considering drastic intervention in the farming industry well before the outbreak of war.

<u>Agriculture in the Second World War</u>

Murray notes that there were three main considerations to be taken into account when drawing up a food production programme in the event of war. The first of these was the continued availability of imported supplies – would these be obtainable in a time of war? Secondly, a consideration of the nutritional needs of the country in wartime in terms of maintaining a balanced diet for health and growth was considered to be vitally important. The third aspect was agricultural practicability:

> "The limits set by natural factors such as climate, soil or topography were clearly recognisable but there were others of great importance such as the supplies of labour, machinery and equipment, fertilisers and other agricultural requisites...the capabilities, knowledge and experience of farmers were also factors that might well condition a production programme" (Murray 1955, p42).

The CWAECs set up during the First World War were revived during 1936-38 and were endowed with extensive powers under the Defence Regulations to "take possession of land, requisition property, enter upon and inspect land, control the use of agricultural land and direct the cultivation of agricultural land" (Short *et al* 2000, p30). Their role in the administration of British agriculture increased as the war continued and they were also responsible for undertaking the National Farm Survey of 1941-3 which is discussed in more detail below.

In April 1939, 6 months before the outbreak of war, proposals were passed for a payment of £2 per acre for the ploughing up of permanent grassland, to be sown with wheat, potatoes, oats, barley, beans, rye or mixed corn. Also, additional quantities of fertilisers were bought and stored by the government, along with 3-5,000 tractors (Murray 1955, p57).

A farm survey was initiated in 1940 by the Ministry of Agriculture, to be administered by the CWAECs, in order to assist with the 'plough up' campaign and to increase food production. The material produced by this first survey was inconsistent and incomplete. However, an extended farm survey was proposed, using a standardised form and this became the National Farm Survey (NFS) which was conducted between 1941 and 1943 although the first summary report was not published until 1946. The NFS is described in more detail in Chapter 5.

By the end of 1941 an extra 4.25 million acres of permanent grassland had been ploughed up (Short *et al* 2000). A further 1.5 million acres was ploughed up in 1942 and 1.1 million acres in 1943. Short comments that:

> "'Dog and stick' farming was replaced suddenly but conclusively over much of the countryside by a wartime emphasis on ploughing up grassland and scrub for human food supplies, a process whose effects, and the reactions to it, have lasted into the twenty-first century" (Short 2007b, p219).

Self and Storing note that "during the war the great bulk of agricultural output was purchased by the Government at fixed prices, and the farmer had an assured market and known price for all he was able to produce." (Self and Storing 1962, p62) and Holderness adds that:

> "Agricultural prices, which determined prosperity in the industry, rose three times as much as the official cost of living between 1939 and 1945...it encouraged farmers to spend, to buy what they could for consumption or investment and especially to acquire land. It also led to a substantial increase in their cash balances which were available for investment in the future" (Holderness 1985, p9).

Farming Post-War

This may be seen as the "productivist phase" of British agriculture (Short 2007b, p218). Productivism will be discussed in more detail in Chapter 2 but it may be broadly characterised as "a commitment to an intensive, industrially driven and expansionist agriculture with state support based primarily on output and increased productivity" (Lowe *et al* 1993, p221). Self and Storing comment that "In Britain, since 1945, the state has assumed an unprecedented degree of responsibility for the functioning and welfare of agriculture" (Self and Storing 1962, p15).

Immediately post-war, the government was concerned to maintain national food supplies and so was committed to expanding agricultural output. The 1947 Agriculture Act may be seen as the first stage in post-war agricultural policy, and was passed with the aim of ensuring that "an adequate supply of food should be maintained at a moderate cost whilst making efficient use of domestic agricultural resources" (Robinson 1988, p150).

There were two parts to the Act. Part I legislated for the Minister of Agriculture to undertake an annual review of the industry in order to produce a "report of conditions and a forecast of trends for the coming year, undertaken in consultation with producers' representatives" (Holderness 1985, p14). Part II of the Agriculture Act "made far-reaching proposals for structural reform in order to increase efficiency" (Holderness 1985, p17). County Agricultural Committees were established to take over where the wartime CWAECs had left off and a combination of incentives and coercion was adopted to "encourage" farmers to adopt more productivist ways of farming. The power of these County Agricultural Committees "stopped short of confiscation, but the committees were allowed to evict bad tenants and to impose practices of good husbandry upon owners and owner-occupiers" (Holderness 1985, p17). Also in 1947 the National Agricultural Advisory Service was initiated which combined regulatory and advisory roles. Holderness comments that:

> "The tendency to impose uniformity upon the whole of a region's agriculture, the too close association of advising and sanctions and the rather unclear status of the committees' judicial functions were controversial from the beginning" (Holderness 1985, p18).

The 1949 Agricultural Marketing Act resurrected the pre-war marketing boards, and free market prices were supplemented by direct "deficiency payments" to farmers in order to guarantee prices. "The idea was to use the annual review...to fix the price standard for each product year by year. This price would be guaranteed, and any deficiency between the standard and actual market price would be compensated by the government" (Holderness 1985, p20). Robinson notes that:

> "Three types of measure were used to limit the cost of agricultural support. These were the use of marketing boards to recoup revenue when market prices were high; the use of standard quantities for produce, such as milk, pigs, eggs and cereals, whereby exchequer support was reduced progressively as production rose above a specified quantity; and, from 1964, the control of cereal imports by a minimum import price" (Robinson 1988, p150).

In 1949 the Calf Subsidy was introduced to encourage the retention of beef calves for rearing rather than slaughter, and in 1952 the Ploughing Grant provided a payment to farmers for cultivating land which had been "in grass for at least three years" (Robinson 1988, p208) with the aim of encouraging ley farming, whereby land was grazed for a period of time then planted with a corn crop for two or three years before reverting to grass to recover its fertility. Neither of these initiatives was entirely successful – Robinson notes that the Calf Subsidy "tended to act as an income supplement rather than as a production deterrent" whilst the Ploughing Grant "followed and subsidised increases in the area of tillage" in areas of mixed farming, only successfully fostering ley farming in upland areas (Robinson 1988, p208).

Holderness argues that the second stage of the government's post-war agricultural policy began around the time when all food rationing was abolished (1953-1954) and lasted until 1960 (Holderness 1985, p19). The gap between standard and actual market prices widened considerably in the middle and late 1950s as domestic and world supplies improved – the government therefore cut guaranteed prices for milk and pig meat in 1953-1955 which caused uproar amongst the farmers. Self and Storing comment that:

> "Two cuts in the pig guarantee still left the pig subsidy costing a quarter of total Government support for 1955-6, which led the Chancellor to comment ruefully that on the national farm all animals might be equal but pigs were more equal than the others" (Self and Storing 1962, p72).

The 1957 Agriculture Act was an attempt at appeasement after the uproar of 1953-1955. It "bound the government not to make reductions in guaranteed prices by more than 2½ per cent in any one year" (Holderness 1985, p21). There was a shift in emphasis towards production and improvement grants rather than price supports during this period. Farm Improvement Grants were introduced in 1957 with the aim of "stimulating capital investment in fixed equipment and land improvement in order to increase efficiency" (Robinson 1988, p209). Small Farm Grants, available initially to farms of approximately 20 to 100 acres, were initiated in 1959 with the objective of enabling "economically marginal small farms to become properly equipped, stocked and managed" (Robinson 1988, p209). A further shift in emphasis at this time was the move away from bureaucratic intervention in agriculture. Part II of the Agriculture Act was repealed in 1957 and the County Agricultural Committees were abolished.

In addition to policy developments in the post-war period, there were several other key factors in the development of agriculture. The first of these was the exponential increase in mechanisation. In 1939 fewer than one in six farmers owned a tractor (Martin 2006, p16), but over the next six years the number of farm tractors tripled (Dewey 2006, p99). Combine harvesters increased twelve-fold in the 1950s and 60s, and livestock farmers were affected "by the age of the electric motor, with milking machine units numbering 300,000 by 1960" (MAFF 1968) (Robinson 1988, p153).

The second key factor was the growing use of biochemical inputs. Robinson comments on the "tremendous increase in the value of inputs purchased off the farm, largely because of advances in the techniques, organisation and scale of the industry which have reduced the real cost of the purchased inputs" (Robinson 1988, p153). The use of fertilisers such as nitrates and phosphates was subsidised by Improvement Grants.

Finally, the trend from the end of the 1950s was toward a growth in farm size and increased specialisation. Walford notes that:

> "Among the significant outcomes of agricultural restructuring during the post-war decades were a decline in the number of farmers and farm holdings, and an overall increase in average farm area. Farms in England and Wales almost doubled in size between 1941 and 1998 (82 acres to 153 acres) with a similar increase in south-east England" (Walford 2006, p219).

The English landscape at the end of the 1950s thus looked very different to the landscape of the 1930s. Farm holdings were larger as were fields due to increased mechanisation. Farm output was more specialised and large fields of cereals had largely replaced the pre-war grassland.

Summary

This first chapter has laid out the aims and objectives of this study. The key datasets have been briefly introduced and the characteristics of the study area have been described. In addition the historical context has been summarised so that changes in the study area can be seen in the wider context of agriculture in England and Wales during this period.

Chapter 2 reviews some of the key contributions in the theoretical debate surrounding the notion of productivism. The use of GIS-based methodology will be discussed in Chapter 3. The various datasets used will be described in Chapters 4-6, together with the processing steps that were undertaken in order to use them in this project. The preliminary results of the analysis are also presented in these chapters. Chapter 7 considers the results as a whole and evaluates the evidence for land use change over time. In Chapter 8 the results of the study are discussed in the light of the aims and objectives, and considered in particular with relation to the theoretical debate. The study concludes with Chapter 9 which draws all the threads together and reflects on the lessons learned through the research process.

CHAPTER 2: THE THEORETICAL DEBATE

Chapter 1 presented the historical context for this study and this chapter will consider the theoretical background by reviewing some of the literature around productivism and related concepts. The use of GIS in historical geography and the more practical aspects of processing the data will be discussed in Chapter 3.

One of the stated aims of the project is to attempt to define pre-productivism and to consider whether it is possible to see a clear transition to productivism occurring in the study area. Therefore it will be helpful first of all to take a brief look at the theoretical debate in this area. It is important to note that this review will concentrate on agriculture in the UK, as this is the sphere which is of relevance to the area being studied in this project. However in recent years the debate has widened in its scope to include, amongst others, Denmark (Kristensen 2001), Australia (Wilson 2004) and developing countries (Wilson and Rigg 2003).

Since the inception of this project a second strand has emerged in the discussion around productivism. This proposes a new transition theory approach to the debate and argues that post-productivism should be replaced by non-productivism. The more "traditional" view of a transition from productivism to post-productivism and beyond will be examined in the first section of this chapter. The productivism/non-productivism approach will then be presented and discussed towards the end of the chapter.

Productivism

In the early 1990s UK researchers developed and popularised the concept of post-productivism and this, in turn, led to the definition of productivism. Walford notes that:

"Reference to agriculture as operating under a 'productivist' regime is significantly absent from the published literature of the time, and was certainly not articulated by policy-makers or farmers. In other words, 'productivism' has been defined in retrospect once the onset of the new post-productivist era had been proposed" (Walford 2003, p492).

The era of productivism in the UK is generally understood to have lasted from about the Second World War to the mid 1980s (Wilson 2001, p89) although some commentators suggest that the transition to post-productivism began in the 1970s (Halfacree and Boyle 1998, p6). Lowe *et al* characterise productivism as:

"A commitment to an intensive, industrially driven and expansionist agriculture with state support based primarily on output and increased productivity ... By the 'productivist regime' we mean the network of institutions oriented to boosting food production from domestic sources which became the paramount aim of rural policy following World War II" (Lowe *et al* 1993, p221).

The main features of a productivist agricultural regime identified in this definition are increased output and state support. However the characterisation is widened somewhat by Ilbery and Bowler who identify three main theoretical conceptualizations which attempt to explain the dynamics of agriculture during the productivist phase. These are:

Commercialization - measured by the proportion of farm produce sold in the market (Ilbery and Bowler 1998, p58).

Commoditization – farm households become dependent on goods obtained in the market and are therefore drawn into commercial exchanges in order to acquire income for the purchase of necessary farm inputs (Ilbery and Bowler 1998, p59).

Industrialization – this has occurred in a series of steps. First machinery replaced animal power, secondly, the introduction of such inputs as hybrid seeds, fertilizers and agrochemicals allowed the modification or replacement of natural biological processes; and thirdly industrial substitutes were developed for agricultural products, such as sweeteners for sugar and nylon for cotton (Ilbery and Bowler 1998, p60).

Evans and Morris (1997, p189) suggest that productivism is firmly grounded in the philosophy of the 1942 Scott Report, which suggests four main issues with regard to the future of agriculture:

(1) It is essential for the Government to formulate and adopt a long-term policy for agriculture.

(2) Agricultural land must be properly farmed and maintained in good heart, and effective control should be exercised over landowners and farmers and a good standard of farming continually enforced.

(3) Measures should be taken to secure as far as possible stability of conditions governing farming.

(4) Agriculture requires a considerable amount of new capital to enable it to produce more economically and efficiently (Scott Report 1942, p55).

There is a clear theme of state support evident here, together with powers to "enforce" a good standard of farming. The Scott Report notes that land should be "properly farmed" and this would be seen to include both mechanical and chemical inputs in order to increase efficiency. The National Farm Survey will be discussed in detail in Chapter 5, but it is interesting to note that surveyors' comments in Section E of the Primary Return form very strongly reflect the feeling that chemical inputs are desirable. The comments for Parkwall Farm, Falmer (XE 218/98/011) note approvingly that "plenty of lime and fertilisers are used," whereas Mr. Mariner, farming at Townings Farm, Chailey (XE 218/94/022), is told in no uncertain terms that "more fertilisers should be used, particularly on grassland." The emphasis is clearly on "economic and efficient" farming and improving productivity. Davidson and Wibberley writing in 1977, arguably towards the waning of the productivist era, comment that:

"In recent years, the changes in, for example, the size of field, the way in which crops are harvested, the size of farm buildings and the materials of which they are made and techniques of livestock production, have been dramatic enough to convince even the layman travelling through the countryside that something dynamic is happening" (Davidson and Wibberley 1977, p13).

Interestingly, G.P. Wibberley is listed on the Primary Return as having completed the primary record for both Parkwall and Townings Farms, and in fact was closely involved with the surveying of much of East Sussex.

The drive to increase productivity may actually result in considerable environmental damage over the long term. Ilbery argues that:

"One of the greatest ironies is that land use policy had evolved to give a high degree of protection to the basic resource of agricultural land for the primary purpose of food production; yet the success in raising levels of productivity and self-sufficiency had been achieved to the detriment not only of the resource itself, but of the rural environment of which it is part" (Ilbery 1992, p133).

Short comments that "Muted environmentalist arguments might be heard, but the CWAECs, backed by the full force of government and authorities such as C.S.Orwin, had little time to reflect" (Short 2007a, p38).

However, the main threats to the countryside in a productivist regime are not perceived to come from within agriculture but from outside. The terms of reference of the Committee on Land Utilisation in Rural Areas were "to consider the conditions which should govern building and other constructional development in country areas consistently with the maintenance of agriculture" (Scott Report 1942, pii). The authors argue strongly for legislative action to arrest this uncontrolled development, "otherwise the old unregulated sprawl of town into country with all its attendant evils will recommence immediately men and materials are released for the work of physical reconstruction" (Scott Report 1942, pvi).

Wilson helpfully summarises the various conceptualisations of productivism based on seven interrelated themes and his table is reproduced below (Table 2).

Ideology	-Central hegemonic position of agriculture in society (Cloke and Goodwin 1992) -Ideological security (Marsden, Murdoch et al. 1993; Halfacree and Boyle 1998) -Agricultural fundamentalism rooted in memories of wartime hardships (Newby 1985; Bishop and Phillips 1993) -Agricultural exceptionalism (Newby *et al* 1978; Newby 1985) -Belief in farmers as best protectors of countryside (Newby 1985; Harvey 1997) -Countryside idyll ethos/rural idyll (Mingay 1989; Hoggart *et al* 1995) -Main threats to countryside perceived to be urban and industrial development (Ward 1993; Marsden *et al* 1993) -'Rural' defined in terms of agriculture (Halfacree and Boyle 1998)
Actors	-Agricultural policy community small but powerful (Cox *et al* 1986; Gilg 1991; Clark and Lowe 1992; Winter 1996) -'Corporate' relationship between agriculture ministries and farming lobby (Cox *et al* 1988; Winter 1996) -Relative marginalization of conservative lobby at fringes of policy-making core (Cox *et al* 1988; Hart and Wilson 1998)
Food regimes	-Atlanticist Food Order dominated by USA (Goodman and Redclift 1989; Le Heron 1993) -Fordist regime (Goodman and Redclift 1989; Ward 1993)
Agricultural production	-Industrialisation (agri-business) (Marsden *et al* 1993; Whatmore 1995) -Commercialisation (Ilbery and Bowler 1998) -Securing national self-sufficiency for agricultural commodities (Ward 1993; Lowe *et al* 1993) -Intensification (Marsden *et al* 1993) -Surplus production (Ilbery and Bowler 1998) -Specialisation (Ilbery and Bowler 1998) -Concentration (Ilbery and Bowler 1998) -Increase in corporate involvement (Marsden *et al* 1993; Lowe *et al* 1993) -Farmers caught in agricultural 'treadmill' (Ward 1993)
Agricultural policies	-Strong financial state support (Cloke and Goodwin 1992; Winter 1996) -Conservative faith placed in ability of state to plan and orchestrate agricultural regeneration (Marsden *et al* 1993) -Encouragement to farmers to expand food production (Whitby and Lowe 1994) -Government intervention (Marsden *et al* 1993) -Protectionism (Goodman and Redclift 1989), -Price guarantees/ financial security for farmers (Potter 1998) -Agriculture largely exempt from planning controls (Marsden *et al* 1993) -Security of property rights/ land use rights (Whatmore 1986; Marsden *et al* 1993)
Farming techniques	-Increased mechanisation (Ilbery and Bowler 1998) -Decline in labour inputs (Lowe *et al* 1993; Whitby and Lowe 1994) -Increased use of biochemical inputs (Potter 1998; Pretty 1998)
Environmental impacts	-Increasing incompatibility with environmental conservation (Knickel 1990; Clark and Lowe 1992; Potter 1998)

Table 2: Current conceptualisations of productivism (Wilson 2001, p80)

There is, then, broad agreement on the characteristics of productivism although individual authors may differ in the aspects that they emphasize. There is a drive for greater outputs and efficiency, often utilising increased inputs, both mechanical and chemical. These greater outputs are often achieved at the expense of the environment itself, but the greatest threat to agriculture is still perceived as external from urban and industrial development. In terms of this project, the study area in 1959 should be firmly rooted in productivism and would be expected to display many of the characteristics described above.

Beyond Productivism

It was noted at the beginning of this chapter that the term "productivism" was defined after the concept of post-productivism had been developed. Many authors such as Ilbery and Bowler (1998) and Mather *et al* (2006) believe that agriculture in the UK began to enter a period of transition in the 1970s or early 1980s and that this represented a move away from productivism towards post-productivism. The time period encompassed by this study ends in 1959 and so later developments might be seen, perhaps, as having little bearing on the project. However it is helpful to have an understanding of the debate as a whole, and not just the section which is of direct relevance. Therefore a brief review of conceptualisations of agriculture beyond productivism will now be presented.

Whilst the definition of productivism is broadly agreed, the definition, and even the existence of post-productivism is hotly contested. Some authors would consider that we are still, at least in part, in a productivist phase now. However, others consider that there has been a move towards a new agricultural regime in the UK. This move may have been precipitated by the changes in agricultural policies in the mid-1980s, where subsidies were reduced and regulation was tightened. Ilbery and Bowler argue that the post-productivist transition has been characterised by the reversal of the three trends that dominated the preceding productivist era (Ilbery and Bowler 1998). These are shown in Figure 9 below.

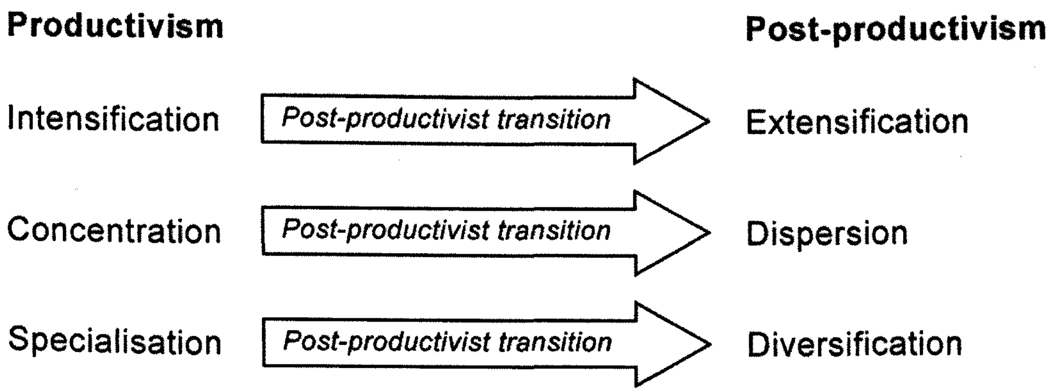

Figure 9: The Post-Productivist Transition (based on Ilbery and Bowler 1998)

Within this post-productivist framework, the role of farmers has changed. Under a productivist regime they were producers – working to maximise output through intensive methods. In the new post-productivist era, the emphasis has shifted away from production towards consumption. Farmers, as they diversify, may become providers of leisure activities, holiday accommodation and so forth, and may even be "hobby" farmers themselves. Walford suggests that:

> "The traditional conceptualisation of a farm is as an economic business unit engaged in land-based enterprises concerned with the production of plant and animal products for food or industrial use. These activities remain at the heart of the work carried out on many farms, nevertheless a significant number are now also concerned with leisure, manufacturing and retail industries...It is time to determine the extent to which farms have become factories, shops and recreation centres" (Walford 1999, p38).

Post-productivism has sometimes been conceptualised as the mirror image of the seven dimensions of productivism described in Table 2. Wilson has summarised these dimensions of post-productivism as shown in Table 3:

Ideology	-Loss of central position of agriculture in society (Lowe *et al* 1993; Ward 1993) -Move away from agricultural fundamentalism and agricultural exceptionalism (Marsden *et al* 1993; Winter 1996) -Loss of ideological and economic sense of security: farmers branded as destroyers of the countryside (Shoard 1980; Body 1982; Potter 1998) -Changing attitude of public toward agriculture: agriculture as villain (Marsden *et al* 1993; Harper 1993) -Changing social/ media representations of the rural (Harrison *et al* 1986; McHenry 1996; Winter 1996) -Changing notion of countryside idyll: contested countrysides (Hoggart 1990; Hoggart *et al* 1995; Pretty 1998) -Main threats to countryside perceived to be agriculture itself (Pratt 1996; Marsden 1999) -Loss of security of property rights (Marsden *et al* 1993) -'Rural' increasingly separated from agriculture; new social representations of the rural (Cloke and Goodwin 1992)
Actors	-Agricultural policy community widened; inclusion of formerly marginal actors at the core of the policy-making process (Cox *et al* 1988; Buttel *et al* 1990; Hart and Wilson 1998) -Weakening of corporate relationship between agriculture ministries and farming lobby (Marsden *et al* 1993; Lowe *et al* 1993) -Changing power structures in agricultural lobby (Winter 1996) -Counterurbanisation: social and economic restructuring in countryside (Cloke and Goodwin 1992; Lowe *et al* 1993; Halfacree 1997; Halfacree and Boyle 1998) -Increasing demands placed on rural spaces by reconstituted 'urban' capitals in terms of new manufacturing and service industries (Lowe *et al* 1993; Murdoch and Marsden 1994)
Food regimes	-Challenge to the Atlanticist Food Order from the early 1970s (Goodman and Redclift 1991; Marsden *et al* 1993; Lowe *et al* 1993; Ward 1993) -Post-Fordist agricultural regime; non-standardised demand for goods and services; vertically disaggregated production (Marsden *et al* 1993; Lowe *et al* 1993) -Critique of protectionism; free market liberalisation; free trade (Potter 1998) -Increased market uncertainty (Marsden *et al* 1993) -New consumption-oriented roles of agriculture (Marsden *et al* 1993) Changing consumer behaviour (Winter 1996; Lowe *et al* 1993; Potter 1998)
Agricultural production	-Critique of industrialisation, commercialisation and commoditisation of agriculture; critique of corporate involvement (Lowe 1992; Lowe *et al* 1993; Ward 1993) -Less emphasis on securing national self-sufficiency for agricultural commodities (Potter 1998) -Extensification (Ilbery and Bowler 1998) -Dispersion (Ilbery and Bowler 1998) -Diversification; pluriactivity (Ilbery 1991; Evans and Ilbery 1993; Shucksmith 1993) -Farmers wishing to leave agricultural 'treadmill' (Ward 1993) -Move from agricultural production to consumption of countryside (Marsden *et al* 1993)
Agricultural policies	-Reduced financial state support; move away from state-sustained production model (Marsden 1999) -Demise of state-supported model of agricultural development which placed overriding priority on production of food (Lowe *et al* 1993) -New forms of rural governance (Marsden *et al* 1993; Pretty 1998; Ray 2000) -Enhancement of local planning controls (Munton 1995; Halfacree and Boyle 1998) -Encouragement for environmentally friendly farming; greening of agricultural policy (Baldock *et al* 1990; Potter 1998), -Increased regulation of agricultural practices through voluntary agri-environmental policies (Cloke and Goodwin 1992; Ward 1993; Hart and Wilson 1998) -Move away from price guarantees; decoupling (Potter 1998; Pretty 1998) -Increasing planning regulations for agriculture (Cloke 1989; Marsden *et al* 1993; Lowe *et al* 1993) -Loss of security of property rights (Cloke 1989; Whatmore *et al* 1990; Marsden *et al* 1993)

Farming techniques	-Reduced intensity of farming (Munton *et al* 1990; Potter 1998) -Reduced use or total abandonment of biochemical inputs (Ward 1995; Morris and Winter 1999) -Shift toward sustainable agriculture (Pretty 1995; Pretty 1998) -Replacing physical inputs on farms with knowledge inputs (Winter 1997; Ward *et al* 1998)
Environmental impacts	-Move toward environmental conservation on farms; critique of notion of production maximisation (Wilson 1996; Potter 1998) -Re-establishment of lost or damaged habitats (Adams *et al* 1992; Mannion 1995)

Table 3 : Dimensions of post-productivism: current conceptualisations (Wilson 2001, p80-81)

Post-productivism, then, may be characterised by a loss of the central position of farmers in rural society, and a change in the role that farms play. There is a reduction in intensity and specialisation and increased diversification particularly into the leisure and retail sectors. Wilson argues that the agricultural community has not simply reacted to external forces, but that there has been a shift in values within the community itself.

However this view of post-productivism is not shared by Evans *et al*, who question the validity of the term itself, and argue that there is little empirical evidence for the postulated shift in agriculture. They suggest that:

> "Overall, some commentators declare that post-productive conditions now prevail and that these will influence the dynamics along which rural space is to become differentiated...If these conditions are founded on the theorization that productivist processes are being progressively reversed, then current evidence shows them to be untenable. There is little to support the assumption that agriculture has passed from one state of coherence to another set of bounded circumstances. Indeed, it is political, economic and social instability and uncertainty that lie at the heart of the contemporary agricultural sector in the UK" (Evans *et al* 2002, p324).

Mather, however, disagrees that "more progress in agricultural (and rural) geography could be achieved by abandoning post-productivism" (Evans *et al* 2002, p326). He argues that post-productivism should be re-characterised as "a shift in emphasis...away from policy concern with increasing material production, and towards the provision of environmental services" (Mather *et al* 2006, p443) and attempts to provide empirical evidence for this through consideration of trends in both forestry and agriculture. He concludes that there is evidence that a shift has occurred and questions the magnitude of change required to justify the use of the term.

This theme emerges in other work too, as the linearity of change from one phase of agriculture to another is questioned. Walford, for example, concludes that the evidence from large-scale farmers in South-East England suggests that "the fundamental processes of concentration, intensification and specialisation persist alongside key changes in the agricultural industry overall and that it is premature to regard 'productivism' moribund" (Walford 2003, p501). Robinson also notes that "at the very least, the idea that the productivist era is over should not be accepted and any transition to post-productivism should be recognized as more complex than has hitherto been acknowledged" (Robinson 2004, p71). Wilson concurs that "productivist action and thought can co-exist alongside post-productivist patterns" (Wilson 2001, p93).

Lowe *et al* consider that, whereas productivism was a national phenomenon based on the requirement for increased food production, post-productivism is much more regional and uneven in character: "No coherence can be identified in the post-productivist phase of rural development. Local unevenness is its quintessential and necessary feature" (Lowe *et al* 1993, p 221).

It may be useful to briefly consider the concept of diffusion of innovations at this point. Ilbery comments that "one important aspect of agricultural decision-making concerns the diffusion or spread of innovations, their adoption or non-adoption and resultant effects on patterns of land-use" (Ilbery 1985, p75). The unevenness of the transition between one phase of farming and another may, at least in part, be due to the unevenness of this process of diffusion.

The acceptance or rejection of innovations is related to the acceptance or otherwise of new information and Ilbery notes that:

> "Diffusion research has demonstrated a close relationship between the use of information and certain farmer characteristics (Jones 1963). For example, the more educated farmers seek and use new information to a greater degree than the less educated and thus tend to be early adopters of innovations. In contrast, older farmers who run small, owner occupied farms, seek new information less, reflecting a more routine habit and pattern of behaviour" (Ilbery 1985, p76).

Jones helpfully summarises the personal characteristics of different categories of adopter as shown in Table 4.

Adopter category	Personal characteristics	Salient values and social relationships	Communication behaviour
Innovators	Highest social status; largest and most specialised operations; wealthy; often young; well educated; often experience in non-farming environment	'Venturesome', willing to accept risks; some opinion leadership; cosmopolite	Closest contact with scientific information sources; interaction with other innovators; relatively greatest use of impersonal channels of information
Early adopters	'High social status'; often large and specialised operations	'Respected'; regarded by many others in the community as a model and an influential; greatest opinion leadership of any adopter category in most communities	Greatest contact with local change agents (including extension or advisory services, commercial technical advisers etc.); competent users of mass media
Early majority	Above-average social status; small operations; little specialisation; relatively low income	'Deliberate'; willing to consider new ideas only after peers have adopted; some opinion leadership	Interaction with peers who are mainly early or late majority, less use of mass media
Late majority	Below-average social status; small operations; little specialisation; relatively low income	'Sceptical'; overwhelming pressure from peers needed before adoption occurs; little opinion leadership	Interaction with peers who are mainly early or late majority; less use of mass media
Laggards	Little specialisation; lowest social status; smallest operations; lowest income; often oldest	'Traditional'; oriented towards the past; avoid risks; little if any opinion leadership; almost isolated socially	Neighbours, friends and relatives with similar values are main information source; suspicious of change agents

Table 4: Characteristics of different categories of adopter (Jones 1975, p42)

Given the wide spectrum of personal characteristics and the varying speeds with which different categories of adopter respond to potential change, it is perhaps unsurprising that transitions between different phases of farming are somewhat complex and not always clear-cut.

In terms of the theoretical debate, therefore, the concept of post-productivism remains controversial with regard to its characteristics and even the utility of the term itself. The current state of agriculture, both in the UK and beyond, also remains hotly disputed. An alternative conceptualisation of agricultural change will be presented later in this chapter.

Pre-productivism

It may seem rather perverse to discuss pre-productivism last as it is the forerunner of productivism and post-productivism. However, whilst much debate has focussed on productivism and beyond, much less effort has been expended considering the pre-productivist era and the shift from this to productivism. Wilson and Rigg comment that:

> "We have...witnessed the retrospective definition of the 'productivist' era from a 'post productivist' vantage point with little theoretical consideration of the possible existence of other regimes predating 'productivism'. If we agree with the conceptual notions of 'productivism' and 'post productivism', then we also need to leave room for the possibility of *pre-productivist* agricultural regimes" (Wilson and Rigg 2003, p687).

Wilson defines pre-productivism as being characterised by "high environmental sustainability, low intensity and productivity, weak integration into capitalist markets and horizontally integrated rural communities" (Wilson 2001, p91) and goes on to attempt to apply this theory to the agricultural situation in much of the South (ie less developed countries). However, no attempts have yet been made to explore pre-productivism in the UK context and so one aim of this study is to produce a fuller definition of the characteristics of pre-productivism. If the Second World War is taken as the pivotal moment in the transition into productivism, then the countryside in the early 1930s at the beginning of the study period could be expected to be more pre-productivist in character.

Certain other elements could, perhaps, be added to the Wilson definition of the pre-productivist countryside from the Scott Report: Lack of mechanisation; farm systems based on mixed farming; relatively small farm size (79% of farms in England and Wales were under 100 acres in 1938, with 62% under 50 acres (Scott Report 1942, p10)), and the decline in arable farming (Scott Report 1942, p15).

Hoskins writing in the early 1950s, towards the end of the period that this study covers, laments the passing of the English countryside:

> "England of the Nissen hut, the "pre-fab", and the electric fence, of the high barbed wire around some unmentionable devilment: England of the arterial by-pass, treeless and stinking of diesel oil, murderous with lorries; England of the bombing range wherever there once was silence...Barbaric England of the scientists, the military men and the politicians: let us turn away and contemplate the past before all is lost to the vandals" (Hoskins 1955, p299).

Whilst lamenting the current state of the countryside, there is an implied harking back to something better in Hoskins' words. This "something better" can be seen as the rural idyll, characterised by "the collective images of what rural living should be" (Newby 1985). Furuseth elaborates on this idea, describing:

> "An idyllic community: an open and clean environment, free of the stress and the pathologies associated with fast-paced urban living, simple face-to-face relationships and neighbourliness, and a local economy that thrives on nature's abundance and hard work" (Furuseth 1998, p233)

Even the Scott Report acknowledges the temptation to romanticise the past: "We have tried to avoid the temptation of looking back to "the good old days"

– bad though they were, they seem attractive in retrospect" (Scott Report 1942, pv).

However, the reality was that the period after the First World War was a period of decline for British Agriculture, as has already been described in Chapter 1. The Scott Report paints a picture of the agricultural landscape in 1938 as follows:

> "Less arable land was to be seen in the landscape; the number of derelict fields, rank with coarse matted grass, thistles, weeds and brambles, multiplied; ditches became choked and no longer served as effective drains; hedges became overgrown and straggled over the edges of the fields; gates and fences fell into disrepair; farm roads were left unmade. Signs of decay were to be seen also in many of the buildings. Barns and sheds were not put in order; farmhouses were allowed to deteriorate; agricultural cottages went from bad to worse. Whilst, when seen from afar, it retained the beauty of the old broad pattern, the landscape of 1938 had, in many districts, assumed a neglected and unkempt appearance" (Scott Report 1942, p15).

Wilson (2001) describes one of the characteristics of pre-productivism as high environmental sustainability. Whilst the landscape depicted by the Scott Report appears to be characterised by low chemical inputs, it is hard to describe the vision of advancing decay as sustainable. Brandon and Short comment that:

> "Surrey and Sussex owe much of their town-centred arcadian view of the cultural landscape to wide-eyed Londoners who painted, sketched, photographed and wrote in lyrical strains of a re-discovered Eden as a foil to the enormous and overcrowded metropolis. They appeared blessedly unaware that stamped over the most picturesque landscapes was a historic round of repeated agricultural failure and defeat" (Brandon and Short 1990, p8).

The most desirable countryside may not, in fact, be wild, abandoned nature but rather an actively managed landscape. The distinctive character of the chalk downlands for example, has developed as the result of centuries of human intervention and is also maintained as a result of active management. Coates comments that:

> "We wish to enshrine what is in fact a transitional ecosystem, not because nature has endowed grassland with special significance, but because we prefer this particular version of nature. The internal dynamic is working to restore a wild condition – not a pleasing prospect for most visitors" (Coates 1998, p7).

The pre-productivist landscape in Britain, then, is rather poorly understood. On the one hand it has been characterised as a rural idyll of community and harmony with nature and on the other hand as a model of environmental sustainability. In reality it seems possible that neither view fully captures the nature of pre-productivism.

Finally, what of the transition from pre-productivism to productivism? Short *et al* (2006) considered whether the changes in agriculture which occurred during the Second World War were indeed an "agricultural revolution" and concluded, with some reservations that:

> "In terms of both internal and external changes, the rapidity of land use change, the degree and lasting duration of state support and control, the adoption of mechanization, and the resultant impact on farming communities, it was undoubtedly revolutionary" (Short *et al* 2006, p15).

This project examines a small area of East Sussex from 1931 to 1959 in order, if possible, to track the course and consider the extent of that revolution in the seven parishes represented in the study area.

Productivism/Non-productivism – an Alternative View

It was noted at the beginning of this chapter that an alternative view of agricultural change has recently been suggested. Wilson (2007) has proposed a new approach to the debate based on transition theory which will be examined in this section. He argues that there are many different ways of conceptualising transition and presents six basic models as shown in Figure 10.

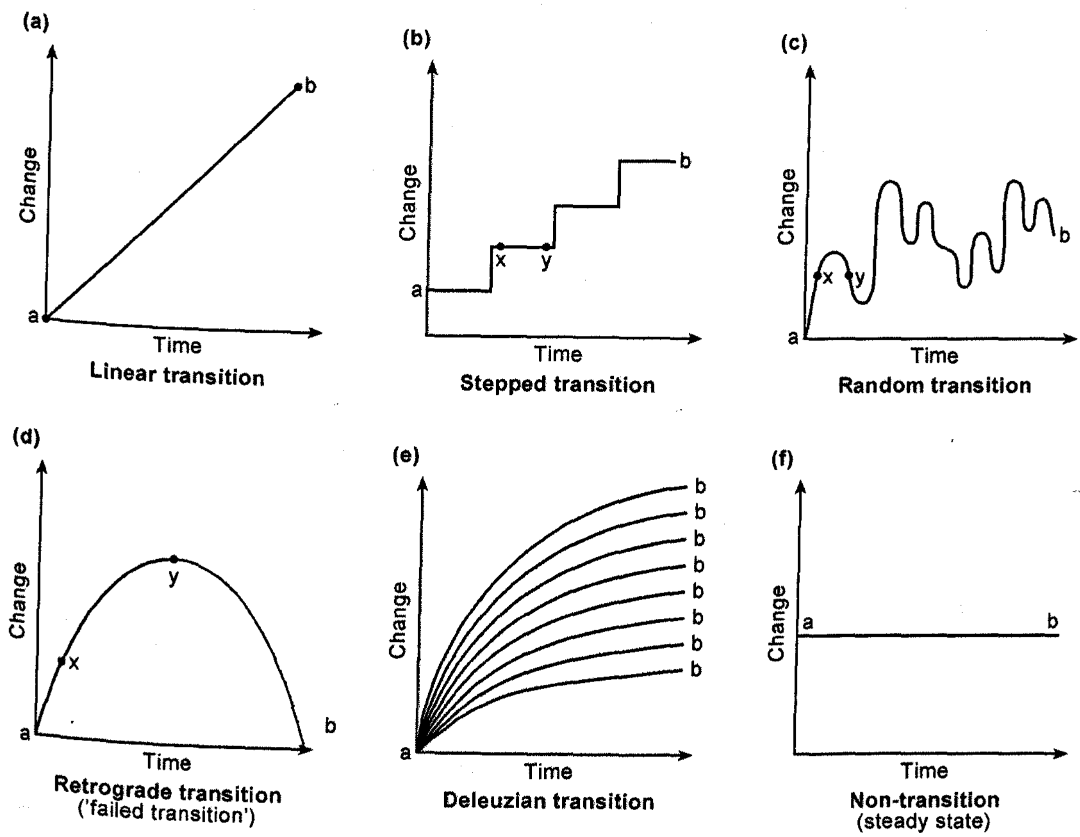

Figure 10: The six basic models of transition (Wilson 2007, p15)

Wilson suggests that the Deleuzian model (e) is the most helpful in terms of depicting the "'reality' of agricultural transition. The basic premise of this model is that "it is impossible to identify one transitional pathway. Instead, and starting from temporal point 'a', we may have a thousand (or more) possible transitional pathways to arrive at point 'b'" (Wilson 2007, p17).

Wilson goes on to identify four transitional fallacies which he feels underlie many debates, including the more traditional view of the productivist/post productivist transition. These are:

Temporal linearity – issues related to transition as a *linear* temporal process from one stage of development to another

Spatial homogeneity – that we can generalise transitional patterns and processes *spatially*

Global universality – that transitional processes apply equally to *advanced economies and developing countries*

Structural causality – that all actors and stakeholder groups are on the same transitional pathway

The first and last of these have particular relevance for this study. In terms of temporal linearity, Walford (2003, p501) and Robinson (2004, p71) have already been quoted above arguing that the posited transition to post-productivism is far from complete, and Lowe *et al* (1993, p 221) comment on the regionality of the process of change. Wilson questions the directionality inherent in the productivist/ post-productivist model and asks

> "If we acknowledge the (problematic) linearity of the shift towards post-productivism ...does pre-productivism then imply a 'direction' of agriculturally-based societies towards productivism? Can post-productivist agriculture, therefore, only occur in rural areas that have 'gone through' the productivist era?" (Wilson 2007, p150).

In terms of structural causality, Wilson suggests that most farmers in advanced economies have "entrenched productivist farmer selves" who "first and foremost, produce food and fibre with the aim to maximise food production and to pass on an economically viable farm business to the next generation" (Wilson 2007, p170). This, again, has similarities with Walford's claims that the evidence from large-scale farmers in South-East England suggests that "the fundamental processes of concentration, intensification and specialisation persist" (Walford 2003, p501).

The solution to this problem of transitional fallacies, according to Wilson, is to retain the notion of productivism, albeit "shorn of its association with the notion of transition" but to replace the term post-productivism with "non-productivism." He argues that:

"*Non-productivism* provides a better conceptual term that describes the *true opposite* of productivism in a temporally non-linear, spatially heterogeneous and globally complex way, and that also acknowledges structure-agency inconsistencies in stakeholder adoption/ rejection of productivism" (Wilson 2007, p113).

Furthermore, he contends that multifunctionality can be seen as lying between the two extreme pathways of productivism and non-productivism (Wilson 2007, p177) as shown in Figure 11 and comments that:

"Embedding both productivism and non-productivism as part of a spectrum allows us to recognise that there may be virtually no action and thought affecting agricultural and rural areas that is *entirely* productivist or non-productivist, but that each action and thought may contain elements of both along Deleuzian development pathways" (Wilson 2007, p175).

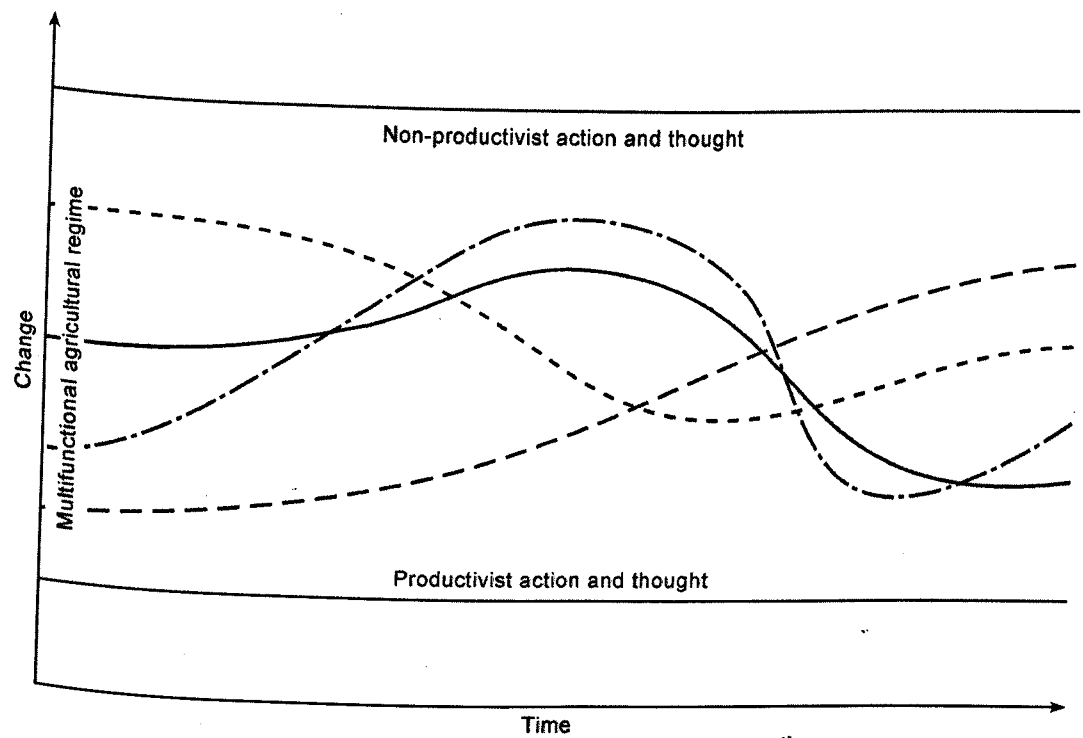

***Figure 11:** Deleuzian transitional pathways and the multifunctional spectrum (Wilson 2007, p223)*

Strong multifunctionality is closest to non-productivist action and thought and is characterised by high environmental sustainability, a high degree of diversification and local 'embeddedness', whereas weak multifunctionality is nearest to productivist action and thought and embodies weak environmental sustainability, long food supply chains, high farming intensity and productivity and a low degree of diversification (Wilson 2007, p229).

Finally, Wilson proposes a model of multifunctional decision-making pathways in Western Europe as shown in Figure 12. The corridor of decision-making pathways represents the boundaries within which most agricultural decision-making at a given point in time can be situated. According to Figure 12 this corridor declined from strong to weak multifunctionality until the 'productivist trough' of the 1950s to the 1990s. After 1990 transitional possibilities broaden and there is rising potential for the adoption of stronger multifunctional pathways (Wilson 2007, p303).

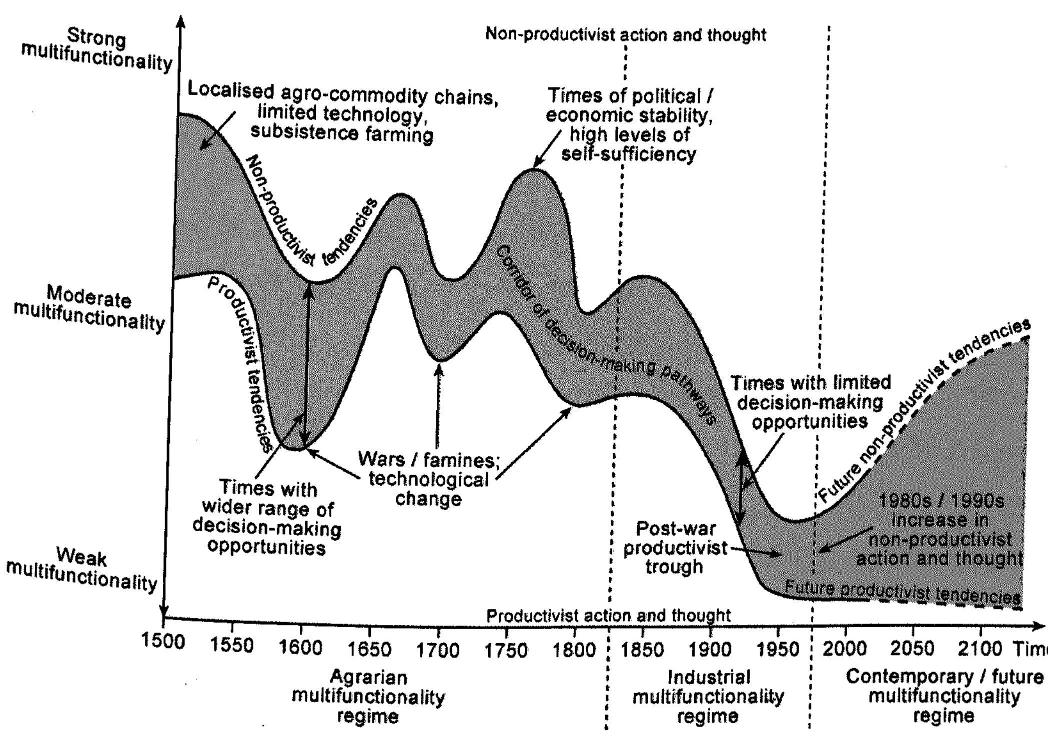

Figure 12: Corridors of multifunctional decision-making pathways in Western Europe, CA AD 1500-2150 (Wilson 2007, p303)

One of the aims and objectives of this study has been to produce a fuller definition of pre-productivism. If this concept is to be abandoned in favour of non-productivism, as Wilson suggests, then it could be argued that it no longer requires a more complete definition.

However, whilst Wilson's arguments have been presented here at some length, at the time of writing there has not yet been a response to his challenge to lay down post-, and indeed pre-productivism and to adopt the concept of non-productivism instead. Wilson himself argues that "additional empirical evidence will be needed to further substantiate (or, indeed, refute) the normative multifunctionality spectrum used as a basis for the argument in this paper" (Wilson 2008, p380). It would therefore seem somewhat premature to abandon pre-productivism. It must, however, be acknowledged that the Deleuzian transition model and the productivist/ non-productivist spectrum have the advantage of allowing for the co-existence of productivist and other forms of thought and action, and also of challenging the linearity which can be suggested by conceptualisations of productivism/post-productivism.

In conclusion, then, the debate regarding characterisations of UK agriculture since the 1980s continues. There is broadly general agreement that some sort of a shift has occurred – even Wilson (2007) recognises a post-war 'productivist trough' - and many would argue that this is a move towards post-productivism. However, as the alternative view presented in the last section suggests, it is problematic to neatly package agriculture into a single regime and to characterise the process of change as a smooth linear transition, and, in fact, many farmers can be seen to exhibit both productivist and post-productivist action and thought at the same time.

CHAPTER 3: USING GIS IN HISTORICAL RECONSTRUCTION

One of the stated aims of this project is to demonstrate the power of GIS as a tool for historical reconstruction and so this chapter will examine the benefits that the use of GIS can bring to a study such as this. Some previous uses of GIS in an historical context will be presented and the reasoning for the approach taken in this particular project will also be discussed. Finally some potential difficulties surrounding the use of GIS with historical data will be considered.

Many definitions of a GIS have been proposed but in its simplest form it may be regarded as a "spatially referenced database…able to map the data and also to query it spatially" (Gregory 2005, p11). One of the aims of this project is to see if the transition from pre-productivism into a productivist agricultural regime can actually be seen in progress through a series of snapshots of land use through time. These snapshots can be represented as a series of maps which can be manipulated to show different features such as the prevalence of Meadow and Grassland or Arable land at a particular time. A textual database alone would allow the acreage for a particular class of land use to be calculated but would not allow the distribution of this land use type to be visualised.

In the case of this study, the character of the northern wealden section of the study area would be expected to be quite different to the southern downland and this becomes apparent very quickly from the patterns on the map. The wealden area is characterised by a patchwork of small fields whereas the downland is far more open. This could be demonstrated by simply stating the average polygon size but is communicated far more effectively via the visual medium of a map. Knowles notes that:

> "One of the technology's most appealing advantages is that, once spatial and attribute data is correctly entered into the system, a GIS

can almost instantly generate maps in answer to queries, and can do so as easily for a large data set as for a very small one" (Knowles 2002, pxv).

In addition, by the use of GIS other forms of spatial query have been enabled such as mapping the 1940 and 1941 plough up.

A second key advantage of using GIS is that it allows:

> "The integration of spatial data *from different kinds of sources*, such as remote sensing, statistical databases and recycled paper maps. Their functionality offers the ability to manipulate, analyse and visualize the *combined* data" (italics added) (Kraak 2005, p49).

This project uses textual and numerical data from the NFS and 4th June agricultural census together with maps from the first LUS and NFS, and aerial photographs from the 1940s and 1950s. The ability to integrate these disparate data sources is a fundamental part of this study and so the use of GIS has been a vital component.

Goodchild and Longley suggest that there are a number of circumstances when an analyst may choose to use a GIS. These include when the data are geographically referenced; when the volume of data is large; when data must be integrated from a variety of sources; when geographical objects under analysis have large numbers of attributes; when visual display is important (Goodchild and Longley 2005). The criteria listed are all applicable to this project which is dealing with a sizeable dataset with quite complex attributes and attempting to integrate data from a number of different sources. The use of GIS would therefore seem appropriate for this study and, indeed, allows outputs to be created which would not be possible using a textual database alone.

GIS in Historical Reconstruction

This project may, perhaps, be categorised as coming under the umbrella of "historical GIS." This is a relatively new field which emerged in the late 1990s (Gregory and Healey 2007, p638) with the first edited collection of case studies published in 2002 (Knowles 2002) and the first major European conference concerned with the use of GIS in historical research only taking place in August 2008 (Gregory 2008).

Knowles (2002, pxii) comments that “Geography is the study of spatial differentiation, history is the study of temporal differentiation. Historical GIS provides the tools to combine them to study patterns of change over space and time.” At one end of the spectrum of research in the field are the national historical GIS projects. These include the Great Britain Historical GIS (GBHGIS) which aims to “provide a systematic spatial framework for historical information about Britain” (Great Britain Historical GIS Project 2007) and has been made available via the *Vision of Britain through Time* website (www.visionofbritain.org.uk). This integrates data from a wide range of sources including historical mapping, travel narratives and local census statistics from 1801 onwards. The site has recently added maps from the first LUS, one of the key datasets for this project.

One of the issues faced by the GBHGIS, and indeed by many GIS projects worldwide, has been changing administrative boundaries. The core of the GBHGIS is “a GIS database that holds the changing boundaries of the major administrative units as they changed from 1840 to 1973. This was built up using information taken from maps at different dates combined with textual sources that provided precise dates for boundary changes” (Gregory and Healey 2007, p640) and proved to be a huge logistical challenge.

The National Historic Geographic Information System is a project designed to produce a comprehensive US census database from 1790 – 2000 (Knowles 2005) which again is available to the public free of charge via a web interface (www.nhgis.org). Other similar initiatives are underway in Ireland, Belgium, the Netherlands, Russia and Korea (Knowles 2005).

The ambitious China Historical GIS Project, launched in 2001, covers over 2,000 years of China’s history from 222BC to 1911AD. The project has, again, faced particular difficulties with the definition of administrative boundaries and has used points to represent settlements with spheres of influence defined around these (Gregory and Healey 2007, p640). The project website notes that

> "The CHGIS aims to build a reliable database of administrative units and settlements, but does not wish to impose a closed interpretation on the relationships among those units. The advantage of creating the CHGIS, rather than printing paper maps, is that the relationships between the units can be modified and improved whenever new information becomes available and the new "edition" needs only to be posted on the Internet for users to download" (CHGIS - Center for Geographic Analysis).

These national GIS projects include huge amounts of data and cover large areas of land. Their aim is to integrate a number of different datasets and to provide a sense of an entire country through time and they tend to encounter particular problems with changing administrative units. The resulting data are often made available via the internet to users at no or low cost.

Towards the centre of the spectrum of historical GIS projects are the mid-scale enterprises that use GIS to consider a particular research question or a particular region. The complex patterns of immigration into and out of New York between 1900 and 2000 have been studied using census tract boundaries. This has allowed the researchers to consider a number of issues:

> "How the influx and outflow of population has altered the city; the shifting location of racial and ethnic clusters; the degrees of segregation and diversity; the density of population; and the relationship of all these to economic inequality" (Beveridge 2002, p66).

Knowles and Healey (2006) have used GIS to analyse spatial and temporal patterns in the development of Pennsylvania's iron industry from 1825 to 1875. They comment that "our over-arching argument is that to understand differences in regional economic development, one must consider economic change in the context of regional conditions, including geographical conditions" (Knowles and Healey 2006, p 609). They found the use of GIS particularly beneficial in revealing spatial connections between various segments of the industry.

One of the first major UK projects to use GIS for an analysis of landscape change was the Monitoring Landscape Change in the National Parks of England and Wales (MLCNP) project which looked at changes in landscape between the mid 1970s and the late 1980s (Taylor *et al* 2000, p2738). Data were extracted from aerial photographs and captured in a raster GIS in order to create a detailed dataset covering 38 area classes for the 11 National Parks which existed in 1988. Particular difficulties were encountered with using and comparing aerial photographs taken at different dates. Taylor *et al* note that:

> "Generally, the 1970s and 1980s photography comprised flight runs taken at different dates, frequently more than one year apart. This led to difficulties in maintaining consistency and accuracy of the API [aerial photograph interpretation] across different flight runs. This was caused by: differences in photograph quality arising from conditions of illumination at the time of photography and changes in film and film processing; differences in the appearance of the landscape classes at different times in the annual cycle; and real changes in the landscape between the dates of the flights" (Taylor *et al* 2000, p2748).

Many similar difficulties were encountered in the course of this project which will be described in later chapters.

The Digital Derby project has sought to map the city of Derby in the nineteenth century and to consider questions such as the spatial mix of rich and poor (Bradshaw and Abrahart 2005). Orford *et al* (2002) mapped Charles Booth's survey into the social and economic conditions of the people of London in the late nineteenth century and compared this to data on social class from the 1991 census together with standardised mortality ratios for 1991-1995. This allowed them to derive an index of relative poverty for both time periods and the authors note that "the construction of an historical GIS of Charles Booth's poverty map has allowed a unique comparison of social and economic changes in London across 100 years" (Orford *et al* 2002, p34). The Map of Early Modern London (http://mapoflondon.uvic.ca/) maps the "streets, sites and significant boundaries of late sixteenth-century and early seventeenth-century London" (Jenstad 2008) and links these to textual information and literary references from the period.

A further example of the use of GIS in order to explore historic and literary themes is the 'Mapping the Lakes' project, which maps out two textual accounts of journeys through the landscape of the Lake District: Thomas Gray's tour of the region in the autumn of 1769; and Samuel Taylor Coleridge's 'circumcursion' of the area in August 1802 (http://www.lancs.ac.uk/mappingthelakes/). The aim of this project is to "test whether GIS technology has the potential to open up new spatial thinking about the geo-specific literature of place and space" (Gregory *et al* 2008).

At the opposite end of the scale to the national historic GIS projects are those covering a small area and often concerned with a very specific issue. Pearson and Collier (1998) studied landownership and agricultural productivity in the parish of Newport using a map base digitised from modern Ordnance Survey maps linked to a database of tithe data. This allowed features such as rent charge per acre, landownership and state of cultivation to be mapped.

Another small-scale UK-based project was undertaken by Fuller (1985) in order to examine land use change in two parishes, Ancaster and Normanton between 1947 and 1981 for the Anglian Water Authority. This used a range of aerial photographs together with data from both the first and second Land Utilisation Surveys to classify 11 types of land use in order to supply "background data for potential use in the development of mathematical models relating nitrate concentrations in the groundwater of chalk and limestone areas to the agricultural land-use history of such catchments" (Fuller 1985, p218).

A very different use of GIS to explore a specific issue was Ray's (2002) study of the Salem witch trials. He used GIS to re-map the locations of the main protagonists in order to challenge the idea that there was a clear geographical separation between the accusers to the west and the accused to the east (Gregory and Healey 2007). Ray also used a series of maps to show the spread of accusations over time. He comments that "using GIS enabled me to incorporate and analyze a larger body of data, and to explore geographical patterns at a variety of temporal and spatial scales" (Ray 2002, p32).

A project very similar in nature to the present study was carried out by Riley and Watkins (2006). They used NFS data and aerial photographs together in order to attempt to reconstruct three case study farms on a field by field basis. The use of GIS is not reported, although it appears to have been used to pick out farm boundaries on the aerial photograph. However the study has all the hallmarks of the GIS projects listed above, involving the integration and analysis of disparate data sources in order to address a specific research question in a new way. They conclude that:

> "The three case studies have given us a much more positive answer to our second question, namely whether the interpretation of the NFS data in combination with near-contemporary aerial photographs can provide insights. They indicate that there is no doubt that such detailed interpretations can provide extremely useful and detailed field-by-field data on land use, cropping and farming systems" (Riley and Watkins 2006, p215).

It is clear from the brief review presented here that GIS is a valuable tool for managing large datasets which include some sort of spatial element. Furthermore the ability to integrate and manipulate a number of different data sources is a huge advantage. As can be seen from the range of projects described, this process can be carried out at national scale but can also be used to analyse a much smaller area such as the parish of Newport in Pembrokeshire.

It is, perhaps, useful to note that this study was commenced before the work by Riley and Watkins was published. Whilst it covers some of the same ground by attempting to use aerial photographs and the NFS data together to map land use on a field by field basis, there are significant differences between the projects. This study relies much more strongly on GIS to hold the coded attribute data and allow these to be mapped. The study area itself is much larger, encompassing 98 complete farms and sections of over 30 more, rather than a few select case studies. The varied character of this part of East Sussex means that the farms on the Weald to the north can be compared and contrasted with the downland farms to the south. Finally this study looks at change over time, and so includes data from the LUS, and later aerial photographs from 1945-7 and 1959.

The Approach Taken in This Study

The review above has presented a number of different types of GIS project, and it is clear that this study lies towards the smaller end of the scale. In terms of mapping land use, the approach taken is often to use a sampling framework in order to cover a large area. The Monitoring Landscape Change project, for example, used a framework of 1km sample squares together with interpretation of aerial photographs in order to measure changes in land cover and landscape features in Great Britain. The 1990 Countryside Survey used a combination of satellite imagery and a field survey of 509 sample squares to produce the Land Cover Map of Great Britain. The 2007 Countryside Survey included field visits to 591 sample squares and the use of digital data capture for the first time (Centre for Ecology and Hydrology 2008).

Short *et al* also used a sampling approach when researching the NFS, selecting one parish from every county in England in order to evaluate the quality of the data across the country as a whole (Short *et al* 2000, p11). In addition they looked in more detail at a Midlands sample and a Sussex sample. Together these samples represented about 1% of the NFS records (Short *et al* 2000, p10).

Despite these precedents, a sampling approach was not adopted for this study. There were several reasons for this. Firstly the project relies on historic data and complete UK coverage is not always readily available. As was explained in Chapter 1, this is particularly the case with the Luftwaffe images which concentrate on towns and industrial centres and do not provide country-wide coverage. Given this difficulty, any sampling scheme would have had to be designed around data availability.

It would have been possible to simply use the first LUS from the early 1930s and then to jump to the RAF survey of 1945/7, both of which cover the whole of England. However, the Luftwaffe image is the most nearly contemporary with the NFS and June 1941 census and so it was felt to be a very useful data source. If the transition to productivism was a consequence of state intervention during the Second World War, then the Luftwaffe image, more than earlier or later imagery, should actually capture the beginning of that transition. It therefore seemed important to retain this dataset and to design the study around the availability of images from the early 1940s.

Secondly the NFS data for Sussex were known to be complete and of good quality from the work done by Short *et al* (2000). Given that they had already analysed a national sample of NFS data, it seemed rather fruitless to repeat this. The study area for this project only partially overlapped the Sussex sample already analysed.

The approach taken has therefore been to consider one small area in detail. This is in keeping with the small GIS projects described above such as Pearson and Collier's (1998) study of landownership in the parish of Newport. The study area has been dictated to some extent by the footprint of the 1940 aerial photograph as has already been described. However the contrasting character of the north and southern sections of the study area means that there is a considerable variety of landscape represented.

Difficulties With Using Historical Data in a GIS

It was established at the beginning of this chapter that using GIS for this project allows disparate data to be integrated and manipulated and is helpful in dealing with large volumes of data. However it must be acknowledged that the use of historical data in a GIS also brings a number of particular problems. Some of these arise from inconsistencies in the data themselves whereas others stem from the processing steps necessary to display and manipulate these data in a GIS.

Longley *et al* note "a general tendency to give computers more credit than they deserve – to believe that because numbers or maps have emerged as if by magic from digital black boxes, they must necessarily be reliable" (Longley *et al* 2005, p68). The use of GIS and the production of computer-generated maps can imply a degree of certainty which is actually unwarranted. Heuvelink comments that "no map stored in a GIS is truly error-free" (Heuvelink 2005, p85) and this is certainly true for this project. This section is therefore an attempt to make explicit the potential sources of error and uncertainty in this study.

Unwin identifies six types of error and inaccuracy as follows:

- Error – the difference between reality and our representation of it
- Blunders – mistakes which can be easily detected, recognised and removed
- Accuracy – the closeness of results, computations or estimates to values accepted as true
- Precision – the number of decimal places given to a measurement
- Quality – the fitness for purpose of the data

- Uncertainty – a measure of doubt or distrust when using the data (Unwin 1995, p550)

In terms of this project, some of these issues affect the source data before they are ever translated into digital form. For example in Chapter 5 the internal consistency of the NFS data is assessed. The acreage shown for each farm on the NFS Primary Return could be expected to be the same as the acreage shown on the June 1941 census return. However the acreage agrees exactly for less than one third of farms.

Fisher (2005) identified seven common reasons for a database being in error as shown in Table 5.

Type of Error	Cause of Error
Measurement	Measurement of a property is erroneous
Assignment	The object is assigned to the wrong class because of measurement error by field, or laboratory scientist, or by surveyor
Class generalisation	Following observation in the field and for reasons of simplicity, the object is grouped with objects possessing somewhat dissimilar properties
Spatial generalisation	Generalisation of the cartographic representation of the object before digitising, including displacement, simplification etc.
Entry	Data are miscoded during (electronic or manual) entry to a GIS
Temporal	The object changes character between the time of data collection and of database usage
Processing	In the course of data transformations an error arises because of rounding or algorithm error

***Table 5:* Common reasons for a database being in error (Fisher 2005, p74)**

It may be useful to consider each of these potential causes of error in turn in relation to this project.

Measurement

The problem of differing farm size cited in the previous section may be seen as an example of measurement error, where the same object (a farm extent) has been measured in two different ways. In general, any measurement errors in this project are likely to be due to deficiencies in the original data as no field surveying has been undertaken.

Assignment

Assignment errors can affect both the source data and also the data within the GIS. In Chapter 4 the differences between the LUS field sheets and one inch maps are discussed at some length. It would seem that a considerable number of corrections were made to the original surveys, presumably due to errors of assignment. Disentangling permanent grass from temporary grass from rough grazing caused considerable difficulties for the original surveyors of the LUS and was also problematic when interpretation of the aerial photographs was attempted for this study. Interestingly, Taylor *et al* report difficulties of assignment between interpreters in the field in the MLCNP project described above. They note that

> "the vast majority of cases were not mistakes but arose because the classification scheme was not sufficiently robust and the observers had to make subjective judgments when choosing the class identity from a number of possible classes. This is because the landscape is a continuum rather than a series of discrete classes and problems arise in landscape classification regardless of the survey methodology employed" (Taylor *et al* 2000, p2749).

Given that the data used are historic it was not possible to check the interpretation by sampling in the field, although some cross checks were performed between the 1940 and 1945/7 aerial photographs and the NFS data. Some of the aerial photograph interpretation was done on a "best guess" basis and these classifications in particular must be prone to error.

Class Generalisation

The classification scheme adopted in this study assigns one type of land use to each polygon, with seven possible land use classes. This is based on the scheme used in the first LUS and is described in detail in Chapter 4. However, Aspinall and Pearson comment that "map polygons represent spatially heterogeneous environmental conditions as homogeneous areas"

(Aspinall and Pearson 1995, p75) and this is true for this study. For example, the classification scheme in use has separate classes for Meadow and Grassland and Forest and Woodland. However areas of grassland very often have some scattered trees within them. The question then arises of how many trees make a forest. In fact a fuzzy classification would be more useful for this type of landscape, where an area could, for instance, be classed as 25% Forest and Woodland and 75% Meadow and Grassland. However, in reality, a subjective interpretation was used – if the area appeared fairly open on the aerial photographs with only scattered trees it was classified as Meadow and Grassland. Where the tree cover was dense and there appeared to be very little open space, the area was classified as Forest and Woodland.

A further difficulty can arise regarding boundaries between features. Aspinall and Pearson note that "the classification process...forces gradual changes and transition zones between classes to be defined by definite lines on maps and removes any notion or record of gradation or transition between classes" (Aspinall and Pearson 1995, p77). The southern section of the study area covers part of the South Downs which include both Heath and Rough Grazing, and Meadow and Grassland. These two land cover types often merge into one another, but on a vector map each has to be assigned a polygon with a very clear boundary which implies a level of definition which is not there on the ground.

Spatial Generalisation

First and second County series Ordnance Survey maps at a scale of 1:10560 were used as the base mapping for this study. Field and polygon boundaries were digitised from this base mapping and used as the basic vector layer for the classification. The base maps themselves are generalised representations of reality and digitising from them will have introduced further error as will be shown in the next section. In addition the information on the published LUS maps was generalised from the field sheets and so some of the detail will have been lost.

Entry

This may be one of the largest potential sources of error for this project as there are a number of points where additional error could have been introduced. Simply getting the datasets into the GIS and displayed correctly in relation to one another may have been a source of error. Each of the County series maps is georeferenced to the British National Grid using a system of control points. However the maps have not been georeferenced with 100% accuracy as described in Chapter 4 – there are errors of a few pixels. Gregory notes that "coordinates measured from a map will have a certain amount of error in them. The locations of the reference points will also have some error. This means that the placement of every location on the layer will be slightly distorted" (Gregory 2005, p37). This was compounded by the fact that the British National Grid was not in use at the time the maps were created and so they were being referenced to a system they were not designed for. There were variations in scale across the aerial photographs and so they did not fit together exactly with the maps, and each set of aerial photographs had different distortions inherent in it. Therefore there clearly will be a certain amount of locational error within the data.

It has already been noted that a polygon layer was created by digitising over a base layer comprising OS County series maps. This process has been found to be a "dominant source of error creation in digital data sets" (Walsby 1995, p113). It is impossible to digitise over a line on a base map with complete accuracy and this is borne out by studies done by Walsby (1995). She asked twelve test subjects to digitise two paper maps and then analysed a number of line and polygon characteristics. Visual checks indicated that the subjects had generally maintained the shape and position of the lines and polygons but statistical tests founds that "nine of the 16 lines digitized for the two test maps displayed statistically significant differences from the originals" (Walsby 1995, p117). Highly curved lines tended to cause more problems than straight lines and Gregory comments that

> "Digitising a line relies on the operator capturing each point at which the line changes direction. For gentle curves, such as those on roads, rivers or contour lines, this is inevitably a subjective choice and

no two operators digitising a line of this type will ever digitise exactly the same points to describe it" (Gregory 2005, p37).

In terms of polygon characteristics, Walsby found that the position of polygon boundaries was generally maintained and that "percentage area errors were greatest for the smaller, particularly narrow, polygons" (Walsby 1995, p119). The study area for this project comprises over 4,300 polygons of all shapes and sizes, and so it is inevitable that some error will have been introduced during the digitising process.

In addition to digitising error there may well be classification errors. The difficulty of assigning polygons to definite classes has already been noted and there may also be some polygons where the land use code has simply been mistyped or the aerial photograph wrongly interpreted.

Aspinall and Pearson (1995) constructed a confusion matrix to assess the accuracy of aerial photograph interpretation for the Land Cover Map of Scotland. The aerial photographs were at 1:24000 scale and were flown between 1987 and 1989. The date the photographs were taken suggests that they are likely to be colour. The classes identified on the map were compared to classes identified by field survey and good agreement was found. In the grassland category, which is the only category common to this study, a mean level of agreement of 68.8% was calculated (Aspinall and Pearson 1995, p74). This suggests that almost one third of the grassland was incorrectly classified from the aerial photograph. In terms of this study the aerial photographs are older and are black and white rather than colour. It is likely, therefore, that the classification accuracy from these images may be poorer than that found by Aspinall and Pearson. However this is difficult to assess in practice as the data are historic and so it is not possible to conduct a field survey to check the accuracy of the classification.

Temporal

Fisher describes temporal error thus: "The object changes character between the time of data collection and of database usage" (Fisher 2005, p74). As this study is concerned with historic data, it is entirely likely that many of the polygons have subsequently changed their land use. However one of the difficulties encountered in this project has been the timescale over which some of the data were collected so that they may represent a span of one or two years rather than an actual snapshot in time. This is discussed in more detail in the section on GIS and Time below.

Processing

The main source of processing error in this project is rounding, where the acreage of the study area and pilot area appears to vary slightly between classifications due to rounding of the acreages for the different land use types.

Having considered the various potential sources of error and uncertainty in a GIS, it is appropriate to consider the other difficulty with using a GIS for this particular project. This is the issue of how a GIS handles time.

GIS and Time

Data may be seen as having three components, attribute, space and time (Gregory 2005, p63). At the beginning of this chapter the advantages of using a GIS to handle the spatial and attribute components of data were considered. However the temporal component of data is handled much more poorly by a GIS. Peuquet identifies two basic types of temporal questions which can be asked:

1. World state; what was/is/will be the spatial distribution of a given phenomenon at a given time? (eg where were the locations devoted to recreational land use in 1993? What was the spatial configuration of the 42nd Congressional District in the last election?)
2. Change; which elements changed/are changing/will change during a given time span? (eg where has growth in recreational land-use occurred between 1988 and 1998? Which congressional districts have shown an increase in unemployment over the past four years?) (Peuquet 2005, p92).

This study asks both types of question. "Is it possible to identify and map the fields which were ploughed up in 1941 or 1942?" is a "world state" question. However the overall aim of this project is to look at change over time which falls into the second category.

The simplest way of studying change in a GIS is to create a series of snapshots and this is the approach that has been adopted for this project. Each layer holds a "world state" map for a particular moment in time and the sequence of maps can be studied to see the change over time occurring. Gregory notes that this approach is "particularly suitable where spatial data are taken from source maps of different dates" (Gregory 2005, p66). Detailed data for this period and for the study area are only available for certain points in time and so the snapshot approach would seem to be eminently suitable.

There are, however, disadvantages to this approach. Peuquet identifies three key difficulties:

1. The data volume increases enormously when the number of snapshots increases since each snapshot is a complete map of the entire region. This necessitates storage of a significant amount of redundant data since in most cases the spatial changes in two consecutive snapshots are only a small portion of the total data volume.
2. The changes of spatial entities that accumulate between two points in time are stored implicitly in the snapshots and can only be retrieved via a cell by-cell (or vector-by-vector) comparison of adjacent snapshots. This process can be very time consuming. More importantly, however, some critical yet short-lived change at some location may occur between two consecutive snapshots and thus may not be represented.
3. Exactly when any individual change occurred cannot be determined (Peuquet 2005, p94).

One particular difficulty of the snapshot approach as applied to this project is that a snapshot implies that the data within that layer all belong to the same moment in time. This is the case for the Luftwaffe aerial photograph which is a literal snapshot taken on 12th August 1940. However the RAF aerial survey was flown between July 1945 and August 1947 and so the data in this layer span a period of over two years. Equally the LUS was conducted over a period of several years and so the land use shown in each field cannot necessarily be pinned down precisely to a particular day or even a particular year.

In terms of the difficulties cited by Peuquet (2005), whilst the study does involve a significant volume of data, the amount of data stored is manageable. This might become more problematic in a larger scale project such as a national GIS project. There is a risk that changes which occur between snapshots will be missed. However the scope of the project is limited by the availability of historic data to some extent and so this risk is unavoidable. One of the objectives of the study is to look for evidence of the transition into productivism in East Sussex. This transition is claimed to be revolutionary and significant by many authors and so the evidence for it could be expected to be strong – if only weak evidence was found this could have arisen due to the deficiencies in the data. Whilst the datasets are not evenly spaced over the study period, they are nevertheless close enough together in time to allow changes to be pinpointed within a few years.

Summary

This chapter opened by considering some of the advantages of using GIS with historical datasets. The ability to display the results of the analysis spatially was felt to be important, as was the capacity to integrate datasets from different sources. Some examples of projects which have used GIS in historical reconstruction were presented and it was clear that GIS can be used at all scales and in order to answer a variety of different questions.

The third section of this chapter considered sources of error in GIS. These are potentially multiple and may be propagated as analysis is undertaken. The existence of these many uncertainties and difficulties begs the question; "Can the use of GIS still be of ultimate benefit to this study?" The answer is that all GIS projects contain areas of error and uncertainty and this may be particularly true of studies involving historic datasets. Hunter suggests that "uncertainty is reduced by acquiring more information...and/ or by improving the quality of the information available (which may also entail collecting more information)" (Hunter 2005, p637). In the case of historic data it may not be possible to "collect more information" and so a degree of uncertainty is inevitable.

As will be described in the next three chapters, quality control measures were in place to ensure that, for example, the data were georeferenced with an appropriate level of error. For 1940 and 1945/7 it was possible to cross-check the aerial photograph interpretation against the NFS data to some extent and to assess the levels of agreement – this is discussed in detail in Chapter 5.

Therefore, whilst it is acknowledged that imperfections and uncertainties exist in the source data, and that these will have been propagated by the processes of data capture and analysis, nevertheless GIS remains an appropriate and helpful tool for the integration and analysis of these data. Steps have been taken, as far as possible, to limit the levels of error introduced so that a reasonable amount of confidence may be placed in the results of the analysis, and the advantages of being able to manipulate and display the data in this way outweigh the uncertainties which form part of the process.

The first three chapters have set out the aims and objectives of this study and have reviewed some of the previous work in this area. The theories underpinning the work have been explained as well as some of the difficulties with the GIS methodology chosen. The next three chapters detail the practical outworking of the study and present some of the initial findings.

CHAPTER 4: BASE DATASETS AND THE FIRST LAND UTILISATION SURVEY

In this chapter the background mapping and the first Land Utilisation Survey (LUS) will be considered. Where the abbreviation LUS is used in this study it always refers to the *first* Land Utilisation Survey – a second Survey was undertaken in the 1960s but is beyond the scope of this project

Background Mapping

In order to create a base polygon layer it was necessary to obtain some background mapping to be used as a backdrop for the subsequent data layers. Digital copies of the County series OS maps at 1:10560 scale dated between 1911 and 1938 were purchased from Landmark Information Group. In addition the 1931 parish boundaries were downloaded from the *Digimap* website.

The second County series revision maps were published between 1904 and 1939 and the third County series revision between 1919 and 1939 (University of Edinburgh 2004). This means that in 1931 a mix of the second and third County series was in use. A complete set of the second series maps was available for 1931. However it was felt that where the third series revisions were available it would be preferable to use these as they were most nearly contemporary with the LUS. A mix of the second series and third series maps was therefore used as shown in Figure 13. The 1911 tiles are from the second County series revision and the tiles dated in the 1930s are all from the third County series revision.

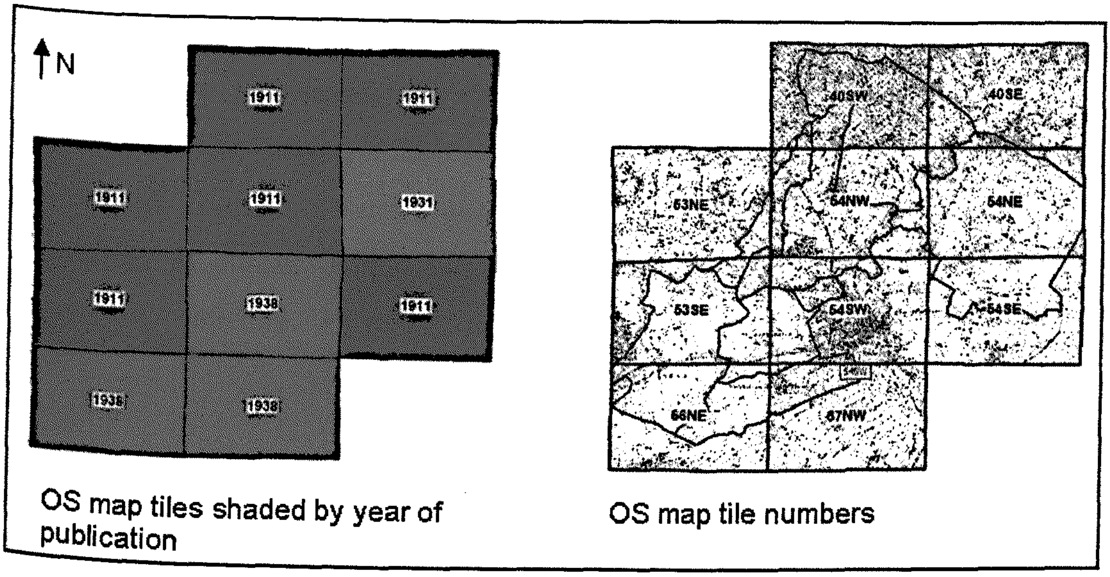

Figure 13 : Map tile number and year of publication
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The map tiles were imported into MapInfo and registered to British National Grid coordinates. The process is summarised in Figure 14. An error level of 5 pixels was felt to be acceptable and so all maps have been registered with this level of accuracy. Each pixel is equivalent to approximately .03 metres on the ground.

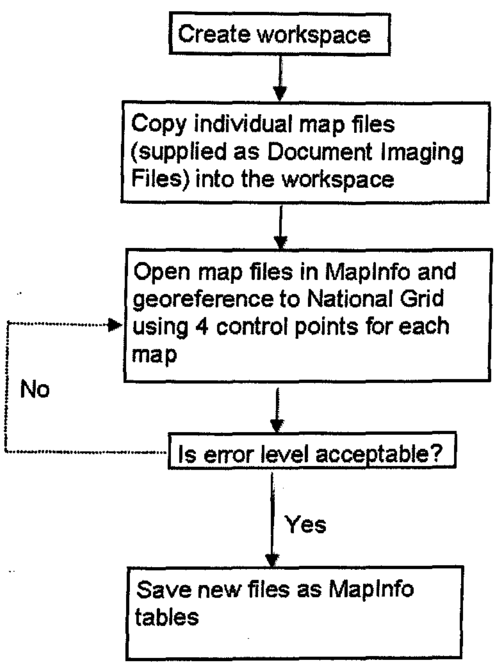

Figure 14: Flowchart of the process of importing and registering the OS base maps

It is important to note that mapping was not transferred to the British National Grid until 1944-1945 (University of Edinburgh 2004). Before this date each county was mapped separately and to its own origin and so maps of different counties do not always fit together neatly. The area chosen for this study is entirely within the county of Sussex and so this should not cause any difficulty. However, in practice, some of the maps do not match well.

Figure 15 shows the edge between map 40SW at the top and 54NW at the bottom. Both are dated 1911 and form part of the second County series.

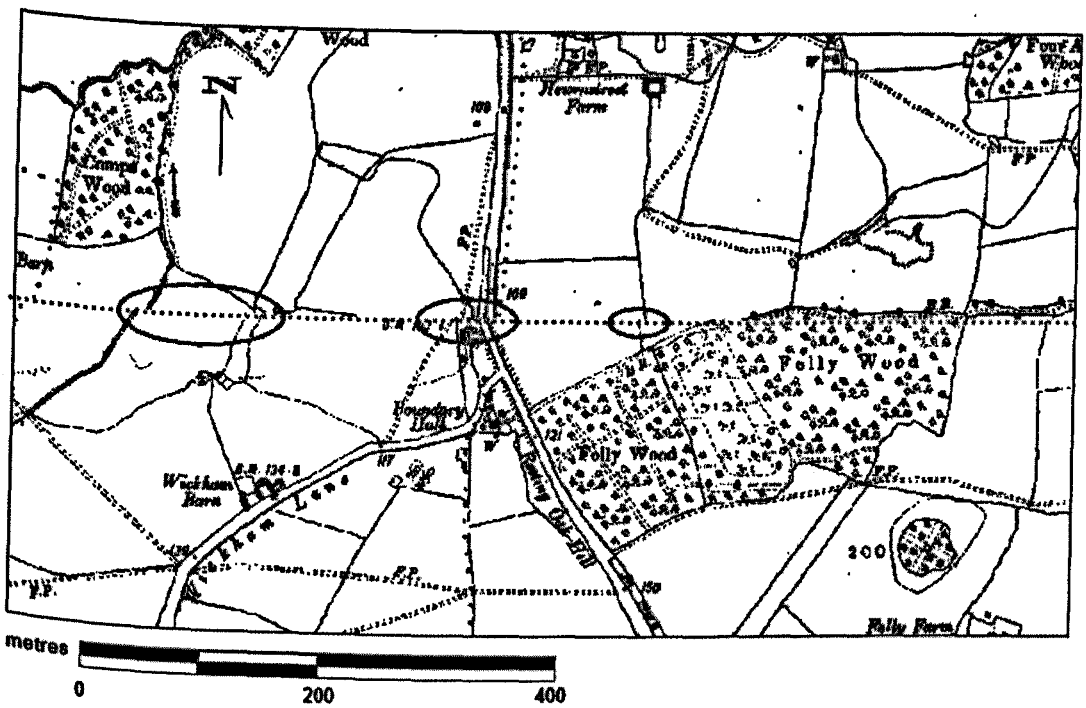

Figure 15: Map join between 40SW and 54NW
© Landmark Information Group Ltd and Crown Copyright 2005

The map edge is shown by the dotted red line and the circled areas highlight lines which do not meet properly across the map join. The registration error for the two maps was checked to ensure that the problems did not arise simply from poorly registered maps. 40SW had an error of zero pixels and 54NW an error of a single pixel. This was insufficient to account for the mismatch as can be seen from Figure 16 which is a close up view of the area just above Folly Wood, the furthest right of the three areas circled in red on Figure 15 above. The individual pixels can be clearly seen.

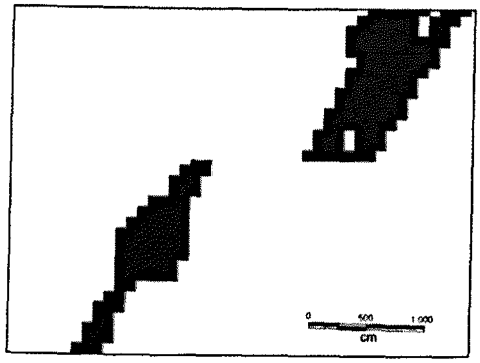

Figure 16: Close up view of the mismatch between 40SW and 54NW

The metadata supplied with the maps by the OS explain the processing problems which have been encountered and may account for the mismatch at some of the edges:

> "These maps are 'working editions' and have therefore been in constant use over the last century. The maps are stored on racking and were only bagged within the last decade; this, coupled with constant handling, has resulted in some maps being torn, folded, and affected by a certain amount of dust. Maps used in the daily business of OS have also been drawn / written on by those who have used them, often obscuring the data originally published (i.e. boundary changes). Finally, because storage has not been in a controlled environment, the paper of some maps have become slightly warped, obviously affecting the accuracy of that map; this is especially the case with Full Sheet 1:10,560 maps" (Landmark Information Group).

The mismatch may also be compounded by the fact that the maps were registered to the British National Grid despite not having originally been created to this coordinate system.

Creating a Base Polygon Layer

Once the base maps had been registered in MapInfo a series of polygons was digitised over this base map. It was decided to create this base set of polygons first and to create a copy for each time period. The polygons would then be modified as necessary for each of the datasets. It was expected that the polygons would tend to become larger over time and so the main work involved would be to merge smaller polygons together and to adjust parts of boundaries. Figure 17 shows a flowchart of the process of creating the base polygon layer.

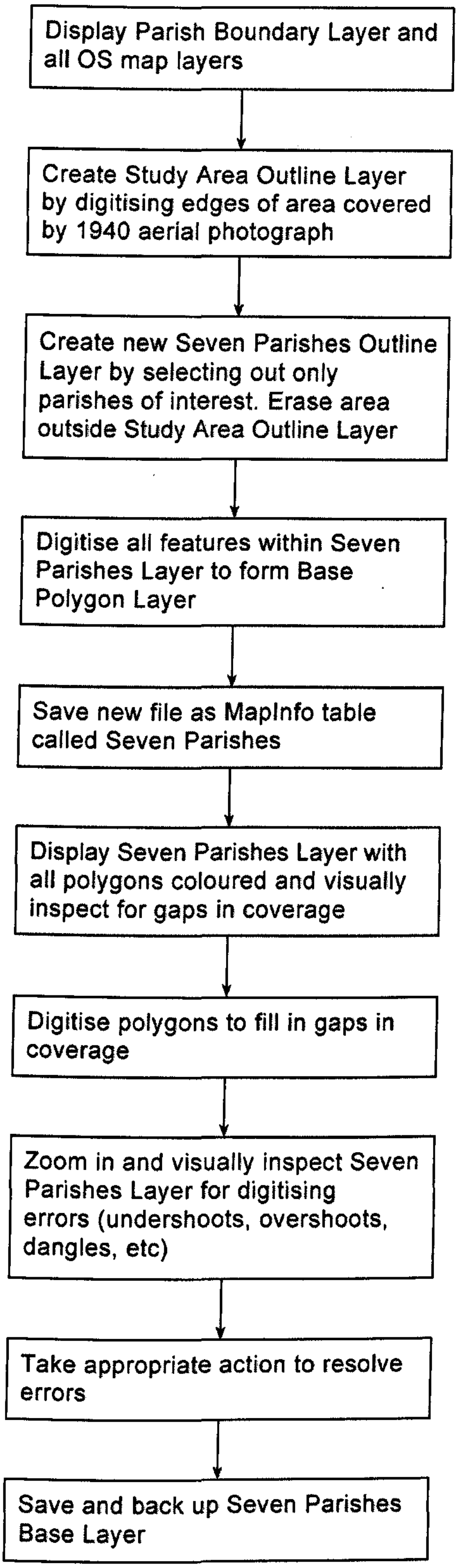

Figure 17: Flowchart of the process of creating a base polygon layer

Detail from the base polygon layer is shown in Figure 18. The digitised polygon layer is represented by the blue lines which are overlaid on the OS base maps.

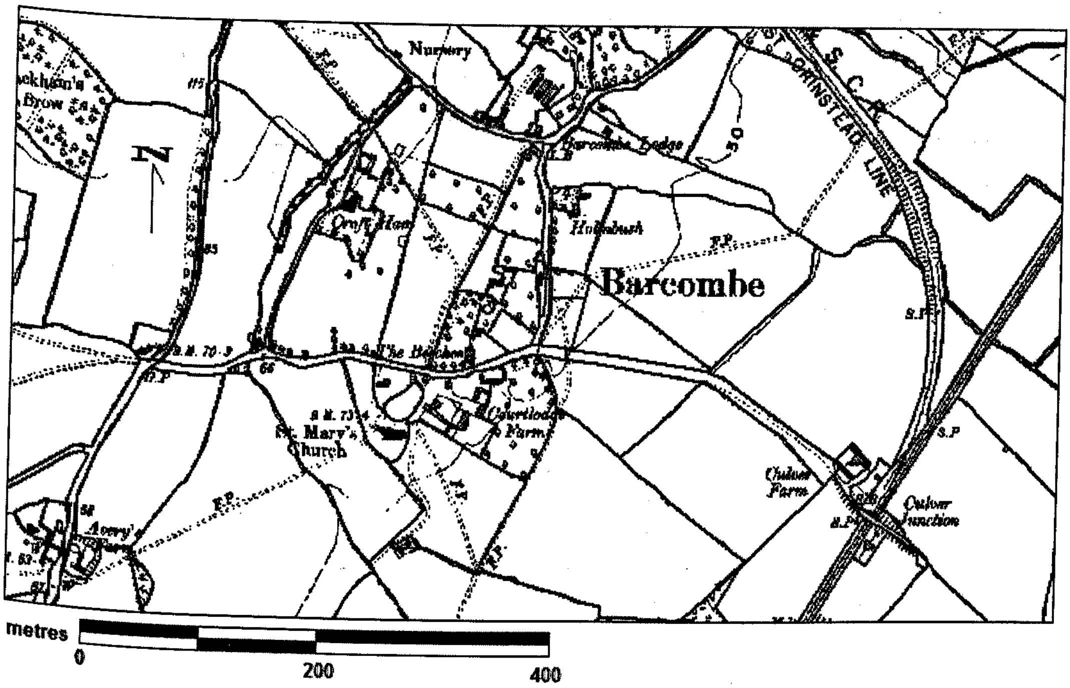

Figure 18: ***Detail from the base polygon layer overlaid on an historic OS map of Barcombe © Landmark Information Group Ltd and Crown Copyright 2005***

Once the base polygon layer had been created, the first dataset could be processed. This was the first Land Utilisation Survey which is described in detail in the next section.

The First Land Utilisation Survey

The historical overview in Chapter 1 touched on some of the reasons why the LUS was felt to be necessary. This section will consider in more detail how the survey was organised and conducted.

Background

The two logistical issues for the organisers to consider were the information to be collected and how the survey was to be conducted. It was decided that the information collected should be kept relatively simple so that the scheme could be readily understood by volunteer staff with varying degrees of geographical knowledge. It was also decided that the scheme should be applicable to the entire country to enable direct comparison between areas. The proposed scheme was devised and piloted in spring and summer 1930 and the final version was adopted in autumn 1930 (Stamp 1964, p4). The outline categories used are shown in Table 6.

	Description	Letter Marking (essential)	Colour Marking
1.	FOREST and Woodland to be marked	F	Dark Green
2.	MEADOWLAND and permanent grass	M	Light Green
3.	ARABLE or tilled land, fallow, rotation grass, and market gardens	A	Brown
4.	HEATHLAND, moorland, commons and rough hill pasture	H	Yellow
5.	GARDENS, allotments, orchards, nurseries etc.	G	Purple
6.	LAND agriculturally unproductive, eg, buildings, yards, mines, cemeteries etc.	W	Red
7.	PONDS, lakes, reservoirs, ditches, dykes, streams and anything containing water	P	Blue

Table 6: Basic categories used in the first LUS (from Stamp 1964, p22)

There was some provision for subcategories to be noted where these were apparent. So, for example, there were several classifications for types of woodland: (a) High Forest; (b) Coppice, (c) Scrub and (d) A forest cut down and not replanted. Furthermore the types of tree could be recorded – (c) representing coniferous, (d) for deciduous and (m) for mixed. Thus an area of mixed coppice would be classified as Fb^m.

One particular difficulty with the classification scheme is that grassland can fall into one of three categories. The first and most obvious category is Meadowland and Permanent Grass. Stamp described four types of grassland which would fall into this category:

a) Waterside meadows, water-meadows and freshwater marsh pasture

b) Other meadows for grazing and for hay

c) Hill pastures – "the short grass pasture of hilly ground, such as may be found on the chalk downs or other limestone regions, is recorded as permanent pasture even if it is unenclosed or is in very large enclosures, provided it is free from gorse, bracken, heather or other rough vegetation" (Stamp 1964, p28)

d) Parkland – "the characteristic of most parkland...is that it consists of grassland with scattered ornamental trees" (Stamp 1964, p29)

Secondly, fallow land and rotation grass would fall into the Arable category. Stamp explains that:

> "In England and Wales, grass was included as temporary (ie classed as arable) if it had not been down more than three years; if it had been grass for four years or more it was considered as permanent and coloured as such" (Stamp 1964, p27).

Finally the Heathland category includes Moorland, Commons and Rough Grazing. Stamp acknowledges that this category covers land of a widely varying nature but contends that:

> "It has this in common, that it is covered by vegetation of a semi-natural character which has not been planted by man but which has developed spontaneously. In this sense, such land is technically described as 'uncultivated' or 'unimproved' (Stamp 1964, p29).

Furthermore in relation to Commons, Stamp notes that "some of these urban commons have lost their rough vegetation and might well be coloured as permanent pasture but for the difference in status" (Stamp 1964, p29). It is important to make the point that whilst land may be described as "unimproved" this does not necessarily mean that it has experienced no human intervention. For example, common land may have been grazed for many years.

In practice the fine distinction between different types of grassland proved difficult to make and Stamp himself acknowledged that "when amateur surveyors saw a field of grass it was likely to be recorded as "M", and some purely temporary grass was doubtless included in permanent in this way" (Stamp 1964, p27).

The second issue to be addressed was how the survey was to be undertaken. Stamp had been impressed by a survey conducted in Northamptonshire under the directorship of Mr. J.L. Holland. In this instance each elementary school in the county had been provided with a set of six inch (1:10,560 scale) OS maps and children were instructed to record whether the fields were grass or arable (Stamp 1964, p4). The results were amalgamated together onto one inch maps (1:63,360 scale) and published in 1929.

Stamp decided to adopt a similar approach for the LUS. The work was carried out on a county basis under the direction of a County Organiser. The initial observations were recorded on six inch OS maps (field sheets) and sent in to the LUS headquarters via the County Organiser. A senior surveyor was then sent out to fill in any gaps and do "a field check of the whole" (Stamp 1964, p25). The six inch sheets were then edited down to one inch scale for publication.

At this stage further quality control checks were carried out – edges of adjoining map sheets were checked for agreement and a traverse check was carried out in the field. Any dubious map work was double checked at this stage. Stamp records that:

> "The main need for editing the six inch sheets arose from differences of interpretation of the instructions....For example, in a well-farmed East Anglian county there was a tendency for the surveyor to record a neglected grass field with a growth of thistles as "rough grazing", whereas it was probably better than the best field of permanent grass on a hill farm of the west."

In the course of this project similar difficulties of definition and interpretation were experienced and these will be discussed later.

The work of reducing the maps to one inch scale was carried out by hand after an initial experiment using photographic reduction failed to produce satisfactory results (Stamp 1948, p25). The work was done on the fourth edition one inch maps supplied by the OS and the field shapes were sketched in and hand-coloured.

The publication of the final maps was beset by a number of financial crises as a series of grants was exhausted and Stamp admitted that "the hardest part of the whole work has been the collection of funds" (Stamp 1964, p12). However with the outbreak of war in 1939 the importance of the maps was recognised and the Ministry of Agriculture made an annual grant to the Survey to enable the publication of the one inch maps as quickly as possible

In 1941 the Ministry of Works and Buildings was concerned with the creation of a series of background maps for Town Planning purposes. These were to be drawn at a scale of 1:625,000 or ten miles to the inch. The LUS offered their map for inclusion in the series and in 1943 the generalised maps showing the findings of the LUS for the whole country were published as two sheets. The southern sheet covered most of England and the whole of Wales with the remainder of northern England and Scotland being covered by the northern sheet.

The 10 miles to the inch maps (hereafter referred to as the "ten mile" maps) were necessarily a generalisation of the one inch maps. However the process proved to be very intricate and time consuming and care was taken to preserve the proportions of each land use type. Stamp describes the process thus:

> "The method followed in the construction of this map was to take each one-inch Land Utilisation sheet whether published or in manuscript and go over it in pencil generalising it by running together adjacent blocks of fields with the same utilisation, taking care that the proportion of each remained true even though field shapes were lost" (Stamp 1964, p33).

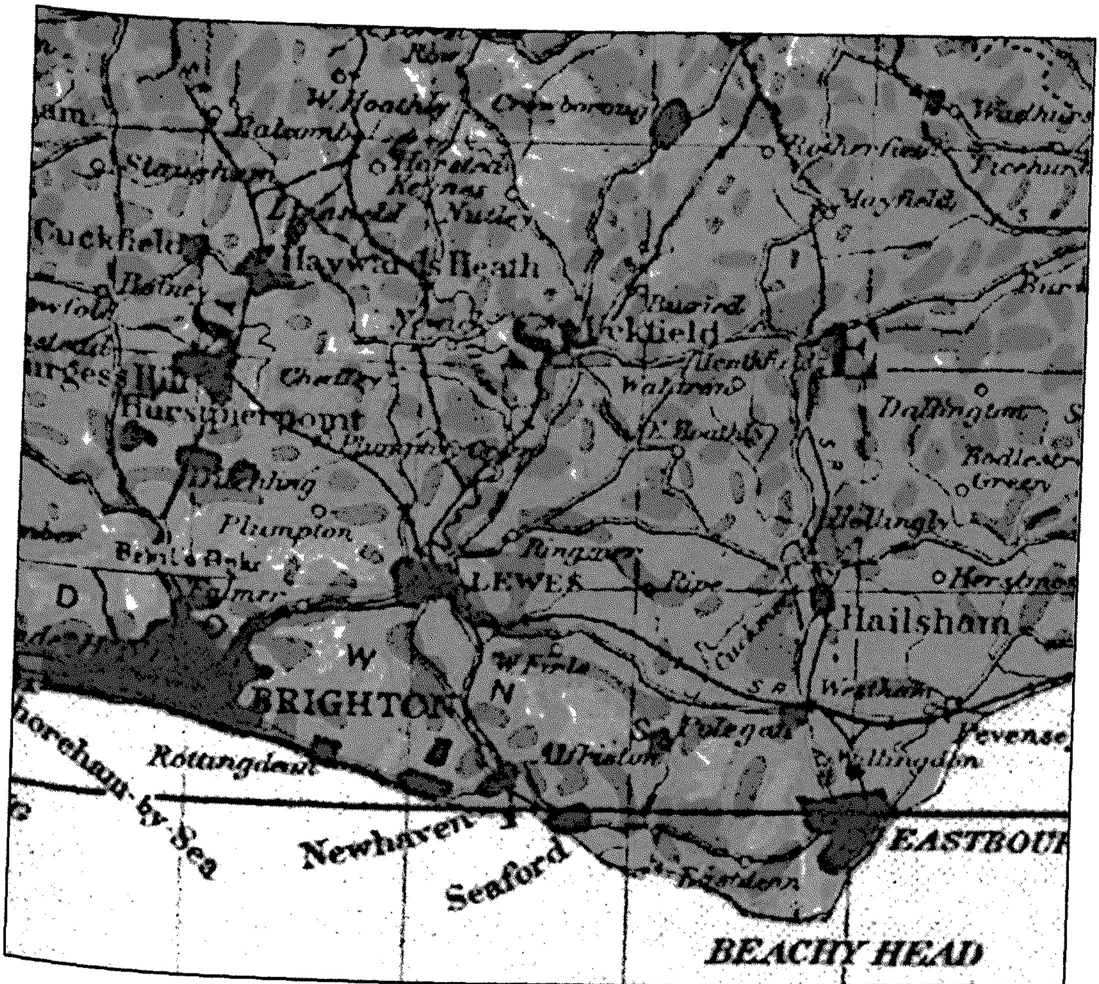

***Figure 19:* Part of the ten mile map of England**
Source: Vision of Britain website

The LUS in East Sussex

The LUS report for East and West Sussex was published as a single volume in 1942. However the surveying for the two counties was undertaken separately. In East Sussex the surveying was carried out "by the schools of the County" (Briault 1942, p471) and East Sussex was one of the first counties to complete the survey work. The six inch maps were distributed and the field work was completed in the summer of 1931. Briault comments that "it would be impossible to speak too highly of this model of expeditious efficiency."

In addition to the work undertaken by the county schoolchildren in East Sussex, H.C.K. Henderson of Birkbeck College was also engaged in surveying the central block of Sussex (East and West) in connection with his own studies. Henderson's field sheets were handed over to the LUS in 1935, thus affording "a complete check" of the central area (Briault 1942, p471). Briault himself extended the survey further east in 1934 and further survey work by H.B. Smith ensured that the whole of East Sussex had effectively been surveyed twice.

The publication of the maps for East Sussex was funded by Lord Leconfield and so circumvented some of the financial difficulties which had beset the LUS at that time. Sheet 134, covering Brighton and Eastbourne, was checked and published in 1936.

Classification System

In order to quantify land use for this project, a system of classification codes had to be adopted. This was based on the six main categories used in the LUS, as shown on the key for the summary maps (Figure 20). These were Forest and Woodland; Arable Land; Meadowland and Permanent Grass; Heath and Moorland; Gardens etc., Land Agriculturally Unproductive. In addition main roads were shown in red and inland water in blue.

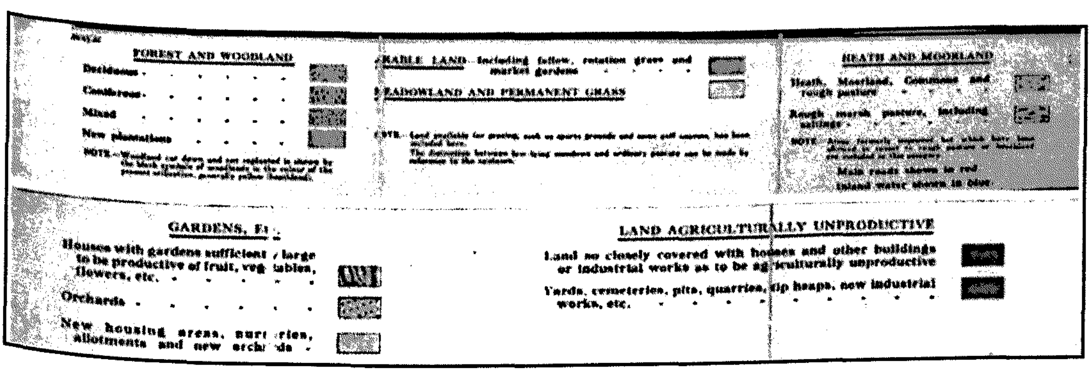

Figure 20: Key for the LUS summary map
Source: University of Sussex

Within these main categories there were a number of subcategories. For example the Gardens etc. category was subdivided into houses with large gardens; orchards; new housing areas, nurseries, allotments and new orchards.

The categories chosen for this project needed to be identifiable not only on the LUS field sheets and maps but also from aerial photographs alone for 1947 and 1959. This influenced the final categories selected. It was felt to be impracticable to try to distinguish between many of the subcategories when relying on aerial photographs, and so only the broad main categories were adopted

The one exception to this was the Forest and Woodland category where some subdivisions were retained. This is because it is possible, in some instances, to distinguish between different types of woodland on an aerial photograph.

Some modifications were made to the LUS categories in the light of the requirements of this particular project. A category was added for Water and major roads were included in the Land Agriculturally Unproductive category and not shown separately. A query category was also added.

Shaws were added as a subcategory within Forest and Woodland. These are a particular type of hedgerow described by Brandon and Short as "the encroachment of trees and shrubs on previously cultivated land" (Brandon and Short 1990, p56) and are often identifiable on the OS map. An example is shown in Figure 21. It was felt that it could be helpful for later analysis to differentiate them as a sub category.

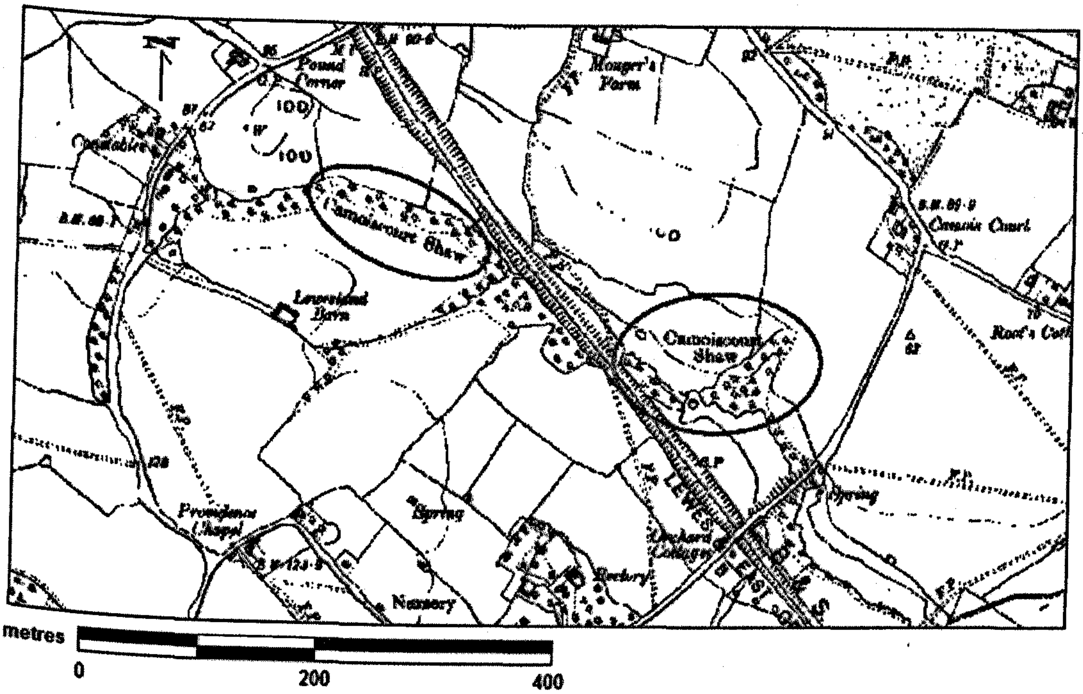

Figure 21: Camoiscourt Shaw
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The LUS category of Meadowland and Permanent Grass was expanded a little to include grass with scattered trees. This could be seen as similar to parkland, which Stamp included in the Meadowland category. One of the difficulties in classifying land use in a GIS is that features on the ground do not always have definite boundaries although capturing them as polygons implies that they do – this is the problem of fuzzy boundaries which was discussed in the literature review earlier. For example at the edge of an area of woodland the trees may gradually thin out – it is difficult to decide at exactly which point the area ceases to be woodland. This is illustrated in Figure 22 which shows a section from the 1940 aerial photograph. Grass with scattered trees was included with Meadow and Permanent Grass to help with this distinction.

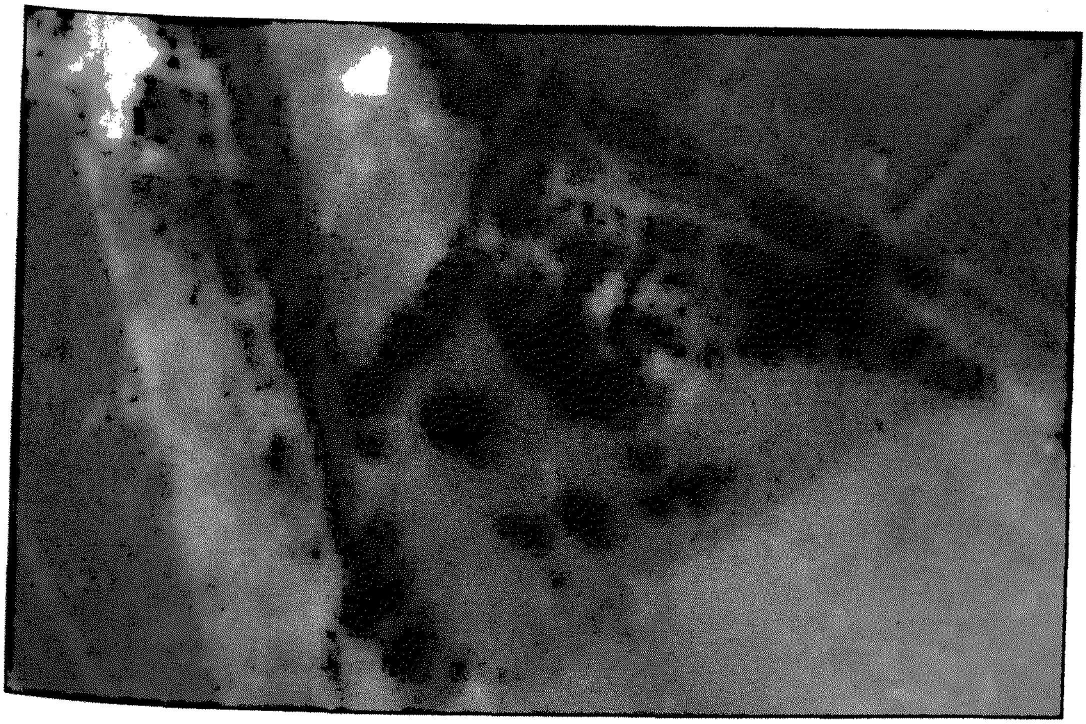

Figure 22: An area of woodland with an indeterminate boundary from the 1940 aerial photograph
Source: University of Sussex

Finally, there is no moorland in Sussex and so the Heath and Moorland category was amended to Heath and Rough Grazing. This category was retained despite some concerns over differentiating this from Meadowland on the later aerial photographs. As explained earlier the fine distinction between different types of grass caused some problems even for the surveyors in the field at the time.

Each category was assigned a numeric code. The numeric codes were structured so that it was possible to distinguish how each polygon had been classified. Codes ending in 00 were classified from the six inch field sheet, 01 codes from a best guess and 02 codes from the one inch published map. The final categories and codes used to classify the LUS data are shown in Figure 14 – these were modified very slightly when the NFS data were classified as described in Chapter 5.

Original Stamp Category	*Stamp sub categories (if used)*	*Abbreviations used on Field Sheets*	*This project equivalent category name*	*This project equivalent subcategory name*	*Code – classified on field sheet*	*Code – classified by best guess*	*Code – classified from one inch map*
Forest and Woodland		F	Forest and Woodland (includes forest, woodland and shaws)		100	101	102
	Coniferous			Coniferous	110	111	
	Deciduous	FbD		Deciduous	120	121	
	Mixed	FbM		Mixed	130	131	
	New plantations or coppices			New plantations or coppices	140	141	
				Shaws	150	151	
Meadowland and Permanent Grass		M	Meadow and Grassland (includes permanent grass, grass and scattered trees)		200	201	202
Arable Land		A	Arable		300	301	302
Heath and Moorland		H	Heath and Rough Grazing		400	401	402
Gardens etc.		G	Gardens etc. (includes houses, allotments, nurseries)		500	501	502
Inland Water			Water		600	601	602
Land Agriculturally Unproductive		W	Land agriculturally unproductive		700	701	702
			Query		801		801

Table 7: The original LUS categories and the categories adopted for this project

The Process of Classification

A copy of the base polygon map was saved for 1931. An attribute table was created related to this map which contained columns for Main_Category_1931, Sub_Category_1931 and Comments_1931. The appropriate category code was entered into the attribute table for each polygon. The comments column enabled the reasons for particular decisions to be recorded as well as relevant notes written on the map. Figure 23 shows the process in more detail and the three stages undertaken will be discussed in the next section.

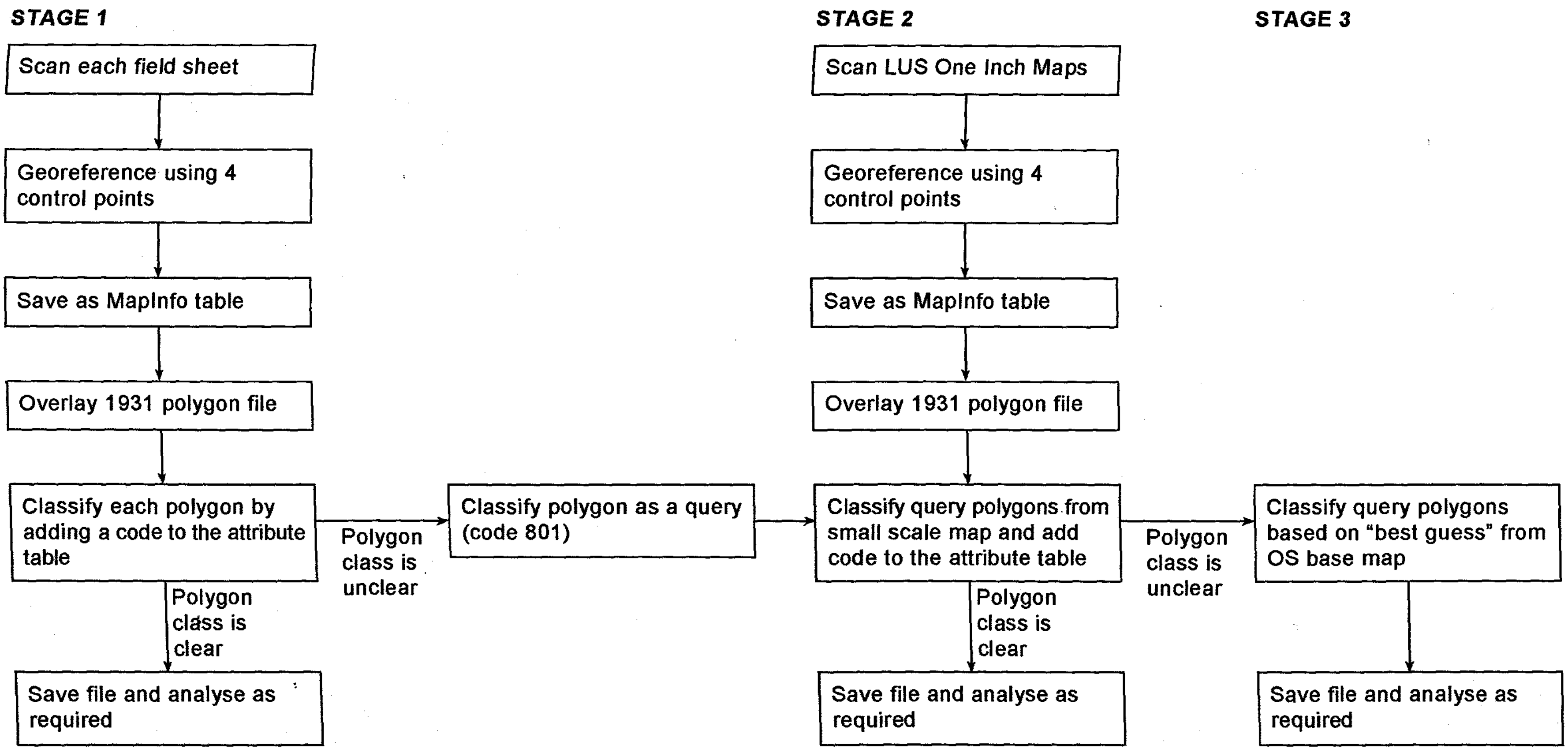

Figure 23: Flowchart showing the process of classifying the polygons from the field sheets

LUS Field Sheets

The aim of the exercise was to identify the land use at the level of individual fields as far as possible. With this end in mind it was decided to use the field sheets from the LUS as the primary source as these showed the land use in the most detail. Copies of all the field sheets for the study area were available for consultation at the London School of Economics as negatives (ie white on black – see Figure 25) and copies were obtained and scanned into the computer. These were then registered to the same coordinate system as the polygon layer so that the maps could be overlaid. Most of the field sheets were based on the second revision County series maps but one (dated 1931) was from the third (Figure 24).

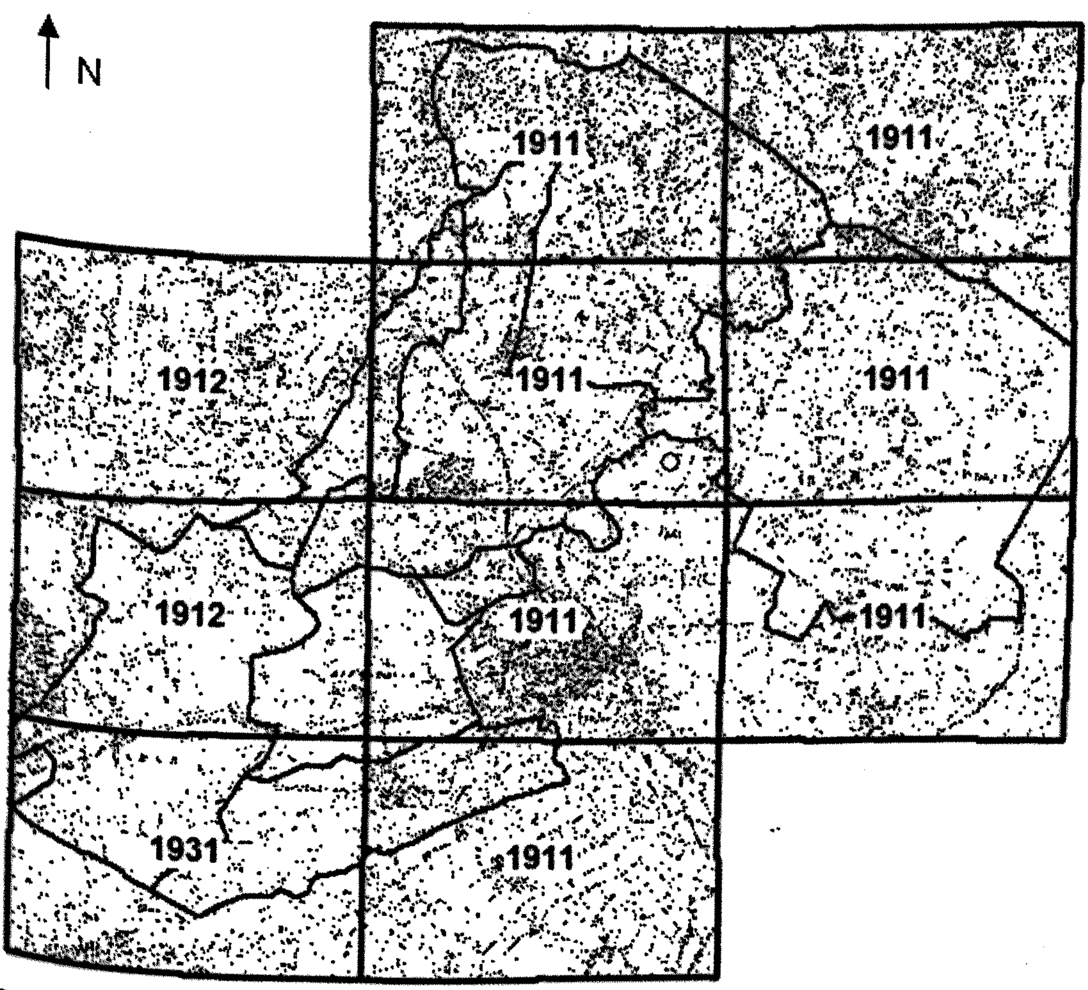

Figure 24: Dates of the LUS field sheets
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The first stage of the process was to classify as many polygons as possible from the field sheets. Figure 25 shows an extract from a field sheet and it is clear that much of the classification simply involved entering a code in the attribute table which corresponded to the letter on the map. The letters used on the field sheets are shown in Table 7 above. Most are obvious abbreviations so that M stands for Meadow, A for arable. However W denotes not water but waste land, ie Land Agriculturally Unproductive.

It soon became clear that the data on the field sheets were not always complete. An example is shown in Figure 25. Whilst most of the surrounding fields have an identifying letter written in them, the area circled in red is blank.

Figure 25: ***An example of a query polygon***
Source: London School of Economics

Further difficulties encountered in classifying polygons from the field sheets were that some entries were illegible or unclear – for example in some cases it was not possible to distinguish "H" (for "Heath") from "M" (for "Meadow"). Finally some polygons were actually given two classifications as in Figure 26.

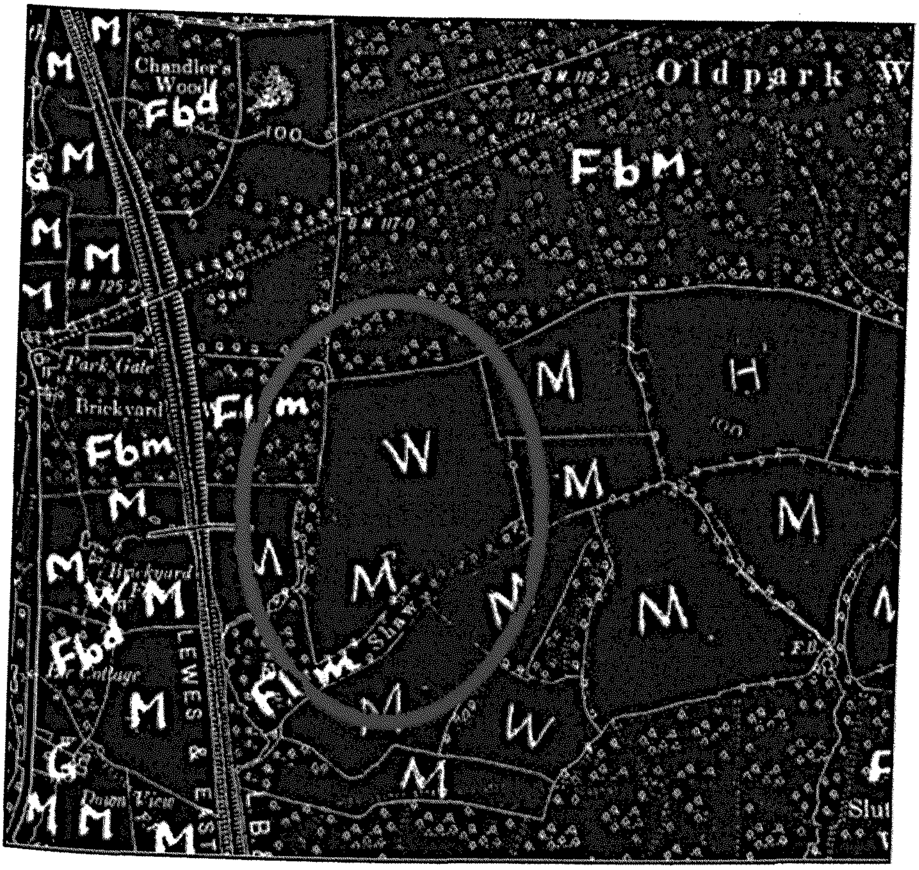

Figure 26: An example of a polygon which has been given two classifications on the field sheet
Source: London School of Economics

Polygons which had no classification shown on the field sheets or which were unclear for any reason were classified as query polygons and coded 801. At the end of stage 1 an SQL query was run in MapInfo to identify all the query polygons and 497 (11.63%) were selected from a total of 4,273 polygons. These were then revisited and reclassified during stages 2 and 3.

One Inch Maps

The one inch published map was now imported and registered in MapInfo and displayed as a backdrop to the 1931 base polygons. Each of the query polygons was then revisited to see if it could be classified from the published map.

In many instances land was able to be classified in this way. However in some cases classification from the one inch map also proved difficult with groups of buildings proving particularly problematic. The process can be illustrated with reference to the area around Falmer. Figure 27 shows the field sheet and the one inch map for the area. The pond and the railway line are the features which are easy to identify on both maps and so these were used as a means of orientation.

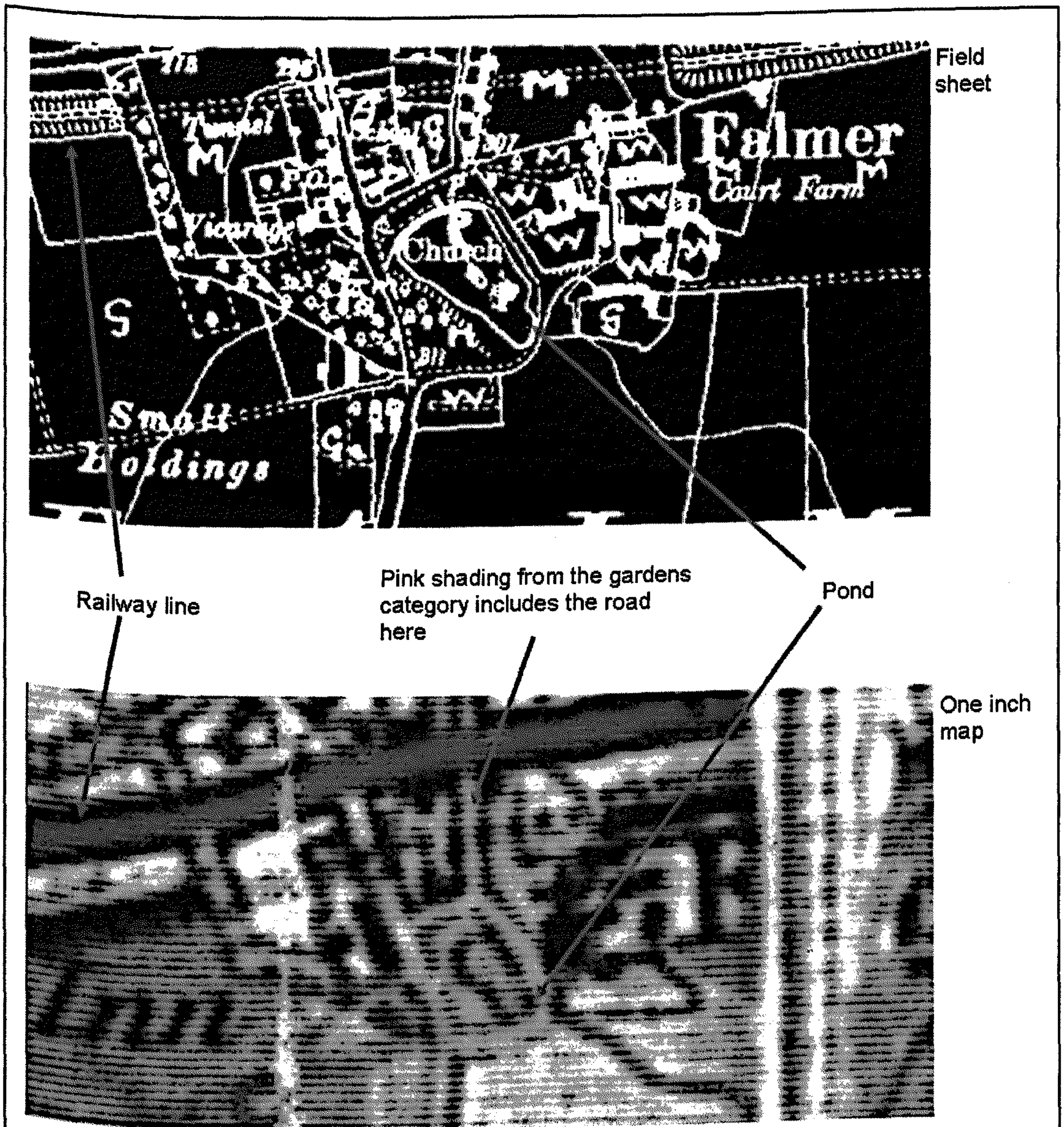

Figure 27: The centre of Falmer as shown on the field sheet and one inch map
Source: London School of Economics and University of Sussex

The first stage of the process would be to classify as many polygons as possible from the field sheet. Some of the letter codes are unclear on the map and there are a few polygons with no codes at all. Turning to the one inch map for clarification further difficulties are encountered. Some land uses are reasonably easy to distinguish but there are two folds which obscure the data. The minor road also appears to be coloured in pink to denote "Gardens etc." Stamp explains why this was done:

> "In the Land Utilisation sheets the secondary and other roads are, of course, exaggerated in width and occupy an undue proportion of the map surface and this has been corrected by showing them in the colour of the fields by which they are bordered" (Stamp 1964, p31).

However this practice does tend to add confusion to the process of map interpretation.

Best Guess

Polygons which were not classified from either the field sheets or one inch maps were allocated using a best guess system. This took into account the uses of surrounding land and clues from the OS base maps. So for example, the area marked as a church in the centre of Figure 27 would be classified as unproductive land – the area surrounding the church would probably be a cemetery and so not suitable for cultivation.

The Pilot Area

It was decided to carry out an initial classification on a pilot area to check that the classification system was workable and that no further problems were identified. The three stage method of classification shown on the flowchart in Figure 23 evolved during the pilot period as it became clear that a full classification would not be possible from the field sheets alone. This will be discussed more fully in the next section.

The pilot area which was chosen was the parish of Barcombe. This lies to the north east of the study area and is shown highlighted in Figure 28.

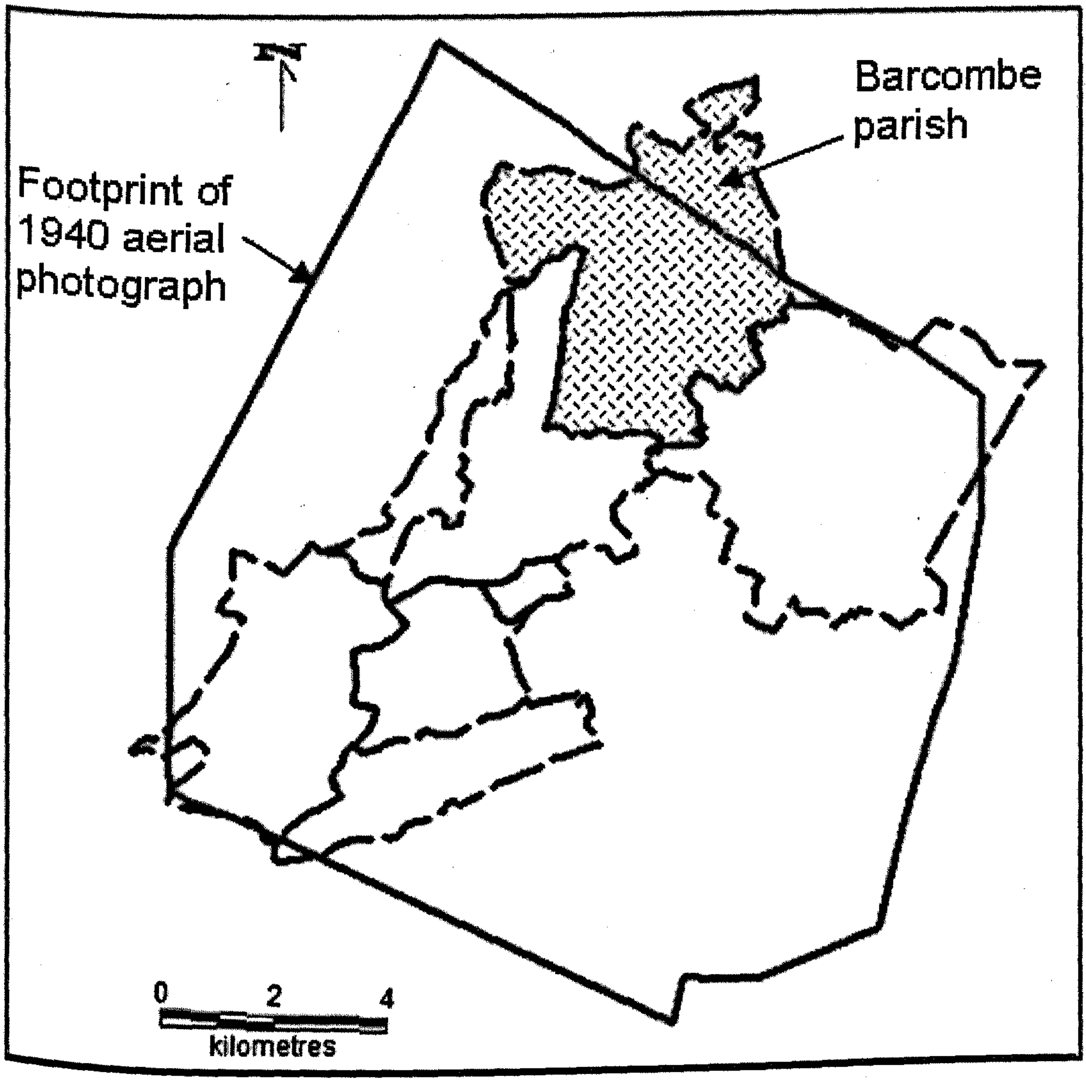

Figure 28: Location of the parish of Barcombe
Source: Parish boundary outline from UK Borders

As explained previously, the study area is constrained by the boundaries of the 1940 Luftwaffe aerial photograph. Therefore only the section of Barcombe parish inside the footprint of the aerial photograph is included in the study area. The actual extent of the pilot area is therefore shown shaded in Figure 29.

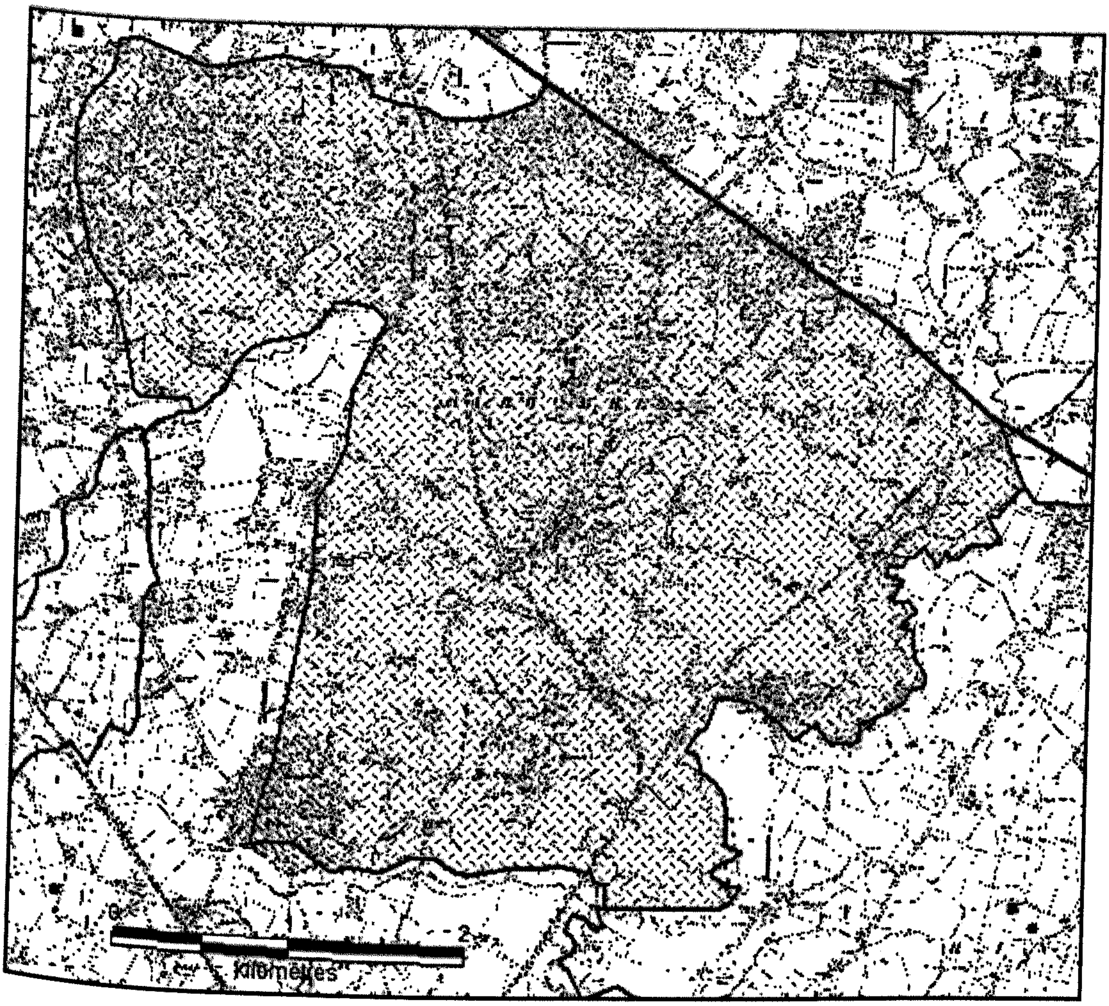

Figure 29: Extent of the pilot area
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This area was chosen as the pilot for two main reasons. Firstly the land to the north of the study area is more established agricultural land and appeared from the OS map and aerial photo to have fairly clear field boundaries. This meant that it should be easier to categorise than the downland to the south which had less defined boundaries. Secondly, from a quick visual inspection of the field sheets, they appeared clear and reasonably complete.

The first stage of the classification process was reasonably straightforward. The field sheets were examined and each polygon was identified in the GIS. The polygon was modified if necessary so that it was the same size and shape as the object shown on the field sheet. The appropriate land use code was then entered into the attribute table. A query code of 801 was added to the classification during this first stage due to difficulties identifying the land use of some polygons as discussed above.

Once the initial classification had been completed for all the polygons in Barcombe parish, a thematic map was created and coloured in approximately the same colours as the one inch published map. The thematic map was then compared with the published map in the expectation that they should appear broadly similar if the classification had been carried out correctly. The maps are shown side by side in Figure 30.

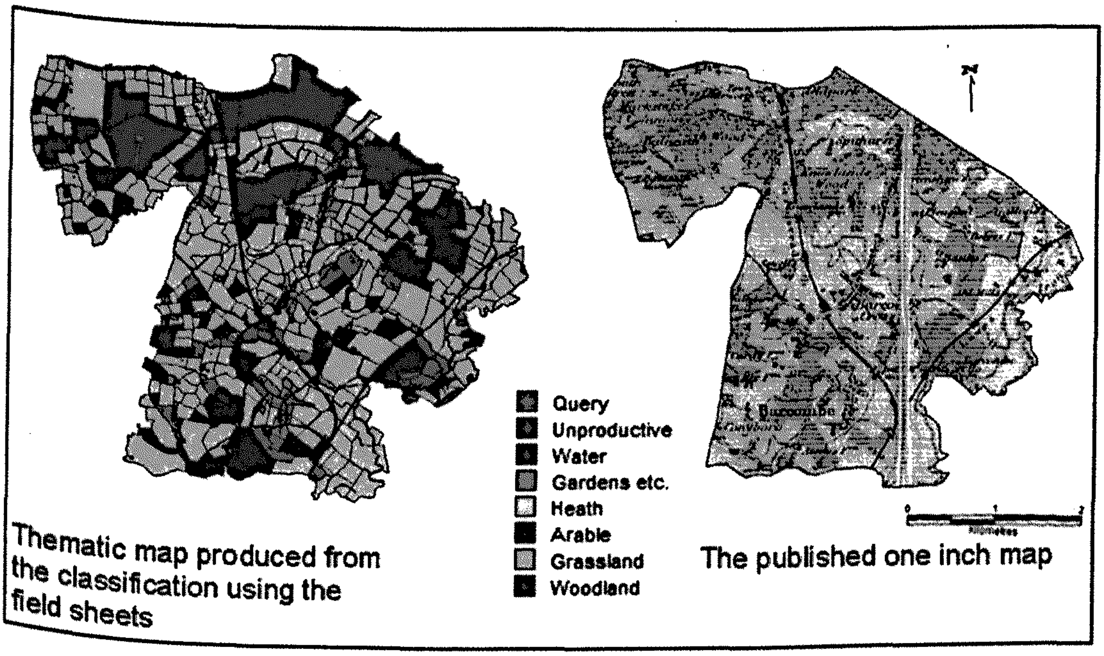


Figure 30: The classification of Barcombe from the field sheets compared to the one inch published map
Source: *University of Sussex*

As the two maps were compared it became apparent that they were far from identical. An example of the differences is highlighted in Figure 31.

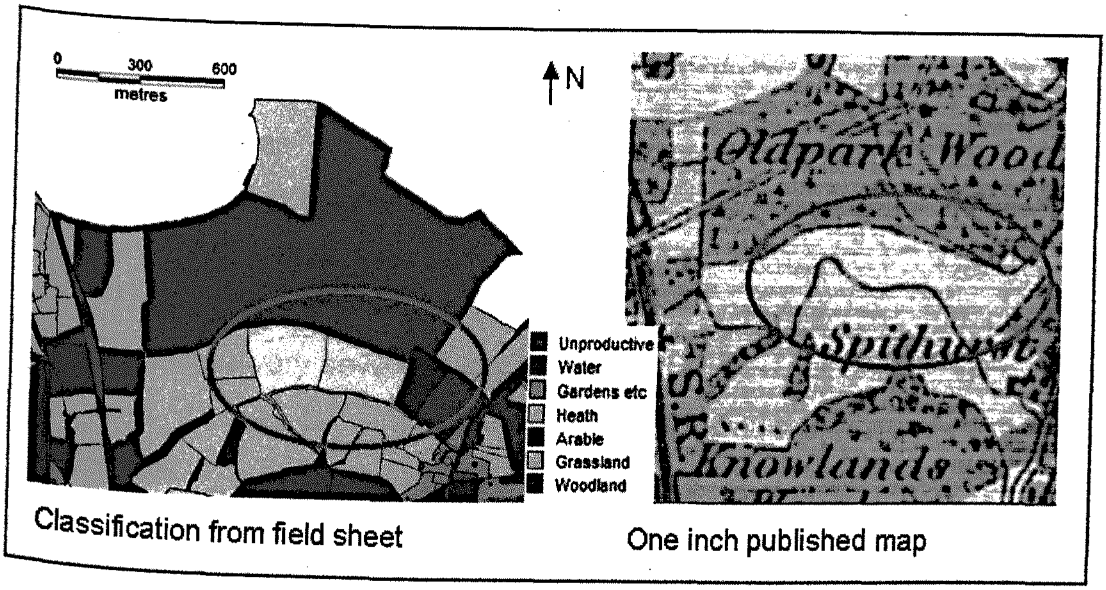


***Figure 31:* Detailed comparison of the field sheet classification with the one inch map**
Source: University of Sussex

The area circled in the centre of Figure 31 was classified as Heath and Rough Grazing and Arable from the field sheets whereas on the published map the area is all shown as Meadow and Grassland.

As a result of these discrepancies the field sheets were checked to see whether the codes had been entered incorrectly. Detail from the field sheet is shown in Figure 32 and it is clear that the codes have been taken across correctly and the discrepancy seems to lie with the published map.

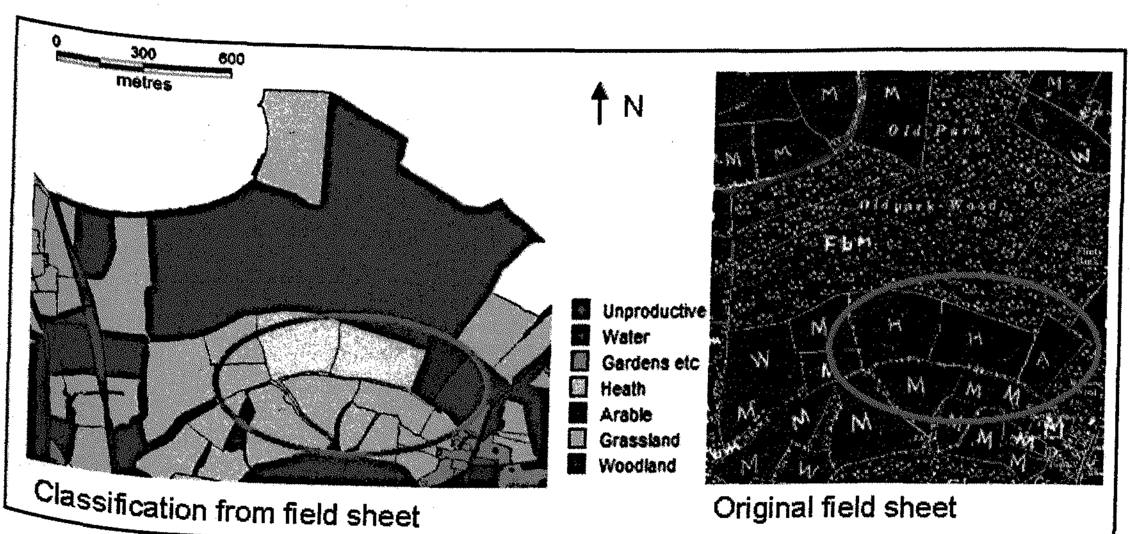


***Figure 32:* The thematic map created from the field sheet classification compared to the original field sheet**
Source: London School of Economics

Further visual inspection of the maps led to the conclusion that there were a significant number of differences between them. It was noted earlier in the background section that considerable checking was carried out during the process of reducing the six inch field sheets to one inch scale for publication. Stamp describes the process thus:

> "First the margins of adjacent sheets were checked for agreement – actually a very severe statistical check – and usually the whole batch was taken out into the field and subjected to a traverse check....Sometimes a sheet had to be marked for complete re-survey but the proportion of such was extremely small. In a large number of sample areas sheets were surveyed entirely independently by two or more surveyors and such checks were invaluable" (Stamp 1948, p25).

We know from Briault (1942) as described in the background chapter, that most of Sussex was surveyed twice.

Given this process of checking it is unsurprising that there are differences between the original field sheets and the one inch published maps. However at first glance the number of differences seemed quite high and so it was felt that it would be a useful exercise to try to quantify these. In order to do this it was necessary to create a MapInfo table containing the information from the one inch maps. This process is shown in Figure 33.

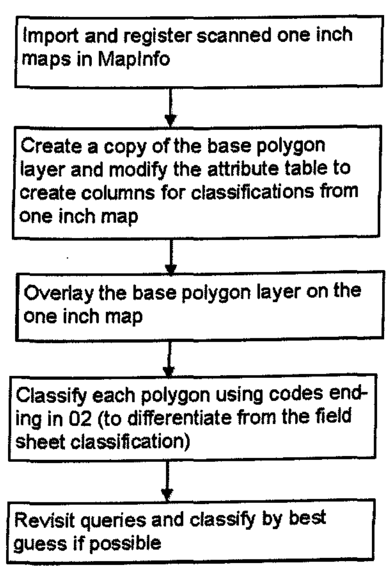
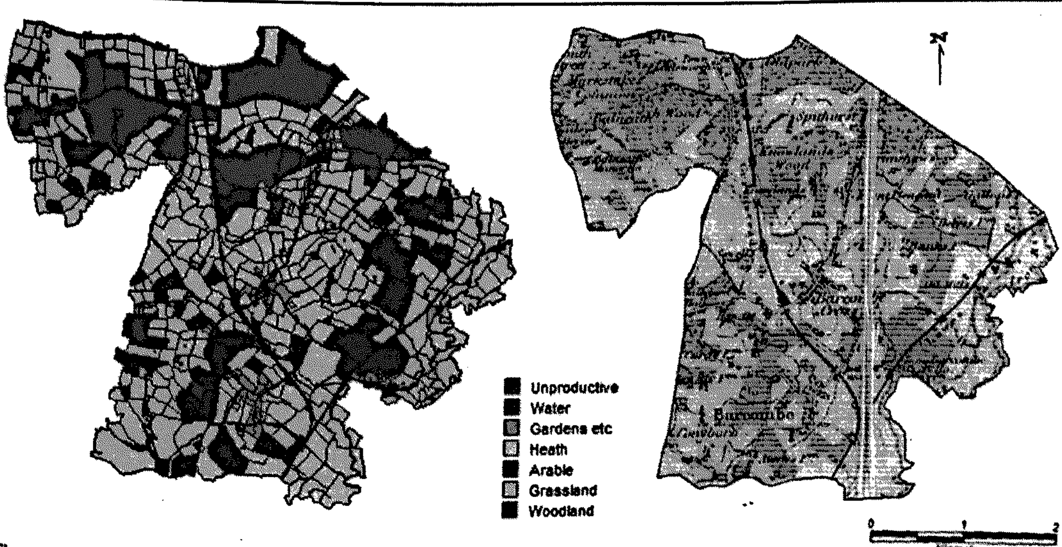


Figure 33: Flowchart describing the process of classifying the one inch maps

As with the field sheets, classification from the one inch map proved somewhat problematic. Areas of detail such as groups of buildings were often difficult to decipher, and there were issues with data being lost where the map had been folded and also difficulties where the colours on the map had leaked. These were illustrated in more detail in an earlier section (see Figure 27). If the class was unclear a best guess was entered (with a code ending in 01) or the polygon was classified as a query (801). The query polygons were revisited at the end of the process and each was assigned to another category. Where necessary, polygons were modified to conform to the shapes on the one inch map.

Once the classification process had been completed a thematic map was created and displayed in approximately the same colours as the original published map. This is shown in Figure 34. Finally an area column was added to the attribute tables for both the one inch map classification and the original field sheet classification. This allowed the area of each polygon and thus the area for each type of land use to be calculated.



Thematic map based on classification from the one inch map

The original one inch map

Figure 34: The results of the one inch map classification
Source: *University of Sussex*

At the same time that the one inch map was being classified, the original classification from the field sheets was also revisited and query polygons were classified from the one inch maps or as a best guess.

The final area values obtained for each type of land use for the pilot area are shown in Table 8. The differences in total area are due to rounding. The three different values for each land use type in the Field Sheet columns represent the three stages of the classification process – any polygons which could not be identified from the field sheets were classified from the one inch map and any query polygons subsequently remaining were classified by best guess. In the case of the one inch map columns, any query polygons were classified by best guess alone and the field sheets were not used in this case.

Land Use Classification	**Category**	**Classification based on Field Sheet (Acres)**	**Classification based on One Inch Map (Acres)**
100	Forest and Woodland (from field sheet)	596.82	-
101	Forest and Woodland (best guess)	15.44	.75
102	Forest and Woodland (from one inch map)	123.95	717.23
	Subtotal Forest and Woodland	736.21	717.98
200	Meadow and Grassland (from field sheet)	2,094.86	-
201	Meadow and Grassland (best guess)	28.61	3.82
202	Meadow and Grassland (from one inch map)	265.09	2,463.22
	Subtotal Meadow and Grassland	2,388.56	2,467.04
300	Arable (from field sheet)	470.21	-
301	Arable (best guess)	3.39	4.05
302	Arable (from one inch map)	3.81	499.30
	Subtotal Arable	477.41	503.35

Land Use Classification	Category	Classification based on Field Sheet (Acres)	Classification based on One Inch Map (Acres)
400	Heath and Rough Grazing (from field sheet)	109.22	-
401	Heath and Rough Grazing (best guess)	-	-
402	Heath and Rough Grazing (from one inch map)	4.52	75.11
	Subtotal Heath and Rough Grazing	113.74	75.11
500	Gardens etc (from field sheet)	41.29	-
501	Gardens etc (best guess)	35.52	2.59
502	Gardens etc (from one inch map)	76.23	109.59
	Subtotal Gardens etc.	153.04	112.18
600	Water (from field sheet)	-	-
601	Water (best guess)	20.21	.86
602	Water (from one inch map)	37.02	59.04
	Subtotal Water	57.23	59.9
700	Unproductive (from field sheet)	6.18	-
701	Unproductive (best guess)	123.82	2.62
702	Unproductive (from one inch map)	3.95	116.92
	Subtotal Unproductive	133.95	119.54
Total		4,060.14	4,055.09

Table 8: Areas of Barcombe parish classified as each type of land use from field sheets and one inch maps

It is noticeable that the acreage classified by the "best guess" method (code ending in 01) is generally higher for the field sheets than for the one inch maps. This was often due to the fact that one letter was written in the middle of an area but it was not clear where the boundary of the area was. This is illustrated by the extract from a field sheet shown in Figure 35. Knowlands Wood has been clearly marked as deciduous Forest. The polygon circled in red is connected to Knowlands Wood by a small strip of land but appears to be a separate parcel of land. No letter is written on the area circled. It was therefore classified as Forest and Woodland but coded 101 (best guess).

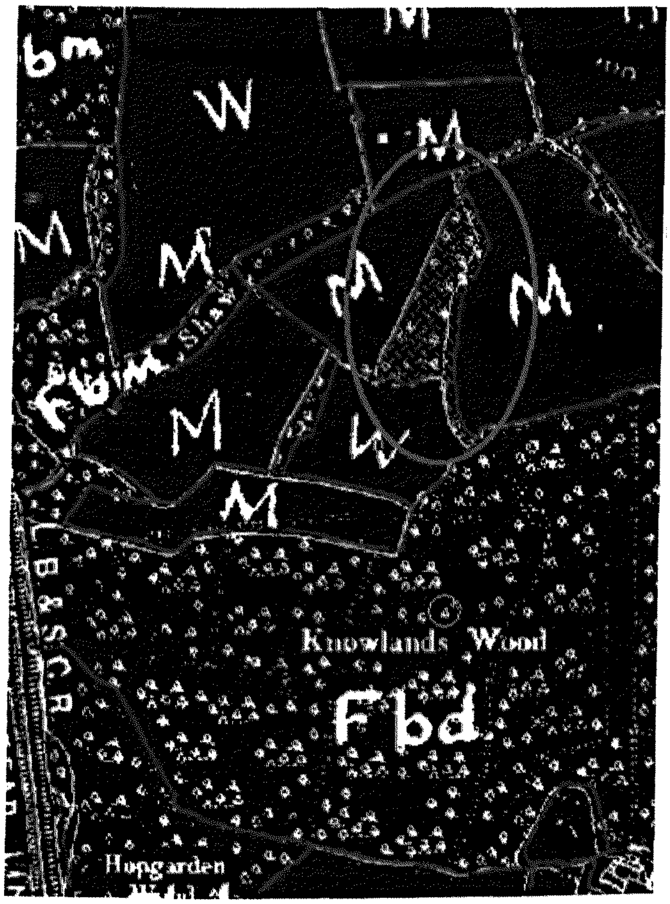


***Figure 35:* An example of a polygon classified by the "best guess" method**
Source: London School of Economics

Polygons from the one inch maps categorised by the "best guess" method tended to be those which lay across the map fold which obscured the land use colouring. This is illustrated in Figure 36.

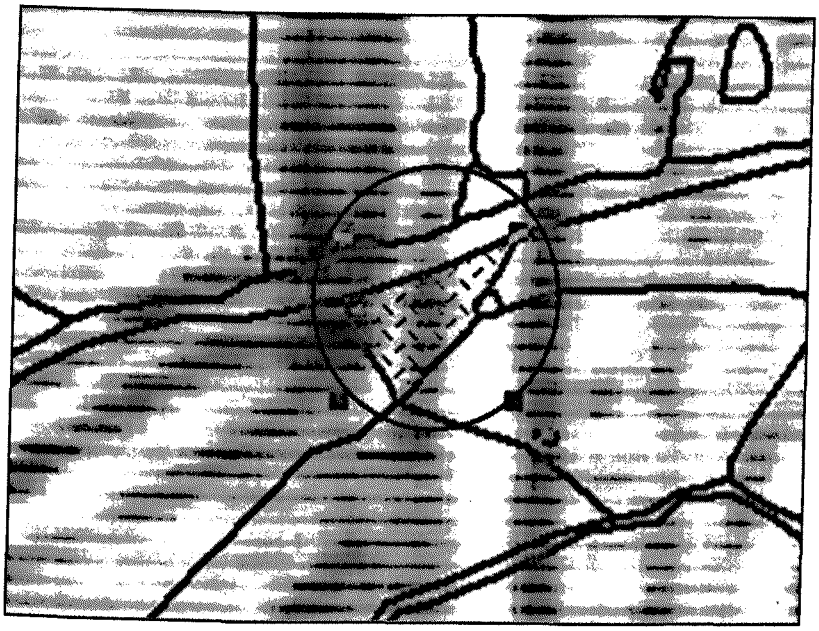


***Figure 36:* Polygon with land use colouring obscured by the map fold on the one inch map**
Source: University of Sussex

Once the field sheets and one inch maps for the pilot area had been completely classified it was possible to compare the two (Figure 37 and Table 9). The slight difference in acreage totals in Table 9 is due to rounding.

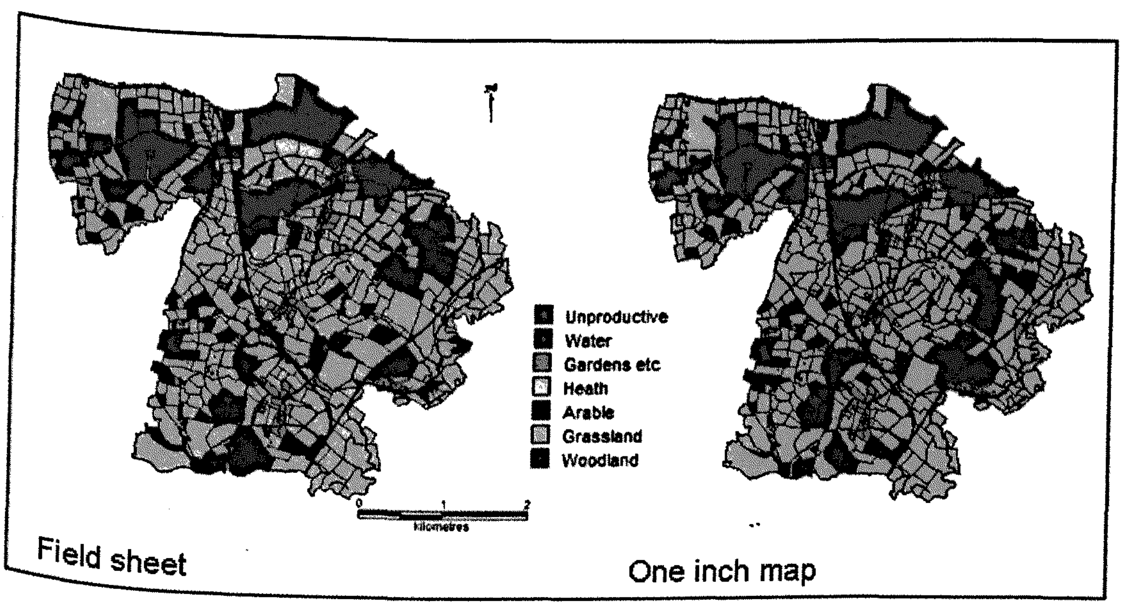


***Figure 37:* Comparison of the classification from the field sheets and the original one inch map**

Land Use Classification	Category	Field Sheet (Acres)	One Inch Map (Acres)	Difference (Acres)	% Difference
100-102	Forest and Woodland	736.21	717.97	-18.24	-2.54
200-202	Meadow and Grassland	2,388.56	2,467.04	+78.48	+3.18
300-302	Arable	477.41	503.35	+25.94	+5.15
400-402	Heath and Rough Grazing	113.74	75.11	-38.63	-51.41
500-502	Gardens etc	153.04	112.18	-40.86	-36.42
600-602	Water	57.23	59.9	+2.67	+4.46
700-702	Unproductive	133.95	119.54	-14.41	-12.05
TOTAL		4,060.14	4,055.09		

***Table 9:* Comparison of classifications from field sheets and one inch map**

There are a total of 219.23 acres with unclear classifications – these comprise 5.33% of the total acreage of the pilot area. The differences go both ways – in some cases the areas classified into a particular category are greater on the field sheets whereas in other cases the higher values belong to the one inch map.

The largest difference in acres is in the Meadow and Grassland category. The two Meadow and Grassland maps are shown in Figure 38.

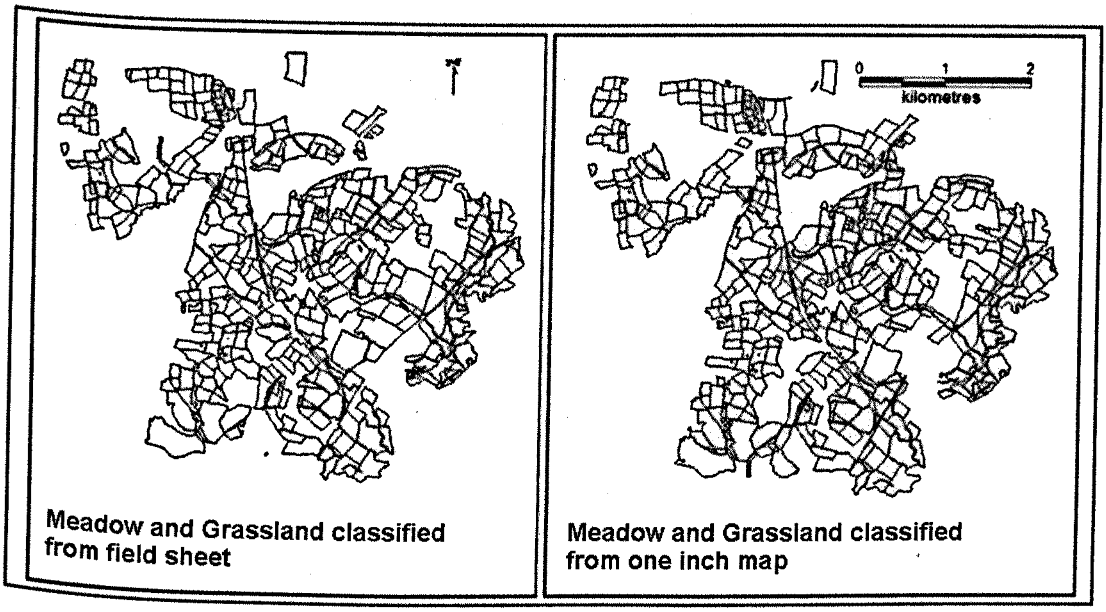


Figure 38: Comparison of areas classified as Meadow and Grassland on the field sheet and one inch map

The largest percentage difference is in the Heath and Rough Grazing category – this is shown in Figure 39. However this was also the smallest area after Water and so a small numerical difference would have a large effect on the percentage.

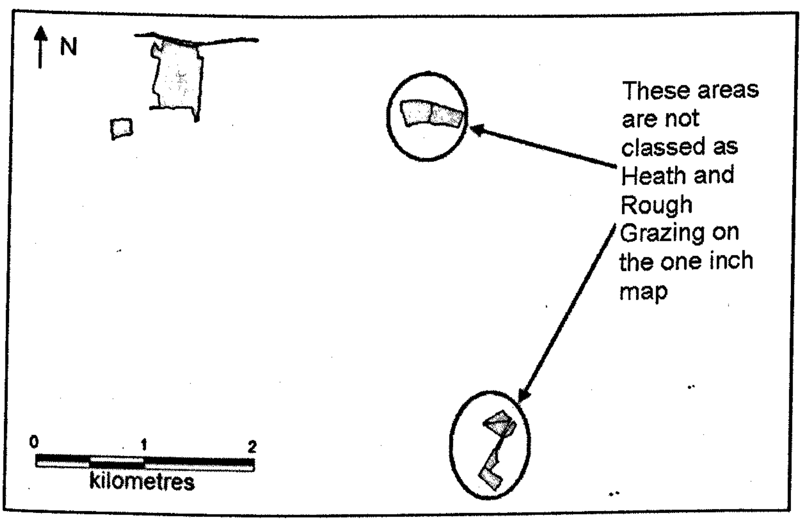


Figure 39: Areas classified as Heath and Rough Grazing on the field sheet

One reason for the differences could lie in the interpretation of the original surveyors. Stamp notes the difficulty in distinguishing between permanent grass which would have been classified as Meadow and temporary grassland which should have been shown as Arable:

> "A difficulty arises where the land is allowed to "tumble to grass"; i.e. is being allowed to become grass after having been ploughed but without having been sown with grass seeds. In the depression years when the Survey was being carried out this was happening very commonly. Such land was often the subject of specific enquiry from the farmer, and where the intention was to plough as soon as times improved it was included as arable, unless the process of deterioration had gone so far that the only possible classification was "rough grazing" (Stamp 1964, p27).

However there was a further difficulty:

> "In England and Wales, grass was included as temporary (ie classed as arable) if it had not been down for more than three years; if it had been grass for four years or more it was considered as permanent and coloured as such. Of course, this general rule could not be followed exactly, and when some amateur surveyors saw a field of grass it was likely to be recorded as "M" and some purely temporary grass was doubtless included in permanent in this way" (Stamp 1964, p27).

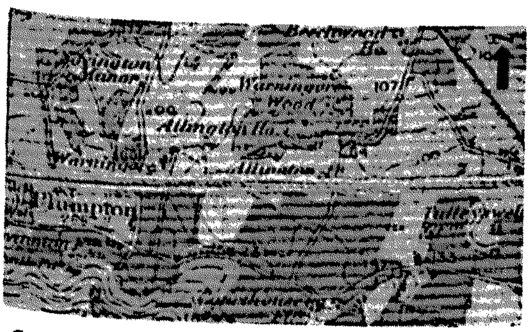
It is possible that some areas were classified as Meadow and Grassland on the field sheets and were then reclassified during the checking process before the publication of the one inch maps.

This process of checking and reclassification is likely to account for most of the differences between the two maps. However, some of the differences in classification could have arisen from human error and so it was decided to recheck the classifications for the pilot area when the whole study area was classified. In the event very few changes were made to the original categories and so human error alone is unlikely to have accounted for all the differences.

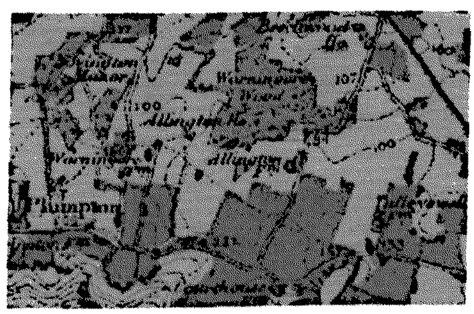
The Whole Study Area

The whole study area was now tackled in the light of the pilot classification. The process described in Figure 23 for the pilot area was used again for the whole area and so polygons were classified firstly from the field sheets, secondly from the one inch map and finally by a best guess.

The problem of polygons which lay along the map folds was addressed using the Land Utilisation maps which were added to the *Vision of Britain* website in 2006 (Great Britain Historical GIS Project 2007). This was after the pilot classification had been performed. The maps on the website were free of the folds that obscured some of the scanned maps which were used for the pilot area (see Figure 40). Polygons lying along the map folds were therefore classified from the website maps.



Scanned one inch map



One inch map from Vision of Britain website

Figure 40: Scanned one inch map compared to map from the Vision of Britain website
Source: University of Sussex and Vision of Britain

Again it was felt that it would be useful to create a digital version of the categories from the one inch map for comparison and so this was done following the procedure in Figure 33 as for the pilot area. Once the appropriate codes had been added to the MapInfo tables, thematic maps were created from the field sheets and from the one inch maps as shown in Figure 41.

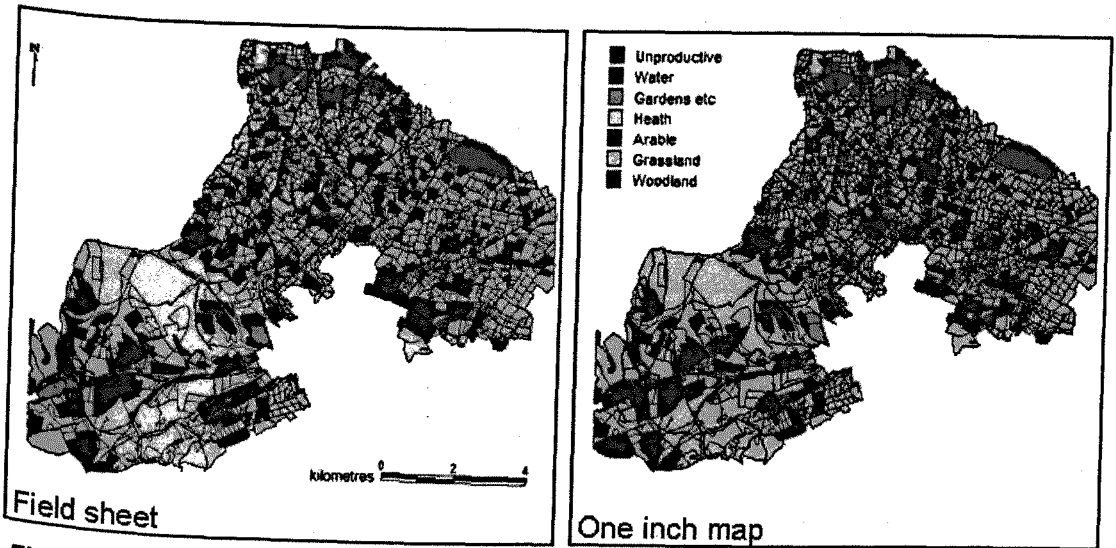


Figure 41: The whole area classifications from the field sheets and one inch map

The final area values obtained for each type of land use for the whole study area are shown in Table 10. Again the area values obtained for the field sheet represent the three stage process. The classification for the field sheet was completed from the one inch map and by best guess in order to resolve outstanding queries.

Land Use Class.	Category	Field Sheet (Acres)	One Inch Map (Acres)
100	Forest and Woodland (from field sheet)	1,307.34	-
101	Forest and Woodland (best guess)	1.94	0.10
102	Forest and Woodland (from one inch map)	225.72	1,543.10
	Subtotal Forest and Woodland	1,535	1,543.2
200	Meadow and Grassland (from field sheet)	9,045.57	-
201	Meadow and Grassland (best guess)	13.45	7.54
202	Meadow and Grassland (from one inch map)	1,428.86	12,002.98
	Subtotal Meadow and Grassland	10,487.88	12,010.52
300	Arable (from field sheet)	3,883.95	-

Land Use Class.	Category	Field Sheet (Acres)	One Inch Map (Acres)
301	Arable (best guess)	-	5.71
302	Arable (from one inch map)	381.02	4,269.02
	Subtotal Arable	4,264.97	4,274.73
400	Heath and Rough Grazing (from field sheet)	3,676.95	-
401	Heath and Rough Grazing (best guess)	7.17	0.31
402	Heath and Rough Grazing (from one inch map)	204.12	2,570.39
	Subtotal Heath and Rough Grazing	3,888.24	2570.7
500	Gardens etc (from field sheet)	258.83	-
501	Gardens etc (best guess)	22.54	10.59
502	Gardens etc (from one inch map)	456.95	650.43
	Subtotal Gardens etc.	738.32	661.02
600	Water (from field sheet)	7.11	-
601	Water (best guess)	45.91	12.73
602	Water (from one inch map)	144.96	153.43
	Subtotal Water	197.98	166.16
700	Unproductive (from field sheet)	129.70	-
701	Unproductive (best guess)	422.68	401.99
702	Unproductive (from one inch map)	147.43	183.88
	Subtotal Unproductive	699.81	585.87
Total		21,812.20	21,812.20

Table 10: Areas classified by each method from field sheets and one inch map

As with the pilot study, a larger area was classified by the best guess method from the field sheets than from the one inch map (513.69 acres as opposed to

438.97 acres). The majority of the polygons classified by best guess fell into the Unproductive category. The explanation for this is that roads and railways were not marked as "W" on the field sheets but were left blank. Equally roads (particularly minor roads) were often not coloured in red (for unproductive) on the one inch maps and so it was felt to be most appropriate to classify these as "best guess". This is illustrated in Figure 42.

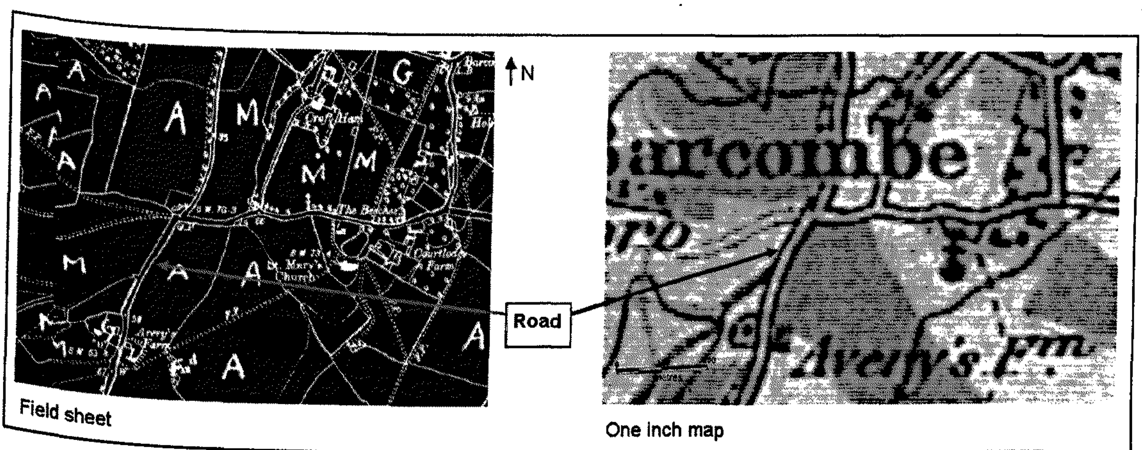


Figure 42: An "unclassified" road as shown on the field sheet and one inch map
Source: *London School of Economics and University of Sussex*

With the Unproductive category removed, the area classified by the best guess method accounted for less than 0.5% of the total for both the field sheets and one inch maps.

The totals for each type of land use classification are shown in Table 11.

Land Use Classification	Category	Field Sheet (Acres)	One Inch Map (Acres)	Difference (Acres)	% Difference
100-102	Forest and Woodland	1,535	1,543.2	+8.2	0.53%
200-202	Meadow and Grassland	10,487.88	12,010.52	+1,522.64	12.68%
300-302	Arable	4,264.97	4,274.73	+9.76	0.23%
400-402	Heath and Rough Grazing	3,888.24	2,570.7	-1,317.54	-51.25%
500-502	Gardens etc	738.32	661.02	-77.3	-11.69%

Land Use Classification	Category	Field Sheet (Acres)	One Inch Map (Acres)	Difference (Acres)	% Difference
600-602	Water	197.98	166.16	-31.82	-19.15%
700-702	Unproductive	699.81	585.87	-113.94	-19.45%

Table 11: Totals for each type of land use classification for the whole study area

It was felt that it would be useful to perform a cross-classification of the frequencies of polygons falling into each land use category in order to gain an understanding of how polygons had changed between the two classifications. The results of this are shown in Table 12.

Field sheets	One inch map							
	Forest	Meadow	Arable	Heath	Gardens	Water	Unprod.	Total
Forest	211	11	1	2	1	1	1	228
Meadow	3	1,496	45	7	15	1	1	1,568
Arable	0	78	218	4	1	0	0	301
Heath	3	70	6	96	0	0	0	175
Gardens	0	47	3	0	953	1	2	1,006
Water	3	155	4	5	9	293	3	472
Unprod.	2	41	0	4	20	0	452	519
Total	222	1,898	277	118	999	296	459	4,269

Table 12: Cross classification of the number of polygons falling into each category

Polygons which remained unchanged lie in the pale green cells along the diagonal of the table. There were six categories where more than 20 polygons had changed classification. These are listed in Table 13.

Field sheet category - One inch map category	No. polygons
Water – Meadow and Grassland	155
Arable – Meadow and Grassland	78
Heath and Rough Grazing– Meadow and Grassland	70
Gardens – Meadow and Grassland	47
Meadow and Grassland- Arable	45
Unproductive – Meadow and Grassland	41

Table 13: Major differences in classification between the field sheet and one inch map by number of polygons

Figure 43 shows all the polygons which changed from one classification to another between the field sheet and one inch map shaded in red.

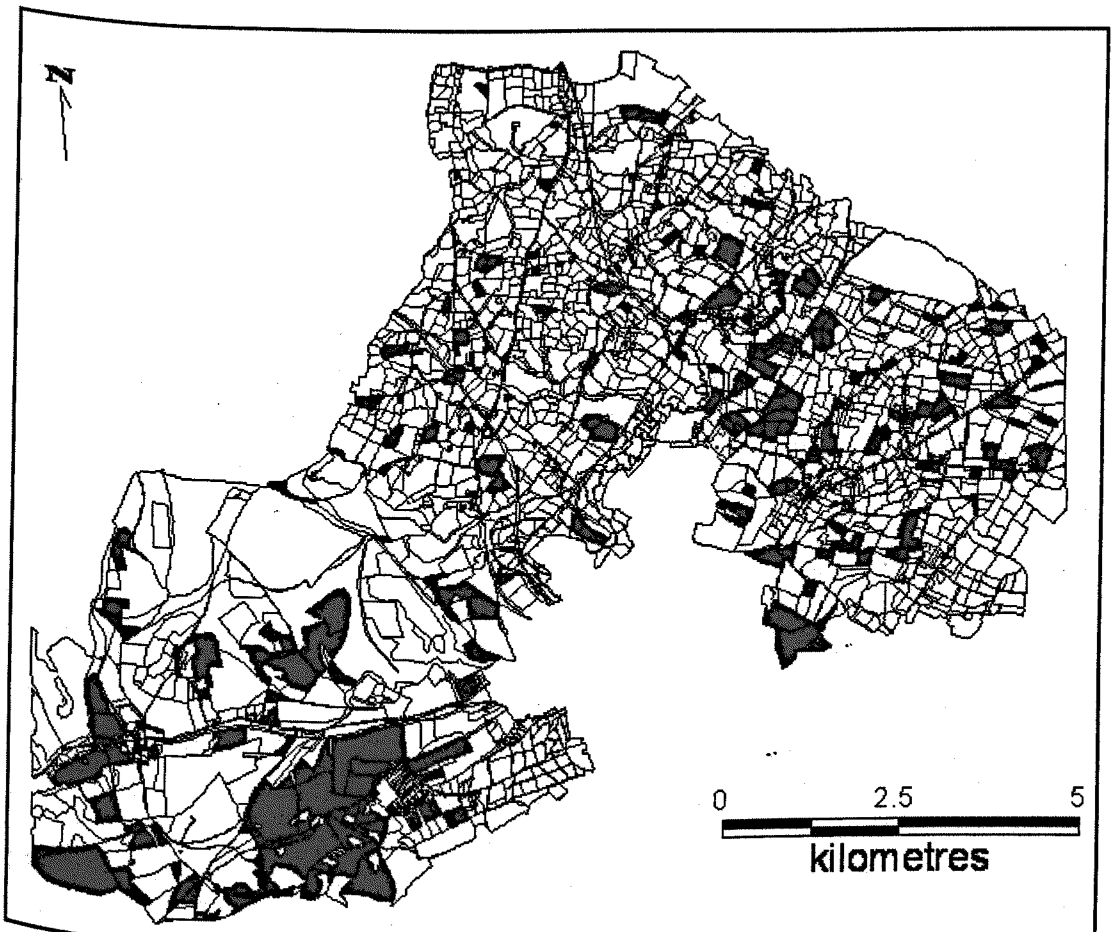


Figure 43: All polygons which changed classification between the field sheets and one inch maps

In terms of numbers of polygons the greatest change was from Water to Meadow and Grassland although this accounted for only 29.41 acres. The polygons which changed from Water to Meadow and Grassland are mapped in Figure 44 and it is clear that the polygon size is generally very small – the average area was 0.19 acres.

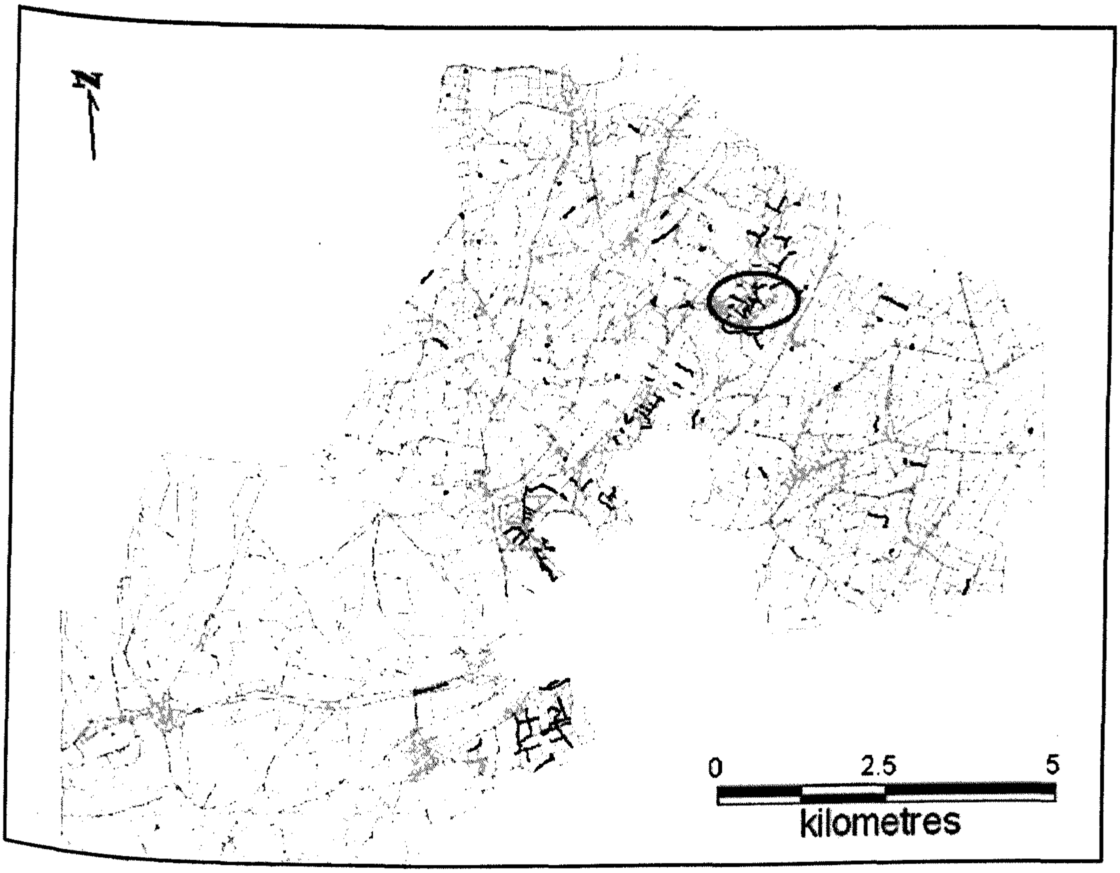
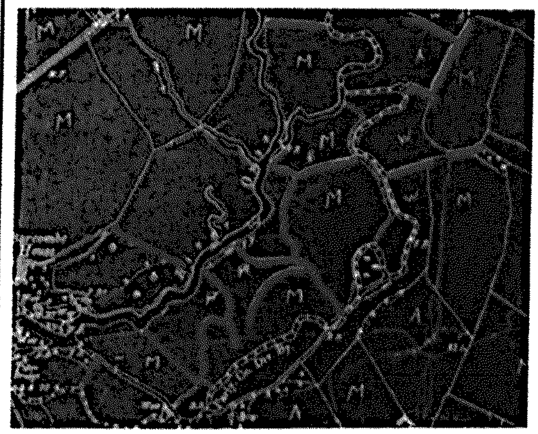


Figure 44: ***Polygons which changed from Water to Meadow and Grassland classification between the field sheets and one inch map***

One reason for the apparent "disappearance" of areas of Water seems to be that the one inch map was at a larger scale and so these small polygons tended to be lost in the process of generalisation. This can be seen in Figure 45 and Figure 46 which show the area around Barcombe Mills, circled in red in Figure 44, in more detail. The smaller streams or ditches can be clearly seen on the field sheet but have been lost on the one inch map.

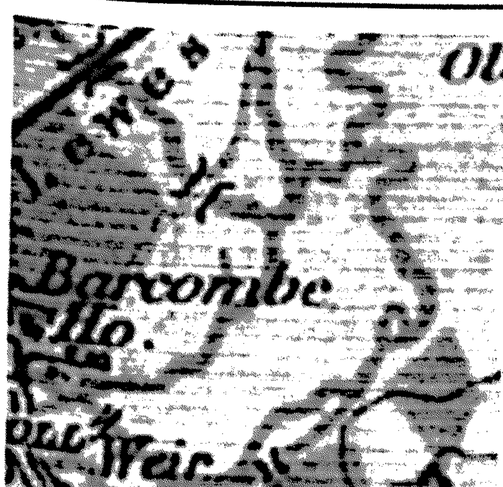
Field sheet



Field sheet with Water - Meadow and Grassland polygons highlighted in blue

***Figure 45:* Field sheet showing polygons which changed from Water to Meadow and Grassland**

Source: London School of Economics



One inch map

One inch map with Water - Meadow and Grassland polygons highlighted in blue

***Figure 46:* One inch map showing polygons which changed from Water to Meadow and Grassland**

Source: University of Sussex

As with the pilot area the largest percentage difference was in the Heath and Rough Grazing category with the one inch map having 51.25% less Heath and Rough Grazing than the field sheet classification. 70 Heath and Rough

Grazing polygons were reclassified as Meadow and Grassland from the one inch map. Figure 47 shows the extent of Heath and Rough Grazing on both maps.

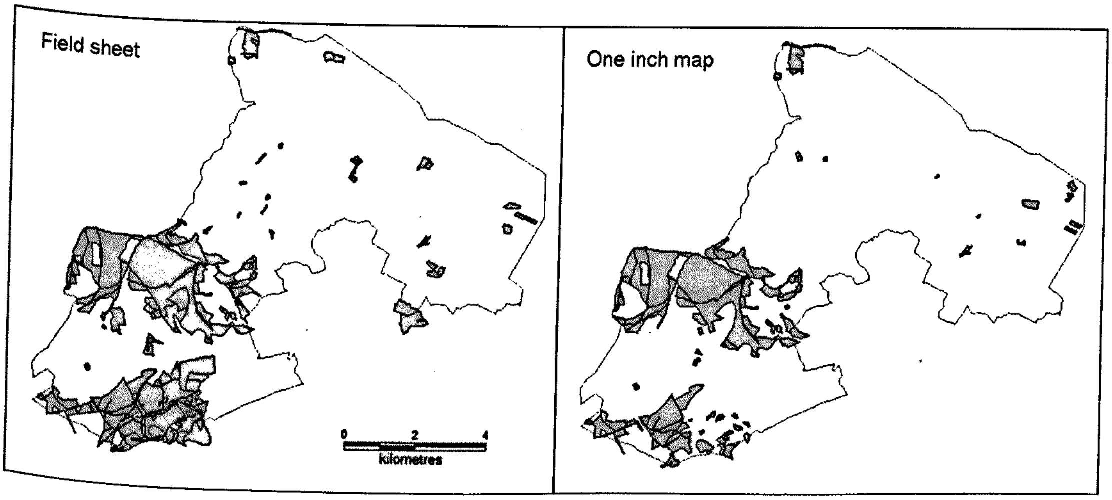


***Figure 47:* Heath and Rough Grazing as classified from the field sheets and one inch maps**

As with the pilot area the field sheets were double checked to ensure that the differences did not arise due to codes being entered incorrectly. However, Figure 48 illustrates very clearly that there are a number of areas marked as Heath and Rough Grazing on the field sheet (the letters are circled in red) but shown as Meadow and Grassland (cream colour) on the one inch map.

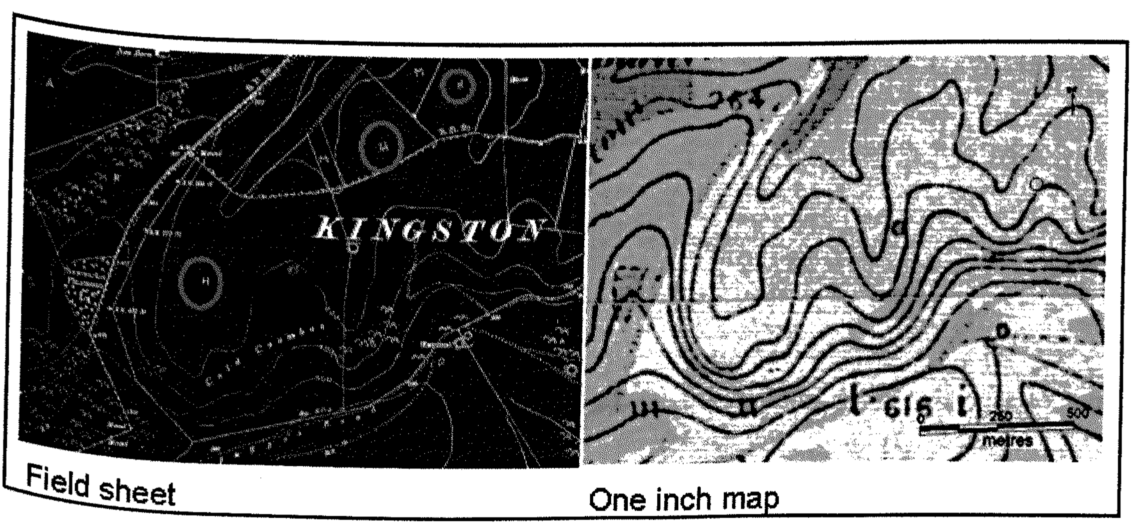


***Figure 48:* Classifications of an area of downland compared**

Source: London School of Economics and University of Sussex

It is clear from Figure 47 that the main concentration of difference is located in the south west corner of the study area. This is part of the South Downs and so the differences may be due to varied interpretation between the surveyors – the original surveyors denoting it as Heath and Rough Grazing whereas this was later corrected to Meadow and Grassland.

The largest difference in acreage (Table 11) was in the Meadow and Grassland category which gained 1,522.64 acres between the field sheets and the one inch map. From Table 13 it is clear that the Meadow and Grassland category received the largest number of polygons from other classes. As explained above, much of the Heath and Rough Grazing which was reclassified between the field sheets and one inch maps was moved to the Meadow and Grassland category (70 out of the 79 Heath and Rough Grazing polygons which changed became Meadow and Grassland). If the two Meadow and Grassland maps are compared (Figure 49) it is clear that the main concentration of difference (circled in red) seems to be in the south west. This is, unsurprisingly, similar to the Heath and Rough Grazing map shown in Figure 47.

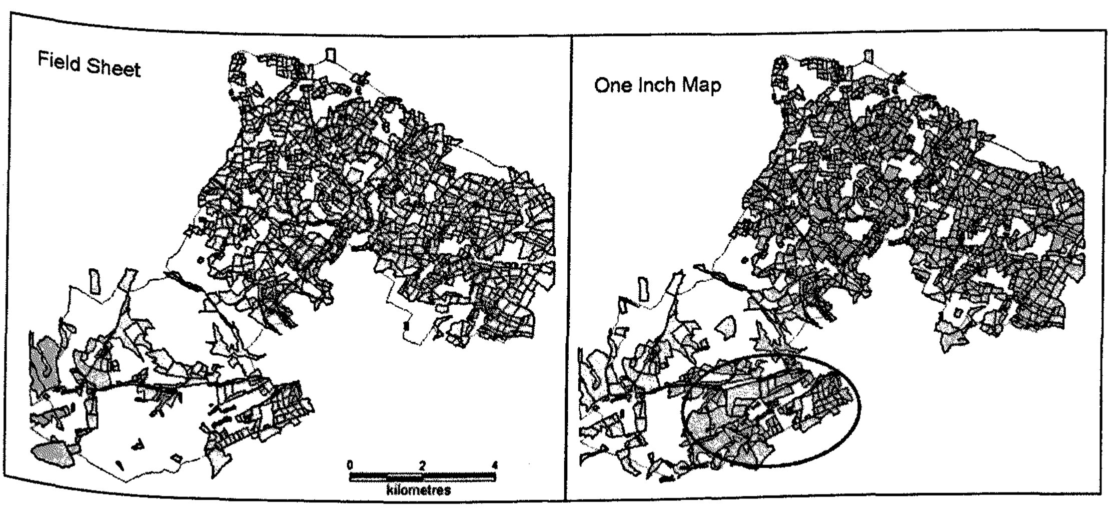


Figure 49: Comparison of Meadow and Grassland classified from field sheets and from the one inch map

Subcategories

As described earlier a number of subcategories had been used to subdivide the main Forest and Woodland category. These subcategories were added to the classification from the field sheets as it was easy to distinguish between the categories based on the letter codes written on the maps (eg Fb^m for mixed, Fb^d for deciduous). The acreage for each subcategory is shown below.

Category/ Subcategory	Acres (from field sheets)
Total Forest and Woodland	1,535
Coniferous	27
Deciduous	374.27
Mixed	736.67
New plantations or coppices	-
Shaws	18.93
Forest and Woodland with no subcategory	378.22

***Table 14:* Subcategories of Forest and Woodland classification from the field sheets**

The main Forest and Woodland subcategory that has been identified is mixed forest, which accounts for almost half of the total forest area. Deciduous forest also covers over 370 acres but coniferous forest and shaws account for a very small proportion of the total. Almost a quarter of the total Forest and Woodland was not assigned to a subcategory at all.

In theory it should have been possible to identify some subcategories of Forest and Woodland from the one inch published maps. The key to the maps shows different patterns for deciduous, coniferous, mixed and new plantations (Figure 50).

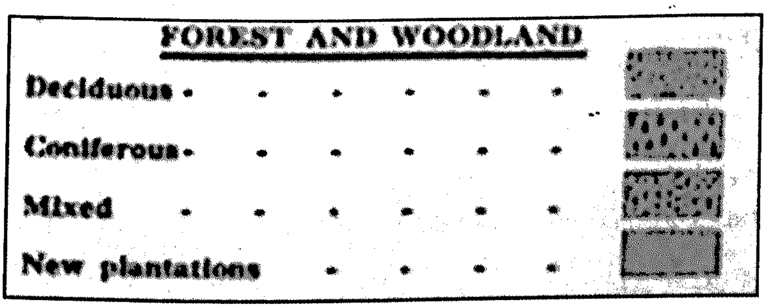


***Figure 50:* Key to the one inch map describing different types of Forest and Woodland**
Source: University of Sussex

However these proved very difficult to differentiate in practice. For example Warningore Wood shown in Figure 51 was classified as mixed forest from the field sheets. However the pattern shown on the one inch map bears little resemblance to the mixed forest patterning on the key. It was therefore decided not to attempt to differentiate any subcategories from the one inch maps as the interpretation of these could be unreliable.

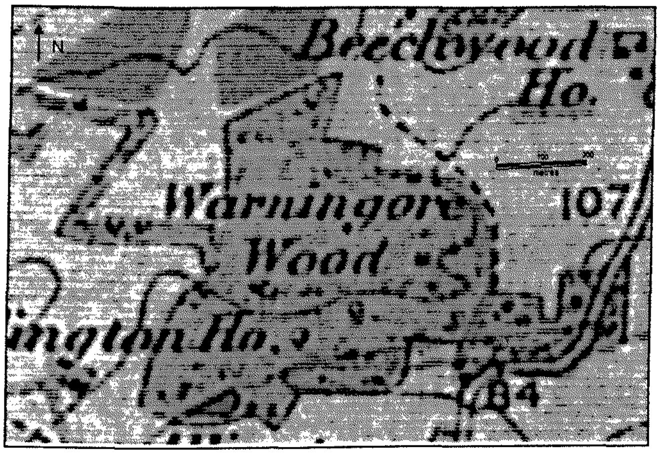


***Figure 51:** Warningore Wood as shown on the one inch map*
Source: University of Sussex

Conclusions

The initial classification of the pilot area resulted in the evolution of a three stage process which was then successfully applied to the whole study area. In reality most polygons were classified directly from the available maps and the best guess method was applied in only a very small number of cases (less than 3% for the whole study area).

Classifying polygons from both the field sheets and the one inch maps allowed some useful comparisons to be made. For the whole study area the difference between the maps was about 7% of the total area and much of this could be ascribed to differences in interpretation with regard to Heath and Rough Grazing and Meadow and Grassland. Some concerns were expressed at the beginning of this chapter about the practicalities of differentiating Heath and Meadow and Grassland on the aerial photographs and so it is interesting to note that this was the category that caused the most problems for the original surveyors even though they were actually visiting the locations in question.

Analysis of the Forest and Woodland subcategories showed that most of the forest which had been assigned a subcategory was either deciduous or mixed. However almost a quarter of the Forest and Woodland had no subcategory and it had not proved possible to distinguish between different types of forest on the one inch map. It was therefore felt that the subcategories were of limited utility and these were not used when the other datasets were classified.

CHAPTER 5: THE 1940 AERIAL PHOTOGRAPH AND THE NATIONAL FARM SURVEY

The previous chapter looked at the base datasets for this project and some of the issues encountered with these. It also considered the creation of the classification scheme and its application to the data from the first LUS. This chapter discusses the processing of the largest datasets, consisting of the 1940 Luftwaffe Aerial photograph, the National Farm Survey and 1941 census forms and the NFS maps.

Aerial Photographs

The Luftwaffe had been photographing the UK under the guise of civilian flights before the outbreak of war in 1939. However, once war was declared, these photographic endeavours were stepped up and major towns and industrial centres were targeted. The images were mainly taken from about 20,000 feet (UK Aerial Photos) and the Luftwaffe photograph used in this project was taken on August 12th 1940 and is centred on Lewes (Figure 52).

Figure 52: Luftwaffe aerial photograph no. 48 centred on Lewes
Source: *University of Sussex*

The process of interpreting the aerial photograph is described later in this chapter.

The National Farm Survey

As noted in Chapter 1, the first farm survey was conducted in 1940 and produced generally unsatisfactory and inconsistent results (Short *et al* 2000, p43). As a result of this a further, more comprehensive survey was planned and a Farm Survey committee was established in October 1940 in order to plan and oversee this. It is interesting to note that Dudley Stamp was a key member of this committee (Short and Watkins 1999, p14). A report to the

Minister of Agriculture and Fisheries from the Committee chairman, Sir Donald Fergusson, clarifies the thinking behind the NFS:

> "The Committee...proceeded by considering the scope of what might be termed the 'ideal' survey, that is to say a survey providing very comprehensive information about farming of a kind which would be of both short-term and long-term use. They then considered how far it was practicable in present circumstances to fulfil this ideal; and in this way endeavoured to arrive at proposals which should be as near the ideal as possible within practical limitations" (Fergusson 1940).

The NFS was finally initiated in 1941 with the following clear aims:

Wartime administration: The survey would be used by the CWAECs to help to raise wartime farming standards

Basis for advisory work: The Advisory Services would be able to locate farms on which there was scope for further technical guidance

Analysis: A great amount of statistical analysis would be needed for post-war planning and administration. This would help with land management and improvement, and with the fuller utilisation of scientific knowledge and more accurate criteria for economic efficiency

Land planning: What agricultural land should be reserved as such and protected from development for non-agricultural purposes

Historical: There would be a permanent record of the main features of every farm, comparable with the Domesday Book but more detailed and comprehensive (Short *et al* 2000, p54).

The survey was administered by the CWAECs, each of which consisted of a Chairman selected by the Lord Lieutenant and the Land Commissioner, together with a committee composed of "leading farmers and landowners" (Short *et al* 2000, p45). The individual survey forms are described below. The fieldwork for the forms had been completed for East Sussex by the end of 1942 and by 1943 the fieldwork for the Primary Return forms was 95% complete in England and Wales (Short *et al* 2000, p61). The survey only included farms over 5 acres – holdings smaller than this were subject to a separate survey.

In addition to completing the forms the surveyors were required to mark the extent of each farm on a six inch OS map. An example is shown in Figure 53. The parcel numbers for each field have been transcribed from the 25 inch OS sheet in black ink and each farm has been outlined in a different colour. The farm number is written on the map in red.

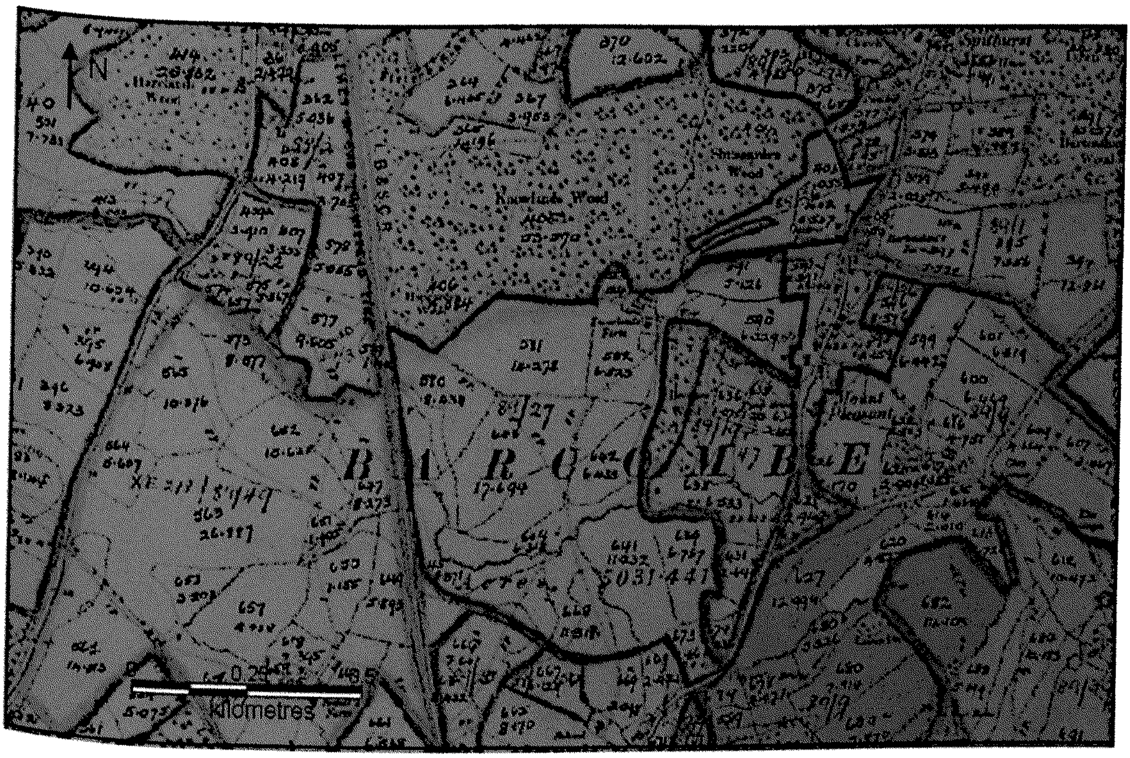


Figure 53: Extract from the six inch National Farm Survey map for Barcombe
Source: TNA MAF 73

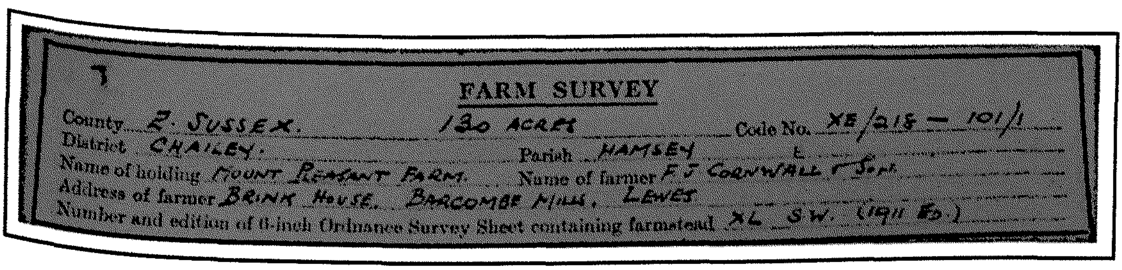
Some concerns were raised about the extra burden that this placed upon the CWAECs and about their ability to fulfil the requirement. A summary of reports on the Farm Survey by Land Commissioners notes that "One committee felt doubts whether farmers were capable of carrying out the inspections and the Commissioner mentions a reason – they cannot read maps!" (Farm Survey Committee). However by July 1943 about 66% of the fieldwork necessary for the maps had been completed.

Once the six inch OS maps had been completed the boundaries were transferred onto 2½ inch map sheets. The intention was that these would be published although this never happened. In some counties farm areas were shown by colour washes, although in East Sussex farms were simply outlined in colour. By 1948 the maps for East Sussex had been finished (Short *et al* 2000, p77). The map work therefore lagged considerably behind the forms.

The NFS Forms

Primary Return

The Primary Return was completed by the CWAECs and additional farm visits were made as necessary. The form begins with information about the farm and farmer, such as name and address. There is no space for the farm acreage to be recorded but in the area studied the total acreage has been added to the top of the form in almost all cases, as it has been in Figure 54.

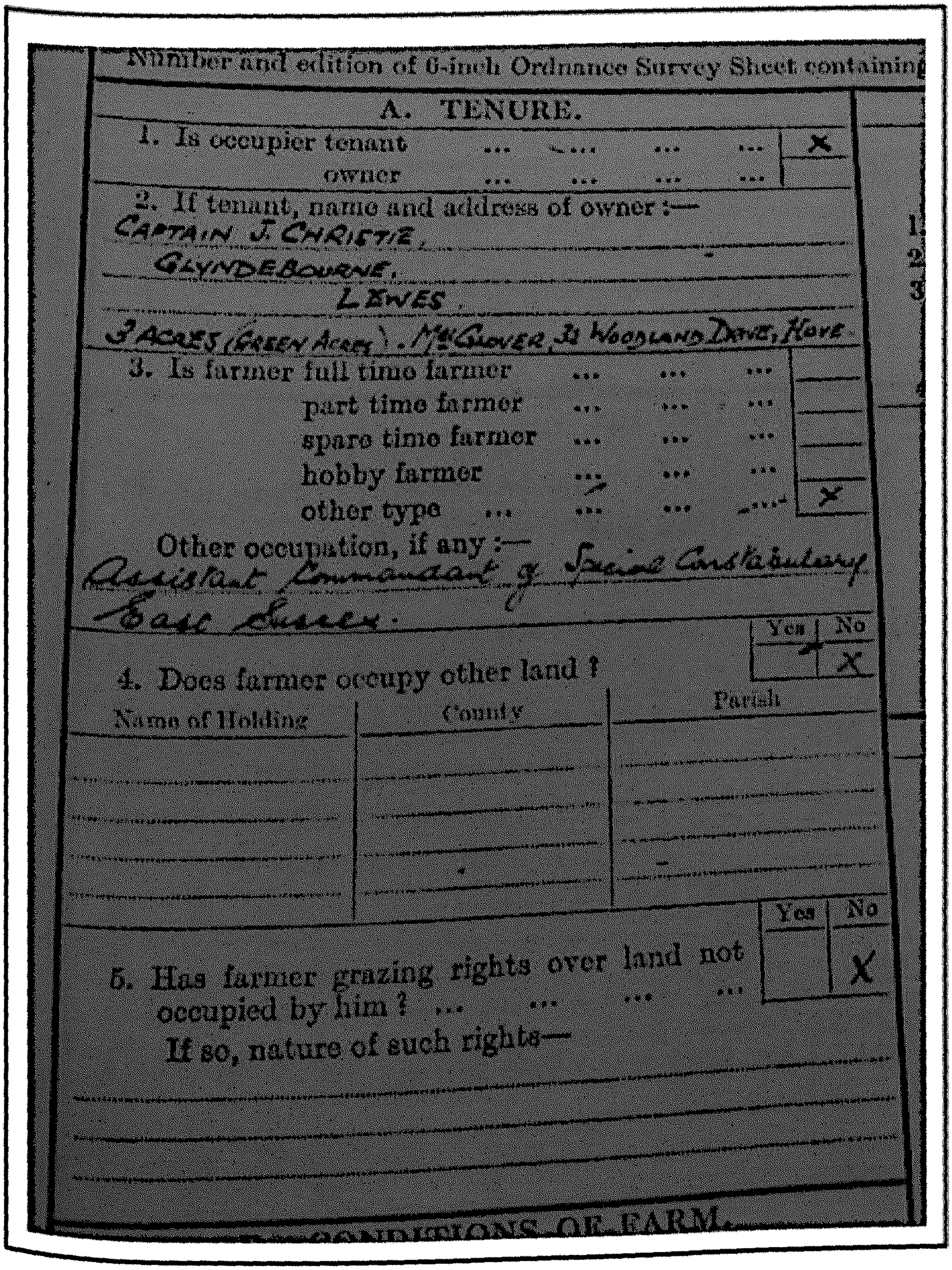


FARM SURVEY

County E. SUSSEX. 130 ACRES Code No. XE/218 — 101/1
District CHAILEY. Parish HAMSEY
Name of holding MOUNT PLEASANT FARM. Name of farmer F J CORNWALL & SON
Address of farmer BRINK HOUSE, BARCOMBE MILLS, LEWES
Number and edition of 6-inch Ordnance Survey Sheet containing farmstead XL SW. (1911 ED.)

***Figure 54:* Extract from the Primary Return form for Mount Pleasant Farm, Hamsey**
Source: *TNA MAF 32*

Section A of the form deals with tenure and seeks information on the ownership of the farm, other land held and also the occupation of the farmer. Whilst there were many full time farmers in the study area, a number of other occupations are also recorded including horse slaughterer, housewife and "assistant commandant of Special Constabulary East Sussex" (Figure 55).



Number and edition of 6-inch Ordnance Survey Sheet containing

A. TENURE.

1. Is occupier tenant X
owner ... ...

2. If tenant, name and address of owner :—
CAPTAIN J. CHRISTIE,
GLYNDEBOURNE,
LEWES.
3 ACRES (GREEN ACRES). MR GLOVER, 31 WOODLAND DRIVE, HOVE

3. Is farmer full time farmer ... ...
part time farmer ... ...
spare time farmer ... ...
hobby farmer ... ...
other type X

Other occupation, if any :—
Assistant Commandant of Special Constabulary
East Sussex.

4. Does farmer occupy other land ? Yes / No: X

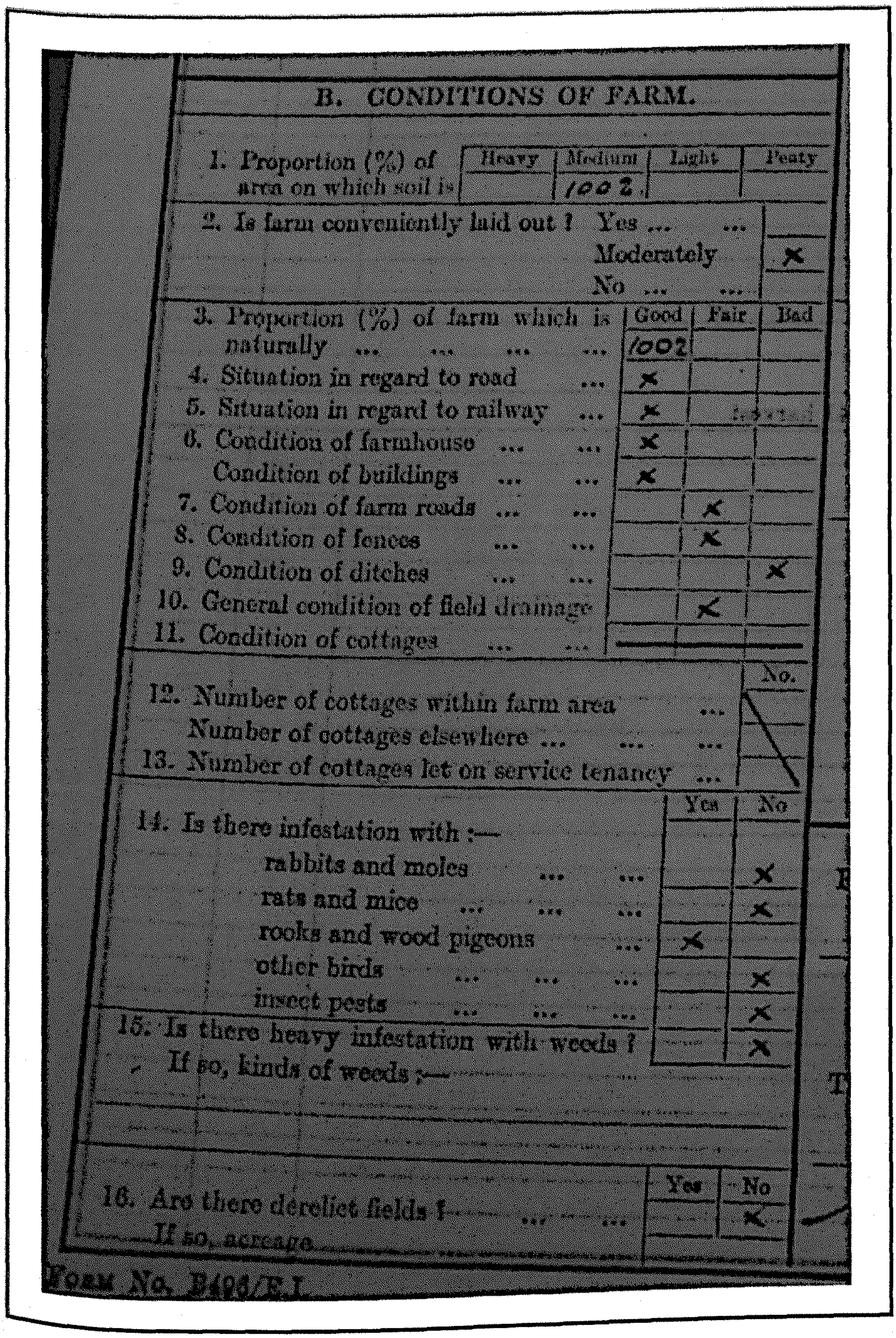
Name of Holding	County	Parish

5. Has farmer grazing rights over land not occupied by him ? ... ... Yes / No: X
If so, nature of such rights—

B. CONDITIONS OF FARM.

Figure 55: Section A of the NFS Primary Return form for Delves House and Green Acres
Source: TNA MAF 32

Section B is concerned with the condition of the farm and the surveyor assesses the condition of the soil, the situation of the farm and levels of infestation with weeds and pests. Just under half of the farms in the database were listed as having significant levels of weed infestation, the most common weeds including creeping thistles, dock, charlock and couch. Wireworm is often noted as an insect pest.



B. CONDITIONS OF FARM.

1. Proportion (%) of area on which soil is	Heavy	Medium	Light	Peaty
		100%		

2. Is farm conveniently laid out ?	
Yes	
Moderately	X
No	

	Good	Fair	Bad
3. Proportion (%) of farm which is naturally	100%		
4. Situation in regard to road ...	X		
5. Situation in regard to railway ...	X		
6. Condition of farmhouse	X		
Condition of buildings	X		
7. Condition of farm roads		X	
8. Condition of fences		X	
9. Condition of ditches			X
10. General condition of field drainage		X	
11. Condition of cottages			

	No.
12. Number of cottages within farm area ...	
Number of cottages elsewhere	
13. Number of cottages let on service tenancy ...	

14. Is there infestation with :—	Yes	No
rabbits and moles		X
rats and mice		X
rooks and wood pigeons ...	X	
other birds		X
insect pests		X
15. Is there heavy infestation with weeds ?		X

If so, kinds of weeds :—

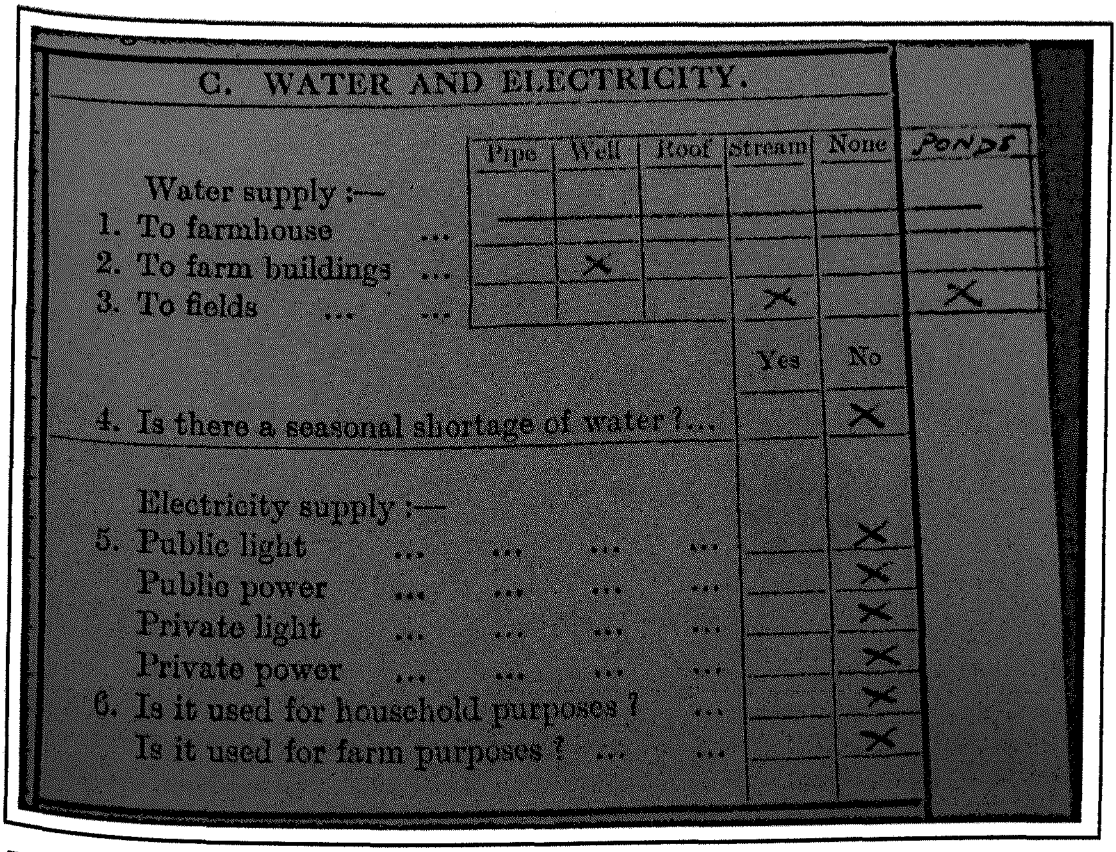
	Yes	No
16. Are there derelict fields ?		X

If so, acreage

FORM No. B496/E.I.

Figure 56: Section B of the NFS Primary Return form for Lower Barn Farm
Source: *TNA MAF 32*

Section C deals with the water and electricity supply to the farm and whether this is used for household or farm purposes. Additions were sometimes made to this section, generally to allow "ponds" to be added as in Figure 57. Over half of the farms in the database did not yet have access to public light.



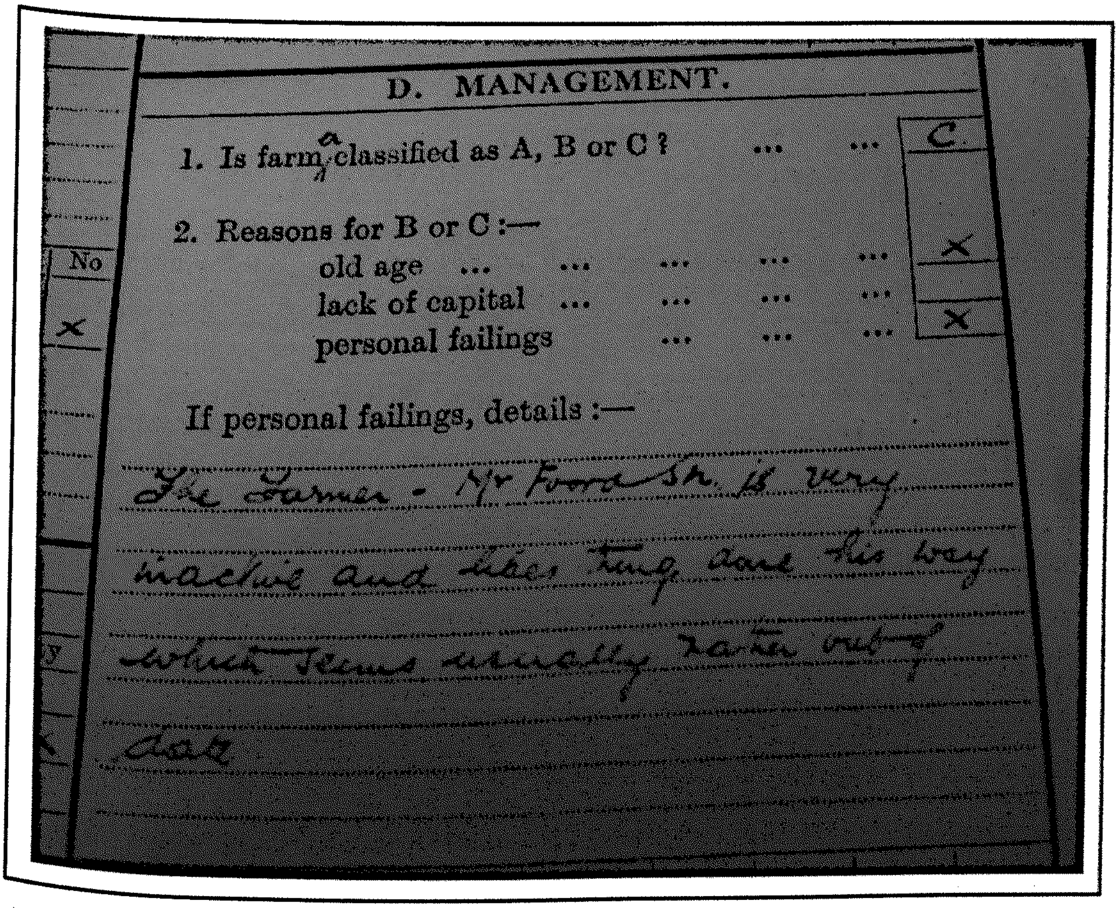
C. WATER AND ELECTRICITY.

Water supply :—	Pipe	Well	Roof	Stream	None	PONDS
1. To farmhouse ...						
2. To farm buildings ...		X				
3. To fields				X		X

	Yes	No
4. Is there a seasonal shortage of water ?...		X
Electricity supply :—		
5. Public light		X
Public power		X
Private light		X
Private power		X
6. Is it used for household purposes ? ...		X
Is it used for farm purposes ?		X

Figure 57: Section C of the NFS Primary Return form for Mount Pleasant Farm
Source: TNA MAF 32

In Section D of the Primary Return the surveyor rates the management of the farm. This includes classifying the Farm as "A", "B" or "C" and giving reasons for poorer grades such as detailing a farmer's "personal failings". Understandably this was the most controversial aspect of the NFS and many practical problems arose from it. "A general criticism noted was that surveyors appeared to be classifying farmers as "A" rather than "B" or "C" because they did not wish to have to describe the farmer's "personal failings". In addition an "A" or "B" classification meant that additional visits to the farm were not necessary" (Short and Watkins 1999, p17). In the example shown in Figure 58 the surveyor emphasizes that the farmer's ability is being rated by amending the question "Is farm classified as A, B or C" to "Is <u>farmer</u> classified as A, B or C"? It is clear from the comments recorded that Mr. Foord is considered to be a poor farmer using outdated methods.



D. MANAGEMENT.

1. Is farm a classified as A, B or C ? ... ... C.

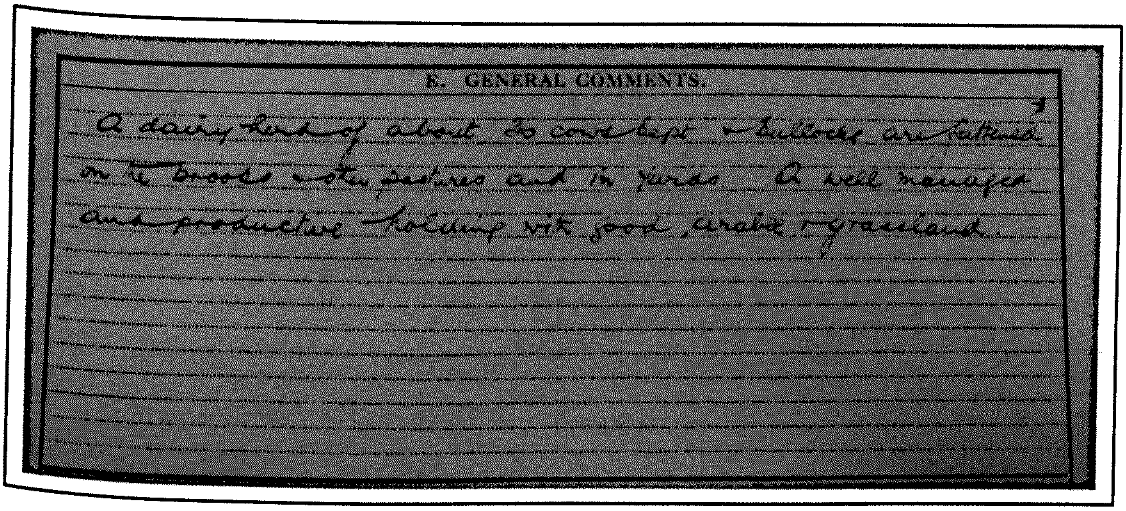
2. Reasons for B or C :—
old age ... ... ×
lack of capital ... ... ×
personal failings ... ...

If personal failings, details :—

The Farmer - Mr Foord Sr. is very inactive and likes things done his way which seems usually rather out of date

Figure 58: Section D of the NFS Primary Return form for Broyle Place
Source: *TNA MAF 32*

Sections E and F were on the reverse of the form. In section E there is space for General Comments and this allowed more detail to be given about the farm and farmer. Unlike Broyle Place (Figure 58), Cooksbridge Farm was graded A, and this is reflected in the positive tone of the comments shown in Figure 59.

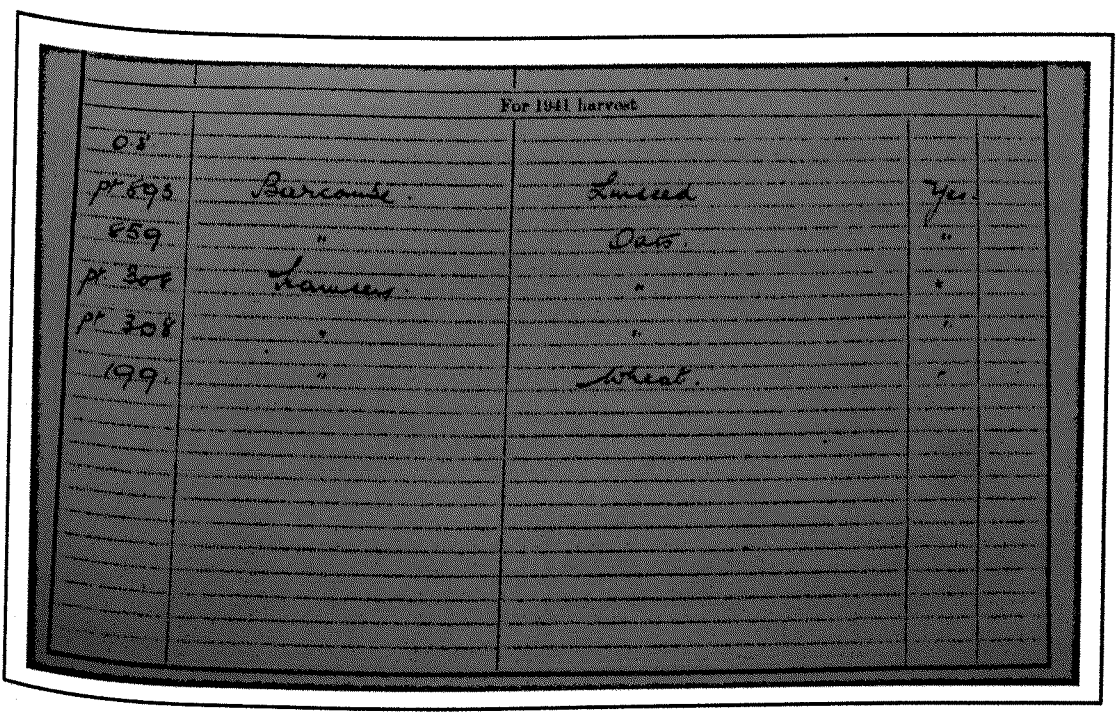


E. GENERAL COMMENTS.

A dairy herd of about 30 cows kept & bullocks are fattened on the brooks & other pastures and in yards. A well managed and productive holding with good arable & grassland.

Figure 59: ***Section E of the NFS Primary Return form for Cooksbridge Farm***
Source: TNA MAF 32

Section F of the Return concerns grass fields ploughed up for the 1940 and 1941 harvests. In the case of the study area this plough up was nearly always carried out under the direction of the WAECs and this appears to have been the case in almost all of England and Wales (Short *et al* 2000, p131). Often only part of a field was directed to be ploughed up, as in the example from Cooksbridge Farm in Figure 60.



For 1941 harvest

O.S.			
pt 693	Barcombe	Linseed	Yes
859	"	Oats	"
pt 304	Hamsey	"	"
pt 308	"	"	"
199	"	Wheat	"

Figure 60: ***Part of section F of the NFS Primary Return form for Cooksbridge Farm showing the 1941 plough up***
Source: TNA MAF 32

There was space on the front of the form for the signature of the field recorder and also for the Provincial Advisory Centre member who copied the record (Short *et al* 2000, p128). The majority of the farms in the study area were surveyed by H. Cawley and J.L. Halliday and copied by G.P. Wibberley. All of the farms in the study area appear to have been surveyed during 1942 except for one holding (XE 218/89/038) which was surveyed in November 1941, although several forms are undated.

In addition to the Primary Return completed by the CWAECs there are also three June 1941 census return forms held for most farms. These were completed by the farmer. The main census return includes information on Crops and Grass, Livestock and Labour. The Supplementary Form collects further information on Labour and also on the Motive Power available to the farmer including steam engines and waterwheels as well as tractors. Details of rent payable and length of occupation of the holding were also required on this form. The final form is the Horticultural Return which covers Small Fruit, Vegetables for Human Consumption and Stocks of Hay and Straw on 4th June.

Processing the NFS Forms

The NFS Primary Return forms are held at the National Archives and are filed together with the June 1941 census records. This is the only year for which the census records have been made available for individual farms (Short *et al* 2000, p10) – normally only parish summaries are held. The term "NFS forms" will therefore be used to describe collectively all of the forms held in this file (4th June 1941 census return, Horticultural Return, Supplementary Form and the NFS Primary Return).

When the NFS was conducted the census forms and Primary Returns were painstakingly matched up. However these were separated out again when the archive was moved to the National Archives (then the Public Record Office) and the forms are stored in bundles of the same form for each parish.

In order to record the information from the NFS forms an Access database was created. A data entry screen was produced for each of the four forms and was designed to look as similar as possible to the original form. Behind this data entry screen were a number of related tables in which the information was stored. Table 15 lists these.

1941 Census Return	**Primary Return**	**Horticultural Return**	**Supplementary Form**	
Crops and Grass Return	Primary Return Sections A-D	Horticultural Return	Supp Form - Labour	Supp Form – steam engines
	Primary Return Section E	Horticultural Return – name of farm	Supp Form – track laying tractors	Supp Form – electric motors
	Primary Return – other land		Supp Form – waterwheels in use	Supp Form – gas engines
	Primary Return - owner details		Supp Form – waterwheels not in use	Supp Form – length of occupation
	Primary Return – Plough up 1940		Supp Form – wheel tractors field	Supp Form – oil or petrol engines
	Primary Return – Plough up 1941		Supp Form – wheel tractors stationary	Supp Form – other motive power

***Table 15:* NFS forms and the tables in the Access database which relate to them**

A start up form (Figure 61) was also created to allow easy access to any of the input forms.

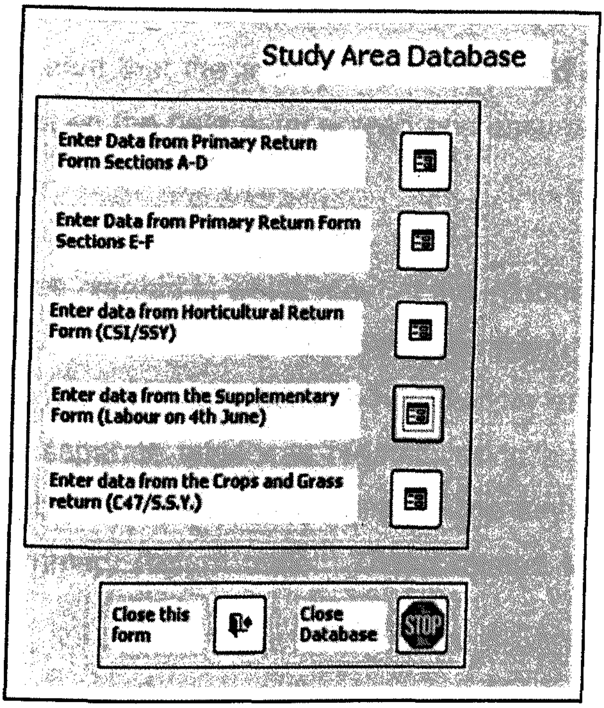


Figure 61: The start up form in the Access database

Primary Return

This was the most detailed of the four forms and so the decision was taken to create two input screens for this. The first input screen covers Sections A-D which comprise the front of the form.

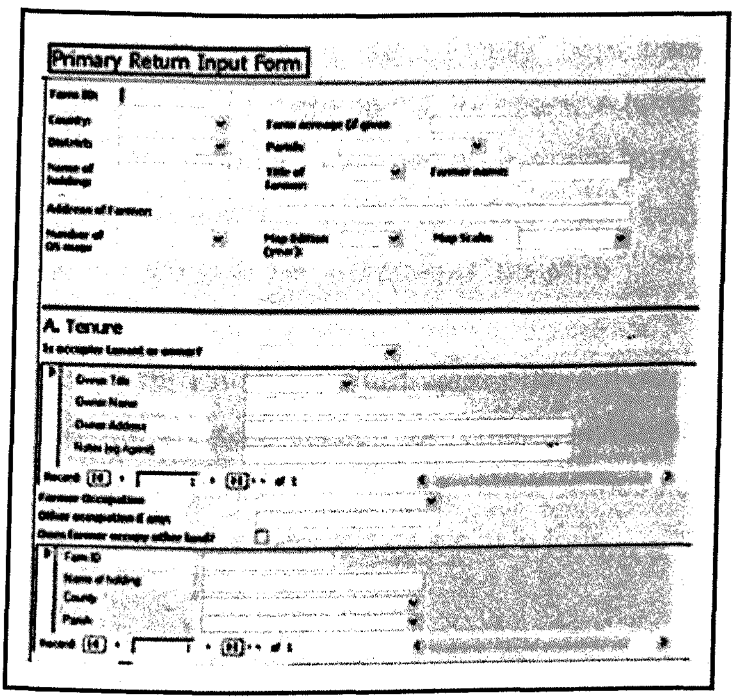


Figure 62: Data input screen for the first section of the Primary Return

15 related look up tables were created for variables such as County, District and Parish. This meant that the appropriate value could simply be selected from a drop down list on the data entry screen and ensured that entries were consistent.

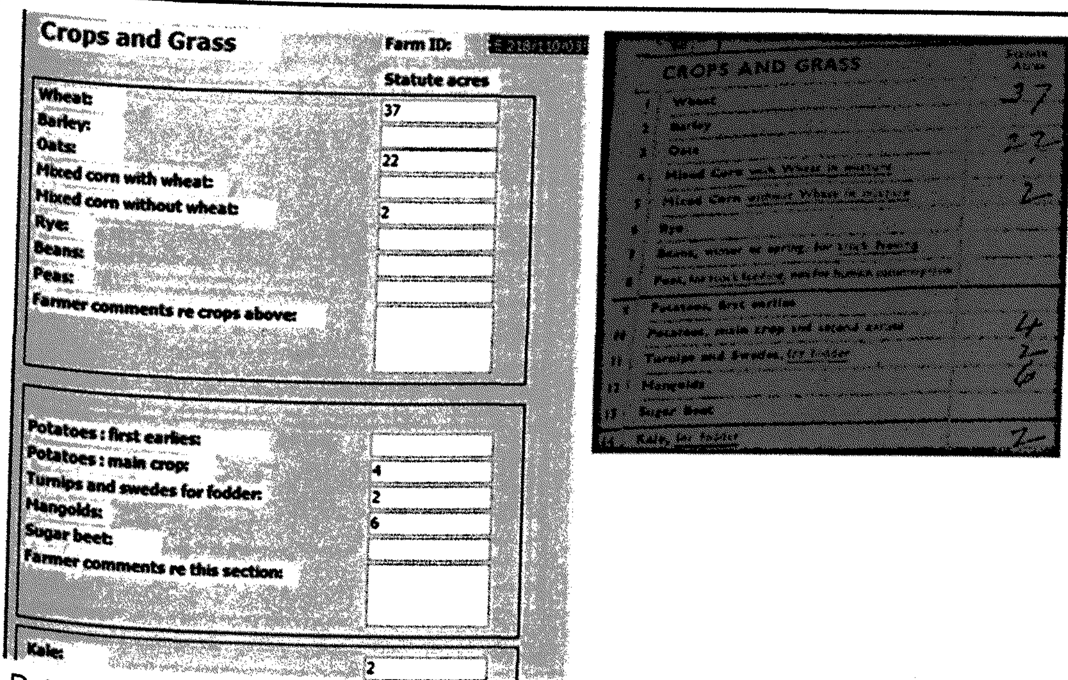
A main data table was created in which most of the information from Sections A-D of the Primary Return was stored. However some variables such as "Does farmer occupy other land?" could have multiple entries for one farm and, in this case, a separate table was created, using a combination of the farm reference number and name of holding as the key field to relate this table to the main Primary Return table. These related tables are listed in Table 15 above.

A space was included at the end of the data input form for "my comments/ other information." Any alterations made to the form were recorded here. For example, the entry for Mushroom Farm, Kingston near Lewes (Farm ID XE 218/103/017) records that in response to the question "Is farmer full-time farmer?" a note has been added in ink saying - "in peacetime." "Land taken over by the military" was sometimes noted on the form (for example farm XE 218/113/002). Other comments and alterations tend to relate to matters such as tenancy, rent paid and insect pests. Finally there were some Primary Return forms which included several farms, for example farms XE 218/89/018 and XE 218/89/037 are recorded together on a single form. In this case a duplicate entry was made in the database under each farm number and a note was made to this effect in the "Comments" column.

Sections E and F of the Primary Return were entered via a separate input screen and, as before, an extra section for "other comments" was added so that any relevant information could be noted. Most of these comments again related to multiple farms being recorded on a single form.

June 1941 Census Form

A single data input screen was created for this form and part of this is shown in Figure 63.



Data input form in Access

Original June 1941 census form

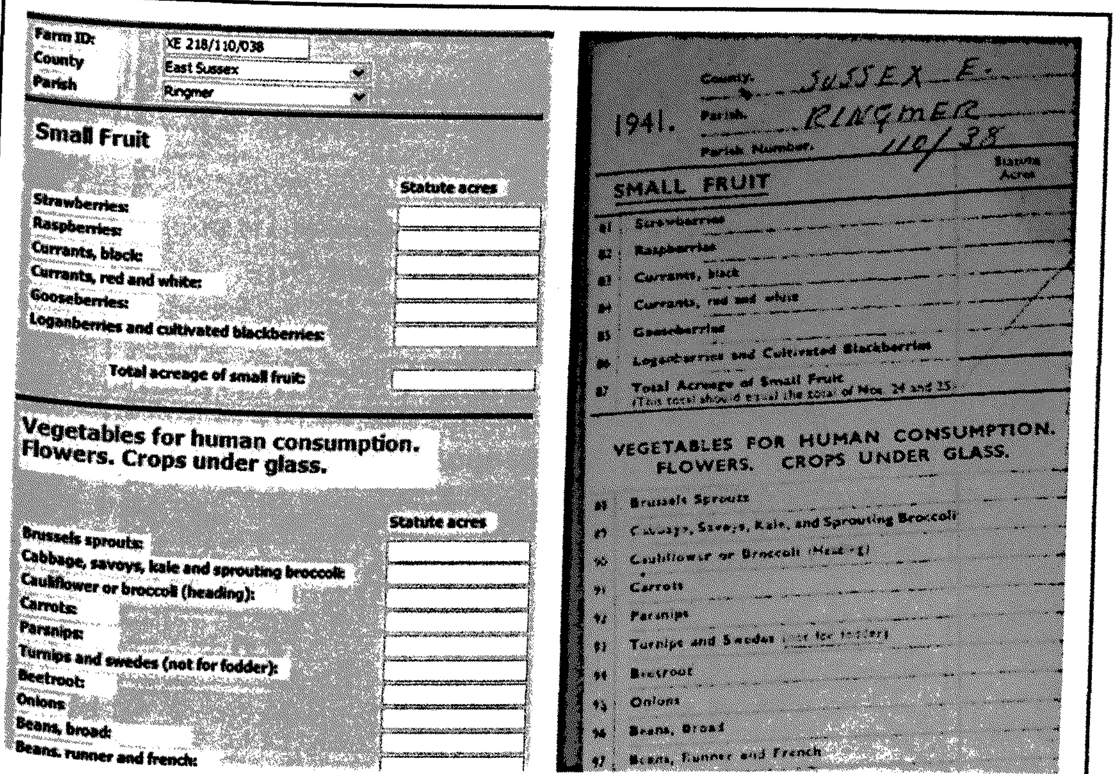
Figure 63: Data input screen for part of the June 1941 census form compared to the original form for Wellingham Holding, Ringmer
Source: TNA MAF 32

As with the Primary Return, a space was added at the bottom for "additional information – mine" to allow any relevant additional information to be recorded. In several instances the figures given by the farmer for individual crops do not add up to the total figure shown and this is noted in the additional information column. Also there are a number of cases where the acreage quoted by the farmer has been queried. For example a note in pencil on the form for farm ref XE 218/101/001 comments "Your schedule gives 129.5 as acreage. Occupier returns 37.5".

Horticultural Return

This was treated in a similar manner to the June 1941 census form with data being entered via a single input screen, part of which is shown in Figure 64.

As usual a space was added to the form for "Other comments – mine" but very few comments have been recorded relating to this form.

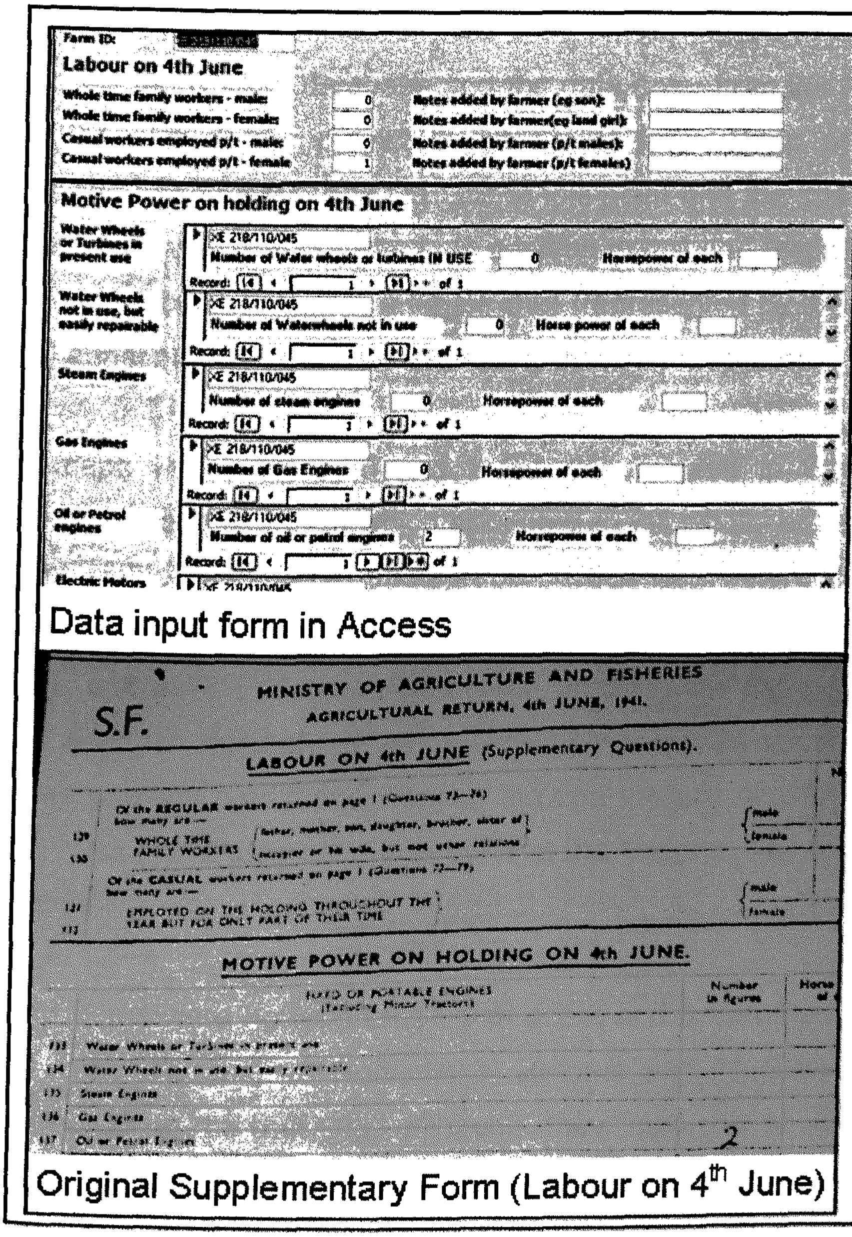


Data input form in Access | Original Horticultural Return

Figure 64:** **Data input screen for part of the Horticultural Return compared to the original form for Lower Barn Farm, Ringmer
Source: TNA MAF 32

Supplementary Form – Labour

This form lists a number of variables where it is possible to have multiple entries for a single farm – for example a single farm may own several tractors. This made the data entry screen for this form particularly difficult to create and the data are actually held in 12 related tables as listed in Table 15. This is reflected in the relative complexity of the data input form, part of which is shown in Figure 65.



Data input form in Access

Original Supplementary Form (Labour on 4th June)

Figure 65: Data input screen for part of the Supplementary Form compared to the original form for Lodge Farm, Ringmer
Source: *TNA MAF 32*

A space for other comments was, as usual, included, and this was well used. A number of the forms included information for two or more farms and this was recorded here. There were also two styles of form in use and so a note was made of any "old style buff coloured forms" encountered. Farmers' additional comments were also recorded here. For example the form for farm ref XE 218/109/033" records the farmer's note to the effect that "the tractor we had was damaged in an air raid".

The Process of Data Entry

The creation of the Access database and the data entry from the NFS forms were the first part of the project to be completed. None of the map information had been captured in the GIS at this point and the specific farms of interest had not yet been identified. In addition to this, the original intention of the project had been to look at a larger area (represented by the full extent of the 1940 aerial photograph) than eventually proved practicable.

The NFS maps were examined and a list was created in Excel of the reference number of every farm which appeared to fall wholly or partly within the footprint of the 1940 aerial photograph. Each farm reference number includes a component which refers to the parish so, for example, the "89" in farm ref "XE 218/89/001" denotes Barcombe parish. The list in Excel was sorted by the parish number. It was then simply a matter of obtaining the folder for the relevant parish and working through the pile of forms entering each in turn. All of the data entry was done at the National Archives using a laptop computer.

Any missing forms were noted on the Excel sheet and 8 Primary Returns, 5 June 1941 census forms, 13 Horticultural Returns and 11 Supplementary Forms appeared to be missing, although they may never have been completed for a variety of reasons such as the size of the holding.

No attempt was made to cross-check the forms at this stage. In many cases the acreage shown on the Primary Return was different to that shown on the June 1941 census but the values shown were simply recorded. The internal consistency of the data was evaluated later in the process and this will be described further on in this chapter.

Information was recorded in the database for 243 farms. Of these farms 135 were contained within, or partially overlapped the final extent of the study area.

The NFS Maps

The NFS maps were used early on in the project simply to identify which farms fell within the study area. Following the creation of the base polygon layer and the first classification from the LUS maps the NFS maps were then revisited and captured in detail.

Firstly each map which related to the study area was photographed in sections at the National Archives. Each photograph was then imported into MapInfo and registered using three control points. This allowed the NFS maps to be displayed with the other map layers and they were used as the backdrop for the initial stage of the 1940 classification.

In order to record the information for 1940, a copy was created of the base polygon layer. This was named 1940_classification and was amended as necessary as the individual polygons were inspected. In practice very few changes were made to the 1931 polygons although a few were merged where one large field was shown on the NFS map.

The detail contained within the NFS forms has already been described. However the maps also contain much information. On the map of Hamsey shown in Figure 66 the farm numbers are written in red, the extent of each farm is outlined in colour and the OS parcel number and acreage is shown for many of the pieces of land.

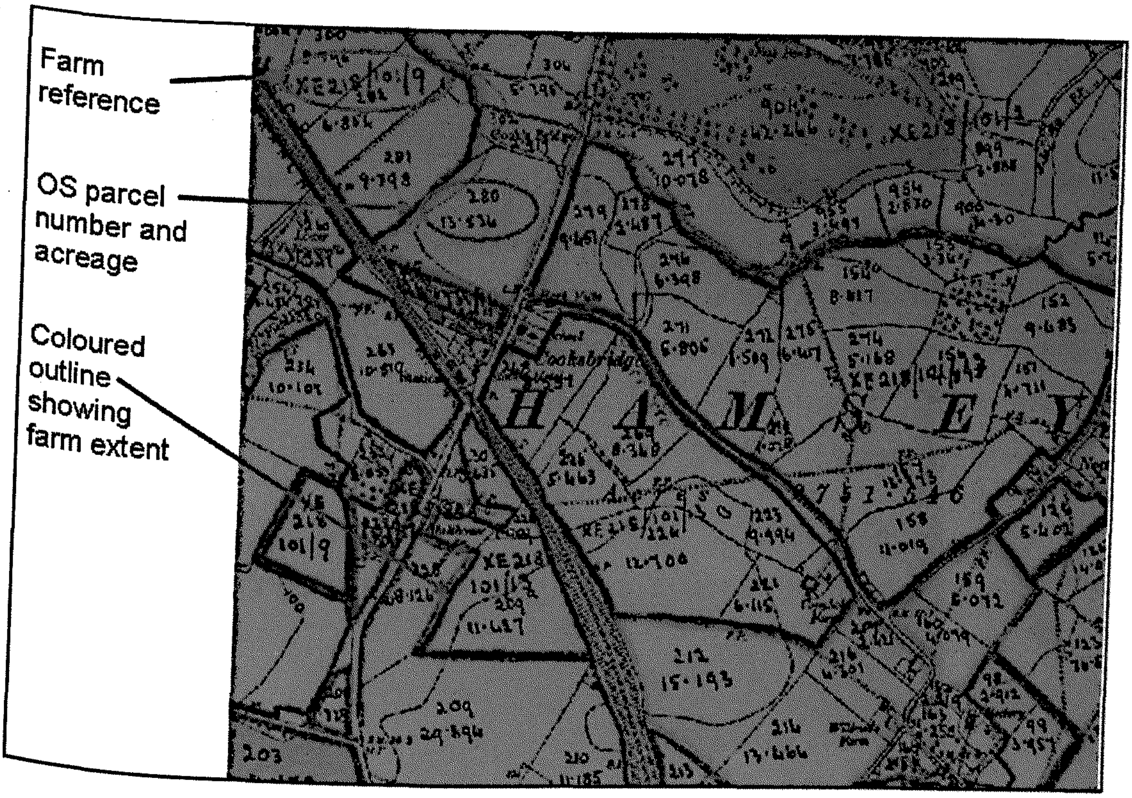


Figure 66: Extract from the NFS map for Hamsey
Source: TNA MAF 73

In order to record this information a table was set up linked to the 1940_classification layer. This included the following columns:

- Farm Reference – three columns as each polygon could have up to three farm numbers associated with it
- NFS Field Ref – this was for the transcribed OS parcel number
- Field classification 1940 – the land use code would be added later
- Field acreage – this was the acreage written on the map below the parcel number
- Plough up 1940
- Plough up 1941
- Comments – to record any decisions made or queries
- Area hectares (calculated by MapInfo)
- Area acres (calculated by MapInfo so not necessarily the same as the acreage written on the map)

- NFS map checked – to allow progress to be monitored and any "missed" polygons to be identified

Once the table had been created, the 1940_classification layer was displayed overlaid on the NFS map layer. Each polygon was selected in turn and the information from the map was entered into the table ie farm reference(s), NFS field references (OS parcel numbers) and field acreage. Where necessary, polygons were modified, for example where a farm boundary divided a parcel in two, as shown in Figure 67. Beeches Wood, the area circled in red, lies partly within and partly outside farm number XE 218/89/019 and 047.

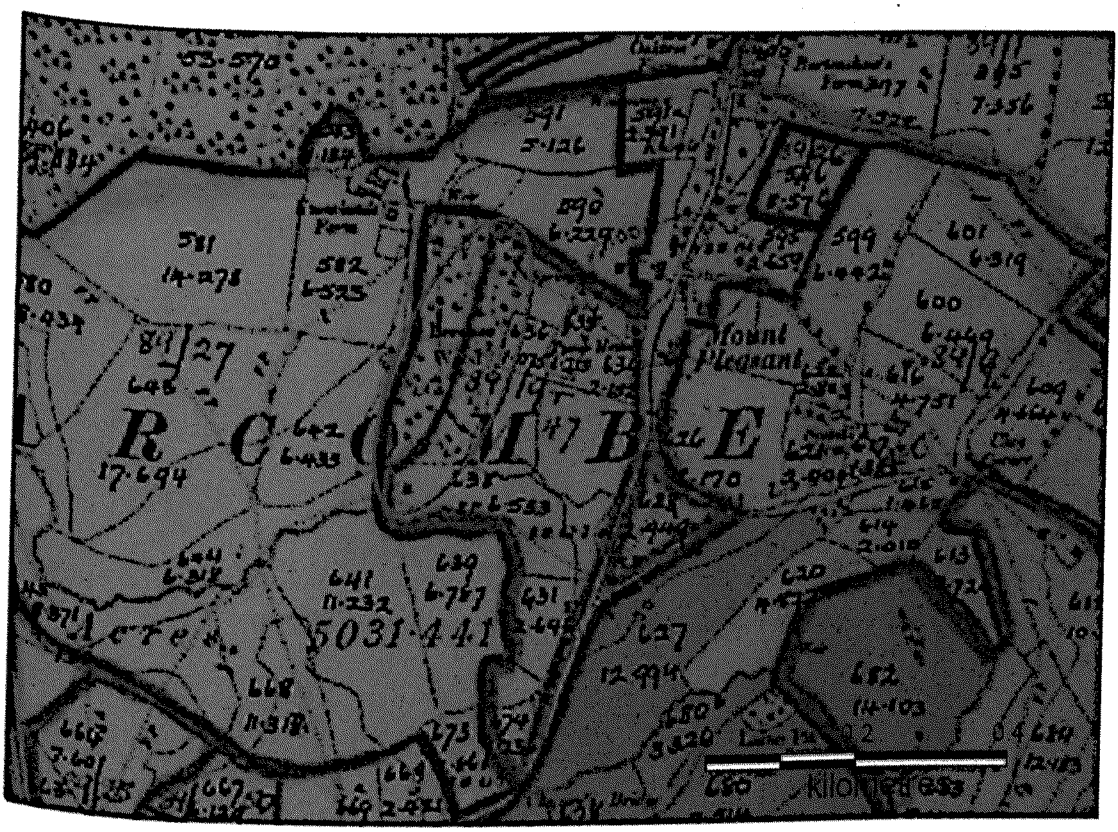


Figure 67: Extract from the NFS map of Barcombe showing a parcel divided in two by a farm boundary
Source: TNA MAF 73

Comments were added to the table where appropriate and the Update Column facility was used to add in the area acres and area hectares calculated by MapInfo.

Some difficulties were encountered in the course of this process. In a few cases the farm number shown on the map was not complete, as in the example shown in Figure 68. The parish reference (110) is shown but the individual farm number which makes up the last section of the reference, is missing. In this instance another area of land was outlined in the same colour close by and had a full farm reference number associated with it. The decision was therefore taken to temporarily allocate all polygons within the "query" area to that farm.

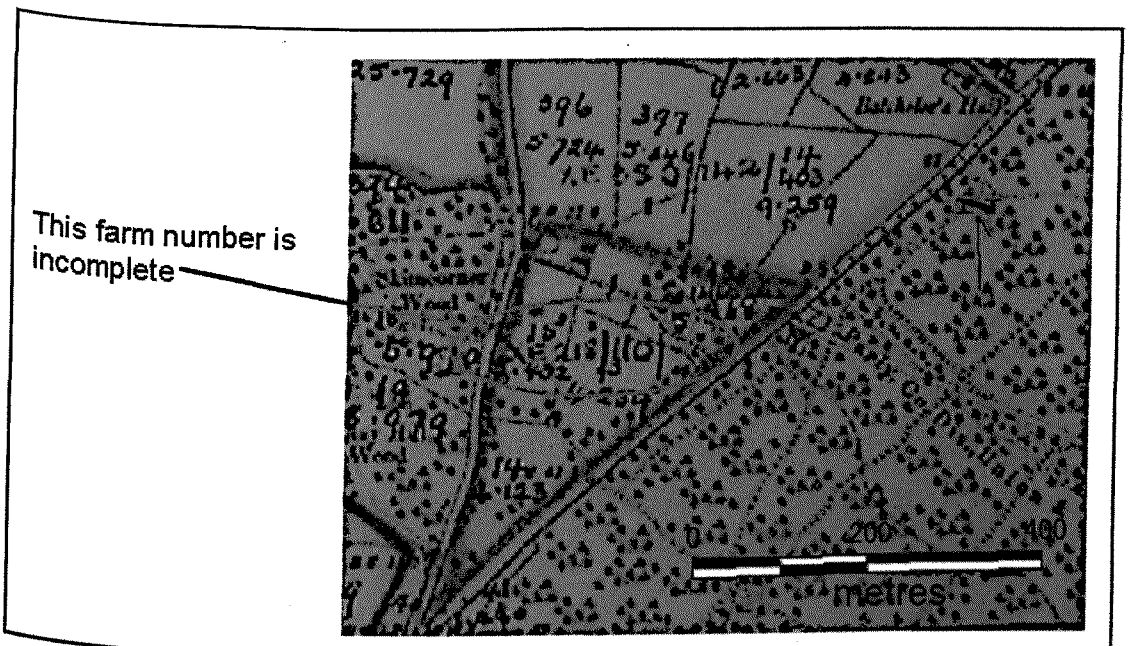


Figure 68: Extract from NFS map showing a farm with an incomplete reference number
Source: TNA MAF 73

Some information was simply illegible or difficult to decipher. Referring back to the original maps at the National Archives was sometimes helpful as was the use of a magnifying glass. Figure 69 illustrates some of the common problems encountered.

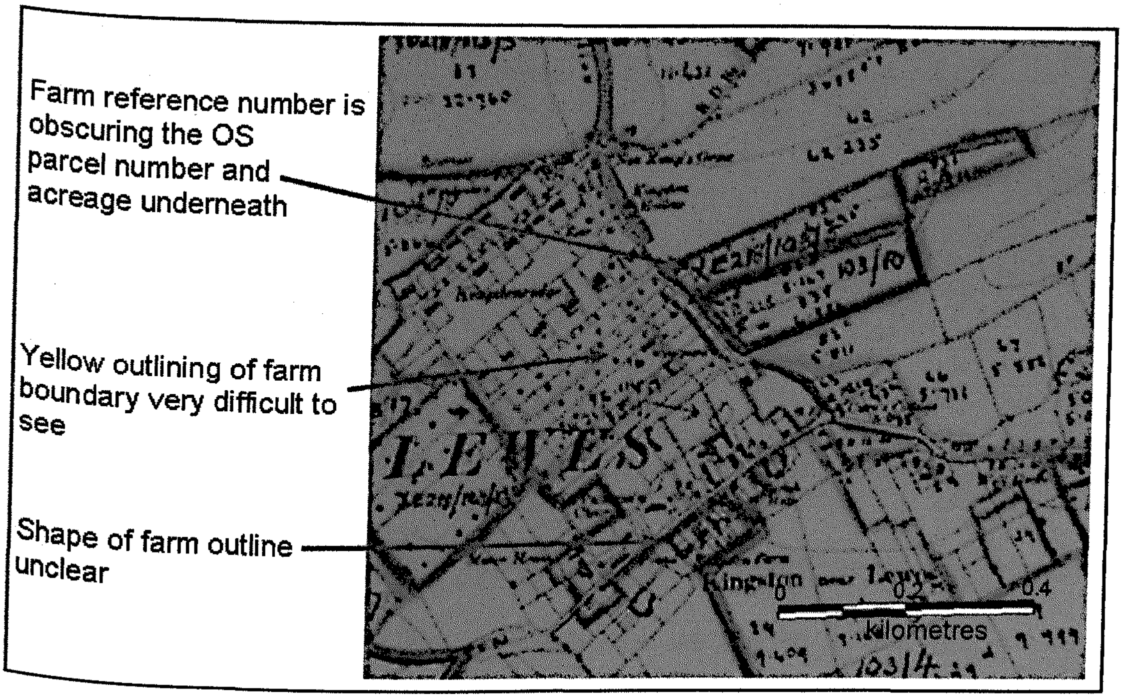


***Figure 69:* Extract from NFS map of Kingston near Lewes illustrating some common problems**
Source: TNA MAF 73

Difficulties included farm boundaries which were unclear due to the colour of the outlining, or due to inconsistent outlining. Information was often obscured, for example where the farm number had been written over the OS parcel number and acreage.

A final problem affected only one farm, XE 218/101/020, which was unfortunately a large holding (464 acres according to the Primary Return) near Offham. In this case the farm outline simply stopped for no obvious reason (Figure 70).

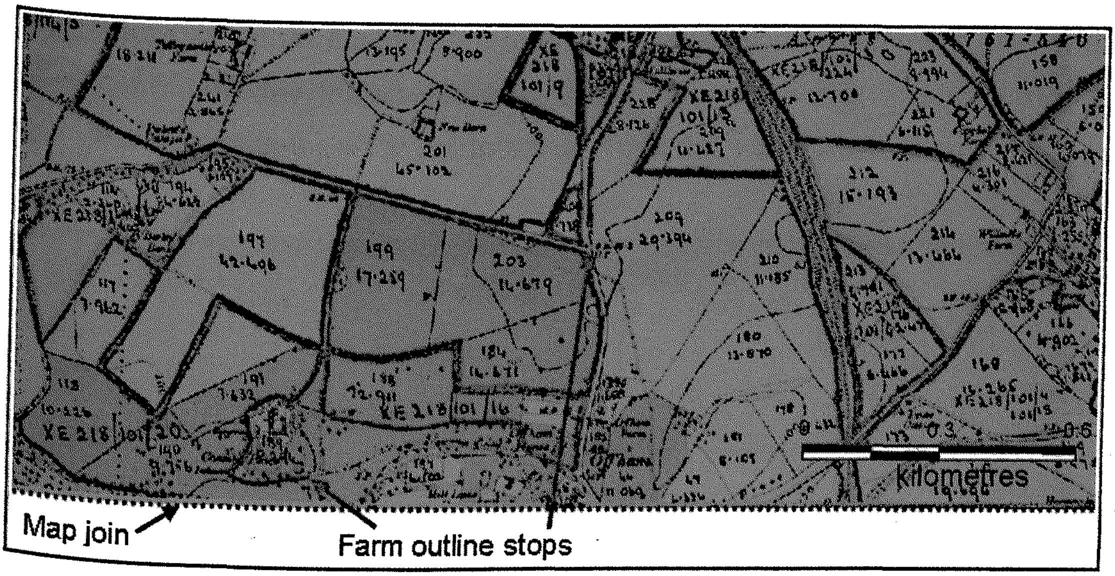


***Figure 70:* Extract from NFS map including farm XE 218/101/020 showing missing outlining**
Source: TNA MAF 73

The problem was compounded by the fact that a map join cut the farm in half. The outlining was equally inconsistent on the lower map and it was not possible to identify many of the polygons belonging to this farm at this stage.

Once each polygon had been examined and the table had been completed as far as possible, a copy was saved and exported as a database file (DBF) into Excel for ease of manipulation. The data were sorted by farm reference and each farm reference was compared to the Access database. This allowed a process of checking and correction to occur. Some farm references had been entered inconsistently and these were amended. It was also discovered that some farms did not appear in the database. These were revisited on the maps and the codes were altered as necessary.

This process can be illustrated with reference to Figure 71. There are two farm numbers circled in red and each is clearly written. However when the farms list was compared to the Access database it became apparent that there was no entry for farm ref 110/004. There was however, an entry for farm 110/14. The map was inspected again and it was clear that the area labelled 110/004 was outlined in the same colour as 110/14 and was adjacent to it. It was therefore decided to assign the 004 polygons to farm 110/14 and so the entries in the table were amended. A further check was carried out when the farm outlines were reconstructed and this will be described below.

Figure 71: Extract from the NFS map for Ringmer showing inconsistent farm numbering
Source: *TNA MAF 73*

As a result of this process an Excel table was constructed which listed each farm within the study area. The following columns were added to the table:

- Captured in MapInfo – a date was entered here so that it was apparent when each farm had been completed
- Status in Access – this allowed any missing forms to be noted. The ideal status was "all forms held."
- MapInfo acreage – this was the acreage calculated by the system (via Update Columns) and not the acreage written on the maps

- Primary Return acreage – this was the figure from the top of the Primary Return form
- Complete? - a farm would be shown as incomplete if part fell outside the study area. In this case the MapInfo acreage and Primary Return acreage would not be expected to match
- Comments – any useful additional information could be recorded here
- Checked at TNA? – some dubious data were double checked at the National Archives and this is recorded here

The Primary Return acreage and Status in Access were filled in straight away with reference to the Access database. The other columns were completed as each farm was reconstructed and checked.

The next stage was to create a farm outlines layer in MapInfo showing the extent of each farm. An SQL query was used to display all polygons which had been assigned to a particular farm reference. All the polygons selected were highlighted and compared to the farm outline shown on the original NFS maps which were displayed underneath. If the farm outline and the selected area coincided, the boundary of the farm was digitised and saved to the new farm outlines layer. The farm reference number was saved to an associated table. Finally the acreage was calculated in MapInfo and then added to the Excel spreadsheet. This was then compared to the acreage from the Primary Return form as a means of checking whether the farm boundary was likely to be correct.

If the highlighted query polygons and the farm outline on the NFS did not coincide the maps were re-examined and corrections made as necessary. If the MapInfo acreage and Primary Return acreage were not within about 10% of each other, the scanned maps were, again rechecked. If this did not resolve the discrepancy the original maps were checked again at the National Archives and the Primary Return was also rechecked.

Lower Barn Farm, Ringmer was another holding which presented particular difficulties which were only addressed at this stage once the farm extents had been identified and captured. The farm was marked on the maps as XE 218/110/037 and the extent can be seen in Figure 72.

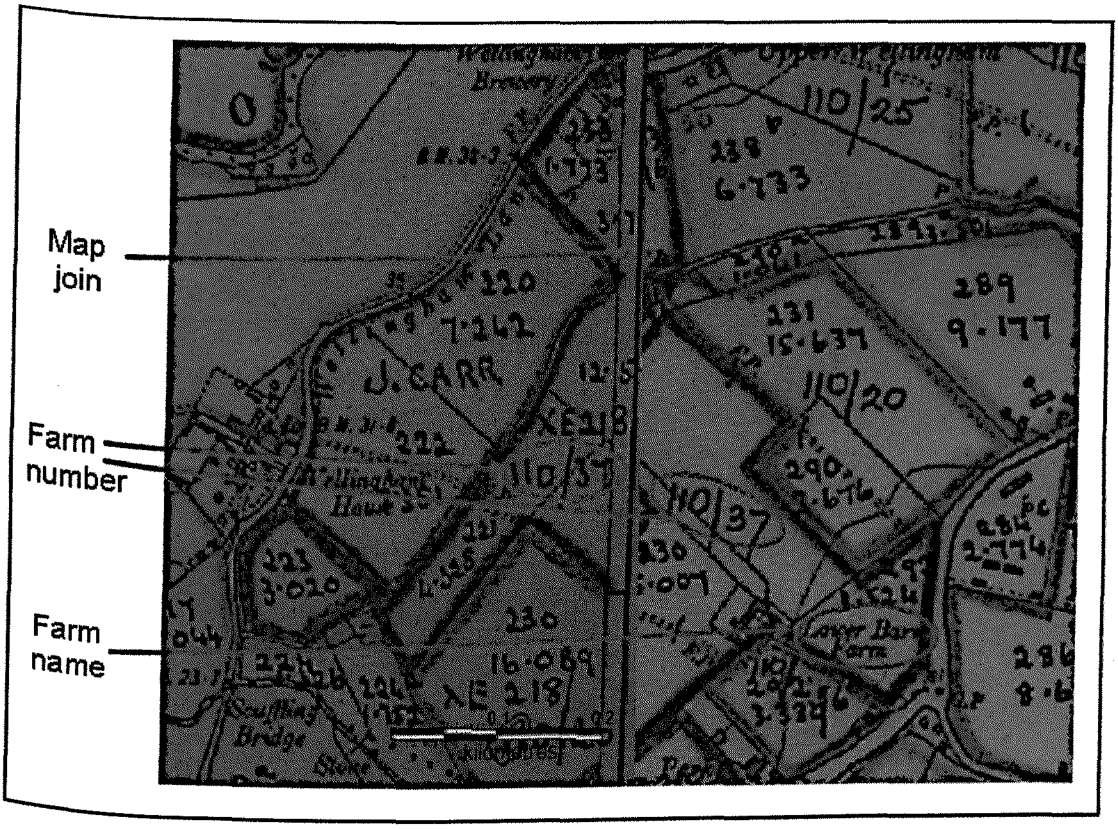
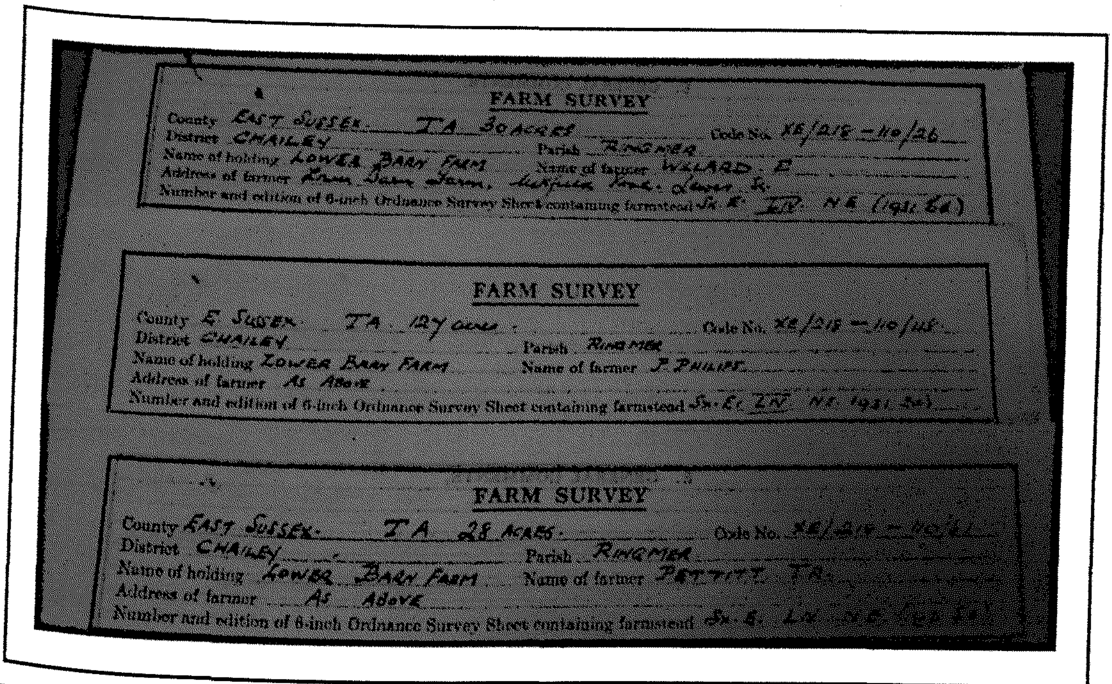


Figure 72: Lower Barn Farm (XE 218/110/037), Ringmer
Source: TNA MAF 73

No forms for farm XE 218/110/037 were found in the database. Farms of less than 5 acres were not surveyed but the outlined extent was clearly larger than this and so would be expected to have a set of forms. It was possible that the forms were missing but, in most cases, one or two forms were missing and not the complete set. It was therefore decided to investigate this farm more closely.

The first stage was to look through the Primary Return forms for Ringmer to see if any of them bore the name Lower Barn Farm. Unfortunately there were three!



FARM SURVEY

County East Sussex TA 30 acres Code No. XE/218 – 110/26
District Chailey Parish Ringmer
Name of holding Lower Barn Farm Name of farmer Willard E
Address of farmer
Number and edition of 6-inch Ordnance Survey Sheet containing farmstead Sx E. LIV NE (1931 Ed)

FARM SURVEY

County E Sussex TA 127 acres Code No. XE/218 – 110/48
District Chailey Parish Ringmer
Name of holding Lower Barn Farm Name of farmer J. Phillips
Address of farmer As Above
Number and edition of 6-inch Ordnance Survey Sheet containing farmstead Sx E. LIV NE 1931 Ed

FARM SURVEY

County East Sussex TA 28 acres Code No. XE/218 – 110/61
District Chailey Parish Ringmer
Name of holding Lower Barn Farm Name of farmer Pettitt TA
Address of farmer As Above
Number and edition of 6-inch Ordnance Survey Sheet containing farmstead Sx E. LIV NE

Figure 73: Primary Return forms for Lower Barn Farm, Ringmer
Source: TNA MAF 32

The next step was to look at the Plough Up information. Lower Barn Farm reference XE 218/110/048 was clearly outlined on the NFS map and also had a plough up field which was clearly identifiable within the outlined extent. The acreage of the farm outline, the Primary Return and the census return showed good agreement. This farm was therefore assumed to be complete. This left Lower Barn Farms reference XE 218/110/026 and XE 218/110/061.

Farm XE 218/110/026 was adjacent to the area numbered XE 218/110/037 on the NFS map. A second area nearby which was marked on the map as XE 218/110/036 but outlined in the same colour had been included in the farm extent as no forms existed for farm XE 218/110/036. The total acreage in MapInfo was 23.58 acres which was rather lower than the Primary Return acreage of 30 acres. However the area occupied by farm XE 218/110/037 was almost 25 acres and so adding this to farm XE 218/110/026 would have made the difference in acreage between MapInfo and the Primary Return even greater. This farm was therefore also assumed to be complete.

The remaining Lower Barn Farm was XE 218/110/061. There was no extent on the map with this number and it seemed likely that this, in fact, corresponded to the farm numbered XE 218/110/037 on the maps. The Primary Return acreage of 28 acres was a reasonable match for the MapInfo acreage of 24.97. The Primary Return was therefore renumbered to XE 218/110/037 in the Access database (with a note added to this effect in the Comments section).

A secondary issue was then encountered. There were no census forms held under reference XE 218/110/037 or XE 218/110/061 in the database. However there were forms held under reference XE 218/110/038 which had the same farm name and also the same farmer, Mr. Pettitt. The acreage shown on the census form was 28 acres which exactly matched that shown on the Primary Return for XE 218/110/037 (renumbered from XE 218/110/061). The census forms were therefore also renumbered in the database to XE 218/110/037 and this was, again, noted in the comments column.

Table 16 summarises the data for the 135 farms which lay within the final study area. It should be noted that one of these "farms" is "Land at Race Hill" which appears to have been farmed by the CWAEC for the first time during the war. This has no farm reference and has been entered into the database as TEMP 01. A few farms had "land lost to military" clearly noted on the Primary Return – these have been listed separately as the acreage between the census and Primary Returns is a poor match.

Number of farms	Comment
28	Incomplete – part of farm appears to be outside study area
5	Incomplete – part of farm lost to military
4	Primary Return or 4th June census return (main census form only) missing or incomplete
72	MapInfo acreage within 10% of Primary Return acreage
15	MapInfo acreage within 20% of Primary Return acreage (not including farms within 10%)
11	MapInfo acreage more than 20% different from Primary Return acreage

***Table 16:** Evaluation of the farms within the study area*

Of the 98 complete farms with both forms, the MapInfo and Primary Return acreage were within 10% of each other around 73% of the time. 11 of the complete farms had large discrepancies in acreage, some for no obvious reason despite rechecking. In other cases there appeared to be a good reason for the difference. For example the MapInfo acreage for farm XE 218/110/046 was calculated as 77.6 whereas the Primary Return showed 102 acres. However there was a note on the Primary Return form to the effect that "25 acs. marsh probably included in above [acreage figure]". If these 25 acres are subtracted from the 102 acres shown on the Primary Return, the acreage is a much closer match to that captured in MapInfo. In some instances the farm acreage is simply very low so that a small difference translates into a large percentage difference. This is the case with farm XE 218/110/052 for example, where the MapInfo acreage is 11.22 and the Primary Return acreage is 14.5. This constitutes a difference of only 3.28 acres but 22.63%.

The area covered by farms was 13,852.26 acres. This constitutes just under two thirds of the total study area. The farm extents are shown shaded green in Figure 74. The yellow areas are sections of the study area which did not lie within a farm. It is notable that a high proportion of the unfarmed area lay on the South Downs, much of which was requisitioned by the military during the war. However the military area also includes some land which belonged to a farm before the war and was either cultivated or used as rough grazing. An example of this is farm XE 218/98/007 where Section E of the Primary Return notes that "The tenant's methods of farming have been greatly altered by the military taking over almost 200 acres of the holding and he is having to reorganize his management." The military area is denoted by the red colouring on the map.

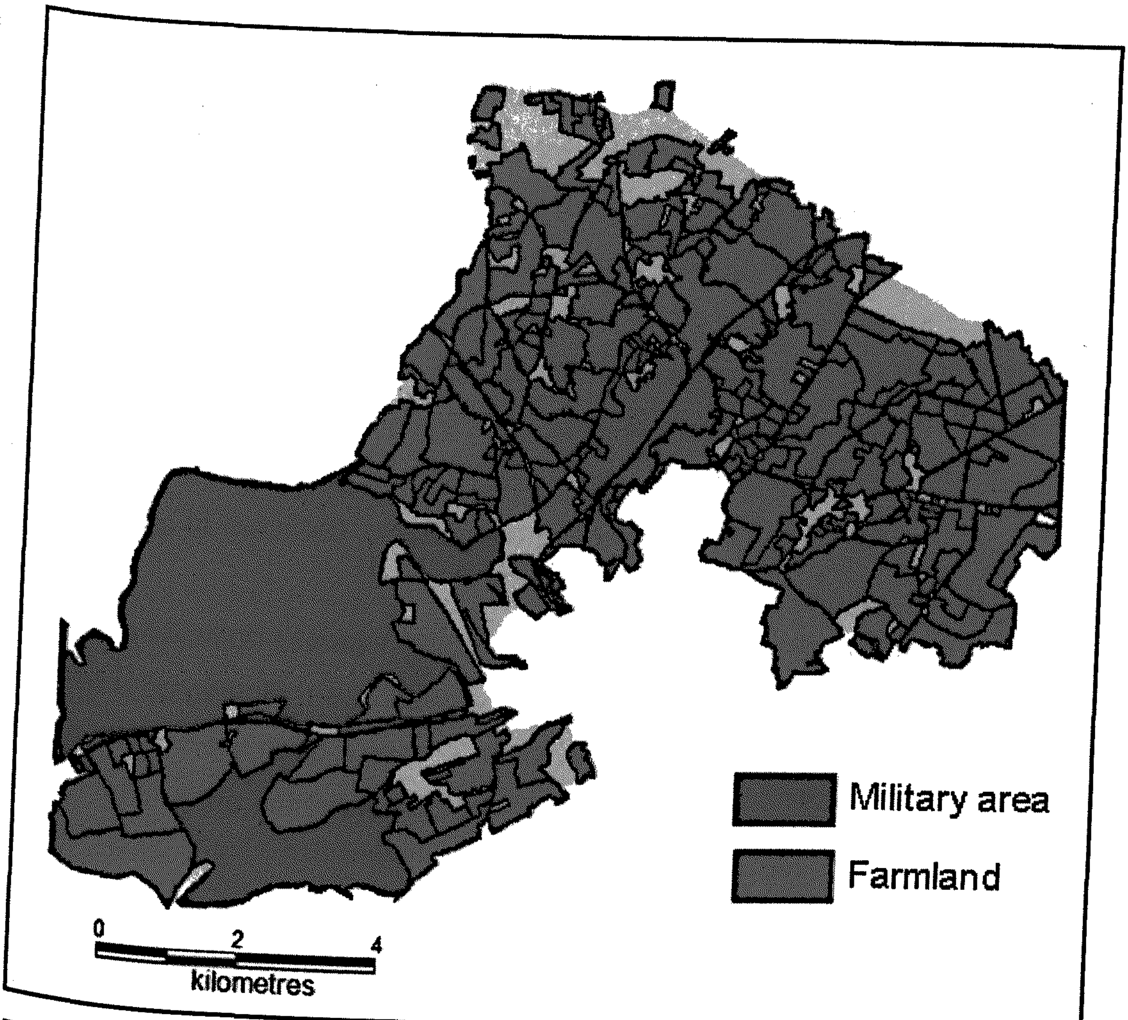


Figure 74: Map showing the extent of the study area occupied by farmland in 1942
Source *(military area): TNA MAF 73*

The aim was to categorise the 1940 land use using a combination of the NFS forms and the 1940 Luftwaffe aerial photograph. The next stage, therefore, was to correct the 1940 photograph and import this into MapInfo.

The Luftwaffe image is a vertical aerial photograph. This means that the scale will not be consistent across the image. This is helpfully explained by Avery and Berlin:

> "With the orthographic position of a map, all features are located in their correct horizontal positions as though they were being viewed from directly overhead. This standard cannot be met by the central projection of a vertical airphoto because all objects are positioned as though they were being viewed from the same point. This means that

the images of most ground objects are shifted or displaced from their correct positions (Avery and Berlin 1992, p74).

In order to display the aerial photograph with the other layers it was therefore important that the image should first be geocorrected so that it would "fit" with the other layers. The process of rubber sheeting was undertaken in Erdas Imagine using a large number of control points to effectively anchor ground objects to their correct horizontal positions as depicted on the map. Once this process had been completed the aerial photograph was imported into MapInfo and registered to the British National Grid. It was then displayed as a backdrop to the 1940_classification layer.

The classification process for 1940 was potentially quite complex due to the use of a combination of datasets. It was therefore decided to use Barcombe as a pilot area once again in order to evaluate the methodology before applying it to the entire study area

Classifying Land Use in Barcombe in 1940

The 1940_classification table had already been created and had columns available for Field Classification 1940 and Plough Up 1940 and 1941. The classification for 1931 had used codes based around hundreds (see Table 7), so Forest and Woodland was coded between 100 and 102, Meadow and Grassland was 200-202 and so forth. It was therefore decided to use codes starting at 10 (so 110, 210 etc) for the 1940 classification. Some measure of certainty was felt to be useful (as with 1931). A straightforward classification of Forest and Woodland from the 1940 aerial photograph would be coded 110 but where this was uncertain or had been checked in some way the code would be 111 to indicate that this was a "best guess". The process of checking involved looking back to the 1931 classification to see what the land use was at that point. Also the OS base maps could be consulted to see if they held any clues such as the name "Wood" or "Common" applied to an area which would be an indication of land use. Land identified as ploughed up was given a code ending in "12" – invariably this was 312 for Arable land.

The complete list of codes applied for the 1940 classification is shown in Table 17.

Land Use Class	Classified from aerial photo	Classified by "best guess"	Plough up
Forest and Woodland	110	111	
Meadow and Grassland	210	211	
Arable	310	311	312
Heath and Rough Grazing	410	411	
Gardens etc	510	511	
Water	610	611	
Land Agriculturally Unproductive	710	711	

Table 17: Land use codes used for the 1940 classification

As the aim was to tie in the classification with the data held in the NFS for each farm it was decided to approach the classification on a farm by farm basis. Therefore the next stage was to identify all the farms which lay within Barcombe parish. This was done from the Farms Masterlist Excel spreadsheet created earlier. Farms within Barcombe were identified by the second section of the farm code ("89" for Barcombe) which was the parish reference. There appeared to be 25 farms entirely within the study area and four incomplete farms. The 25 complete holdings were therefore tackled first.

A new worksheet was added to the Farms Masterlist in Excel and relevant information from the NFS forms for the complete farms was summarised here. It became clear that there was no June 1941 census form for two farms. Therefore only the remaining 23 farms were included in the initial pilot classification. These are shown shaded green in Figure 75. The 23 pilot farms covered around 2,696 acres. The outline of the section of Barcombe parish which falls within the study area is shown in red and the whole study area is edged in black. In a few cases a farm spills over the edge of the study area – this is where the parish boundary appears to cut across a field and the whole field has been included.

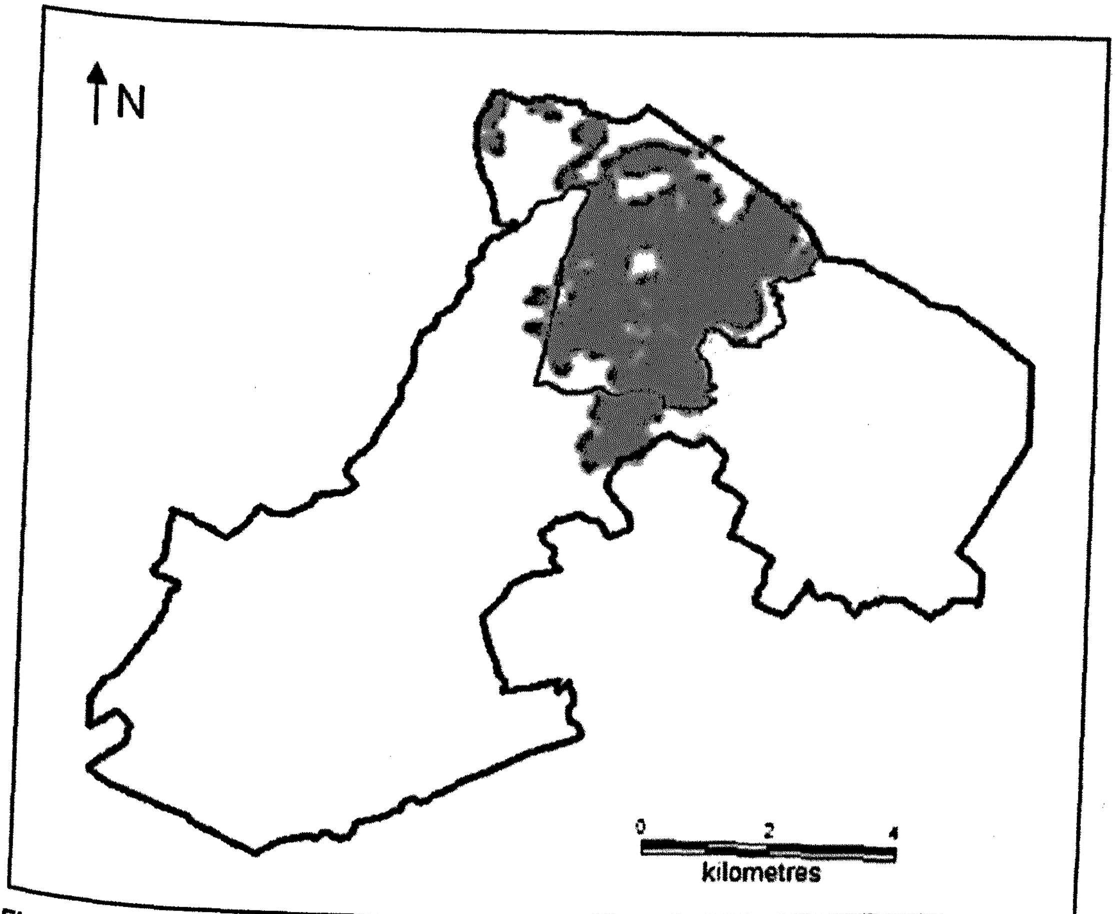


Figure 75: The 23 pilot farms (shaded green)

From the Primary Return, the information of interest was as follows:

- Acreage
- Derelict fields. The OS parcel number was sometimes given and so these could be identified and coded as unproductive. If the OS parcel number was not given this was still a useful indicator that some unproductive land lay within the farm extent
- Date surveyed. Some farms were surveyed two years after the date of the aerial photograph and so the land use could be expected to agree less closely than farms surveyed very near the photograph date
- Plough up 1940 and Plough up 1941.

The Crops and Grass section of the June 1941 census return form was also used as this gave extensive information about crop types. This was summarised by land use category and added to the Farms Masterlist. One difficulty encountered was assigning the crop types listed on the census form to the broad land use categories used in this project. Table 18 summarises the decisions taken:

Census category	My land use class	Comments
Section 1 (wheat, barley, oats, corn etc)	Arable	
Section 2 (potatoes, mangolds, sugar beet etc)	Arable	
Section 3 kale to flax	Arable	
Hops	None in study area so not applicable	
Section 4 (orchards and small fruit)	Gardens etc.	Stamp included orchards, nurseries and allotments in this category
All other crops, bare fallow	Arable	
Clover, sainfoin and temporary grasses for mowing this season	Meadow and Grassland	See section below
Clover, sainfoin and temporary grasses for grazing	Meadow and Grassland	See section below
Permanent grass	Meadow and Grassland	
Rough grazings	Heath and Rough Grazing	Stamp included rough grazings in the Heath category

Table 18: Land use categories assigned to the June 1941 census

Once again a major difficulty was encountered in classifying the various types of grassland. Ideally the distinction between permanent and temporary grass would have been preserved, with temporary grass falling into the Arable category. However it was felt that this distinction would be very hard to make based on the 1940 aerial photograph and so anything that looked like grass was put into the Meadow and Grassland category. The exception was rough grazing which was more distinctive on the aerial photograph as it tended to consist of grass with scrub or bushes, as shown in Figure 76. This was categorised as Heath and Rough Grazing.

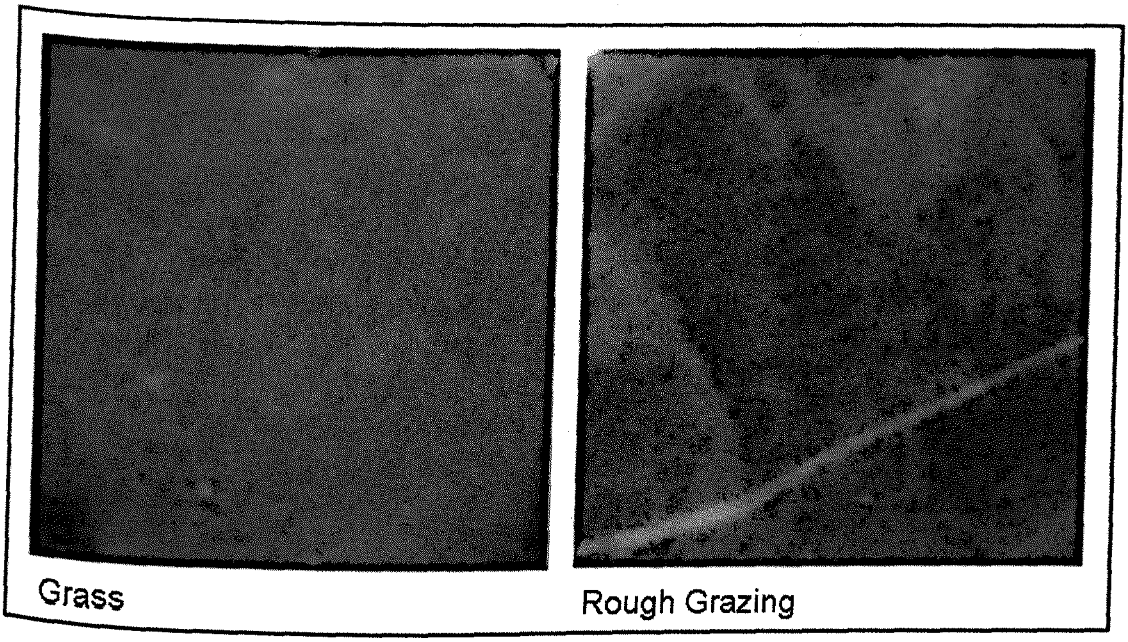


Figure 76:* *Grass compared to Rough Grazing on the 1940 aerial photograph
Source: University of Sussex

Figure 77 summarises the process of classifying each farm.

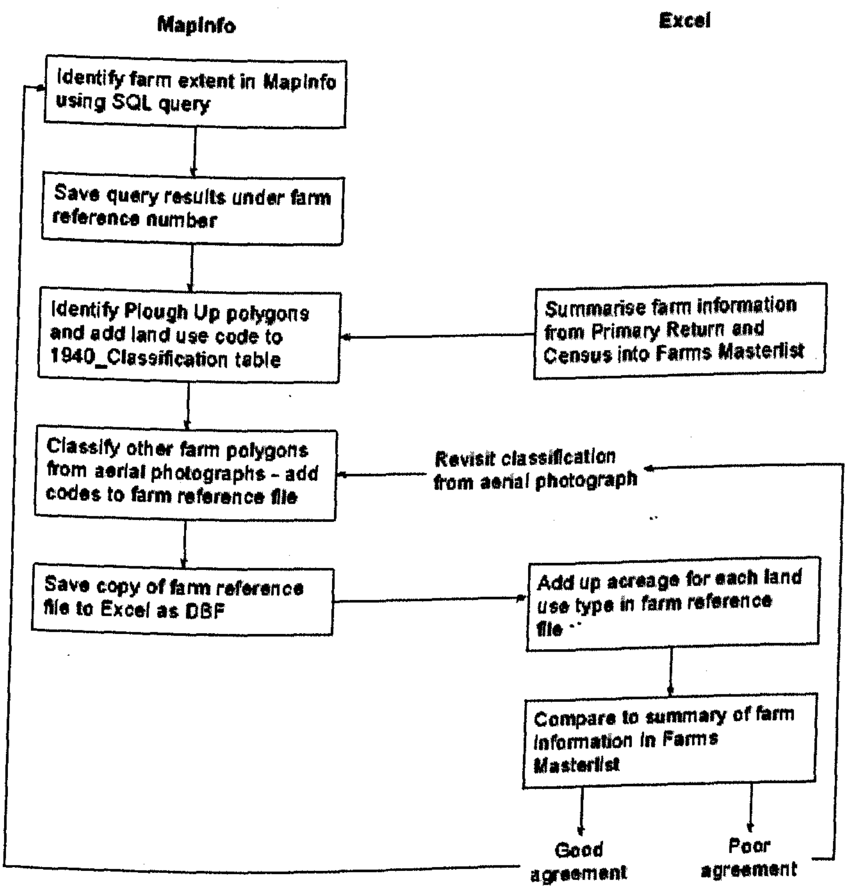


Figure 77:* *The process of classifying each farm in Barcombe for 1940

Once the farms had been classified the rest of the parish of Barcombe was examined and all the polygons were classified. Some of these polygons belonged to farms which were mainly in another parish and in this case the whole farm was inspected and classified as per Figure 77.

Interpreting the Aerial Photograph

There are a number of characteristics or recognition elements which can be used in the interpretation of aerial photographs. These include shape; size; pattern; shadow; tone or colour; texture; association; site (the location of an object in relation to its environment) (Avery and Berlin 1992, pgs 52-56). These recognition elements were applied to the Barcombe section of the 1940 aerial photograph. Figure 78 illustrates the characteristics of some of the main land use types.

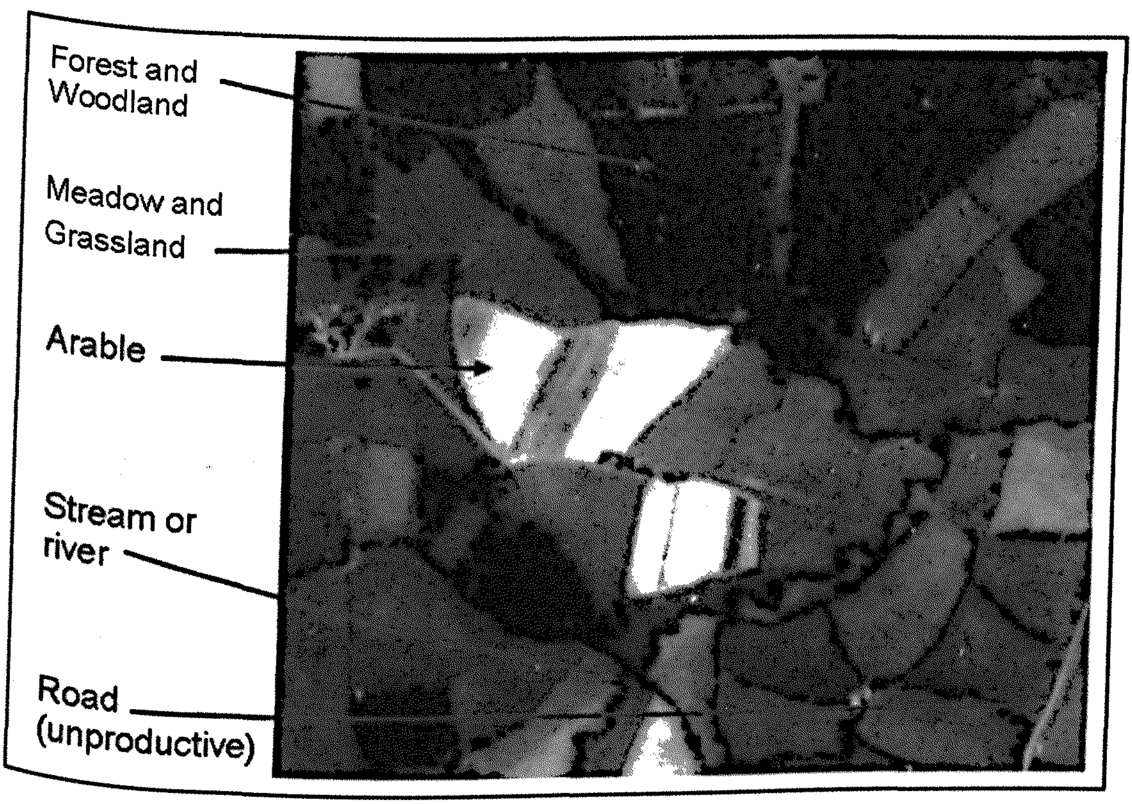


***Figure 78:** Extract from 1940 aerial photograph showing some of the main land use types*
Source: *University of Sussex*

Forest and Woodland is one of the easiest features to pick out. It is dark coloured and the individual trees can be seen. Meadow and Grassland tends to be flat and relatively smooth toned whereas the Arable areas are very bright and often have characteristic stripes. The 1940 photograph was taken in August when Arable crops would have been at a mature stage. The stream or river in Figure 78 has trees or bushes growing along its banks. However it is clearly distinguished by the pattern of meanders. This contrasts with the road which is very straight in comparison.

Gardens and orchards were not as straightforward to identify and in general were double checked with the 1931 classification and so coded as "best guess." Figure 79 shows Barcombe village. The garden polygons are smaller than in the surrounding area and the pattern on the ground is generally more complex. Houses and gardens are also likely to be associated with a road and the road can clearly be seen running between the two rows of houses in Barcombe village.

Figure 79: Pattern of houses and gardens in Barcombe village
Source: University of Sussex

Heath and Rough Grazing was the most problematic category to identify. In 1931 there were a few small areas of Heath and Rough Grazing in Barcombe. One of these is shown highlighted in green in Figure 80. From a quick glance at the aerial photograph the area would probably have been classed as Woodland. However the map shows the area as Markstakes Common. Stamp included Common land in the Heath category and so it was decided to class this area as Heath and Rough Grazing.

1940 Aerial Photograph NFS Map

Figure 80: Markstakes Common as it appears on the aerial photograph and NFS map
Source: University of Sussex and TNA MAF 73

There were a number of issues which arose during the classification process and some of these have been described already. The internal consistency of the NFS data presented a problem in some cases and this will be discussed in the next section. Also some of the information had to be interpreted on a "best guess" basis, for example where farm extents were misnumbered on the map. Furthermore some of the NFS data were simply missing.

A further difficulty with the NFS data lay in locating the plough up fields. In some cases the particular OS parcel number identified did not appear on the NFS map. In others the plough up only affected part of the field and there was no indication of which part or the acreage affected. The plough up has therefore been evaluated in more detail below.

A final problem was the time gap between the date of the aerial photograph and the NFS survey of Barcombe. The photograph was taken in August 1940 whereas the earliest farm to be surveyed in Barcombe was visited in November 1941 and the rest were completed in 1942. The census forms were returned in June 1941 but could have been completed earlier than this. This meant that it was quite possible that the land use had changed considerably between the time of the photograph, the census, and the NFS survey and so the datasets might not match up well.

Some concerns were felt regarding the decision to include temporary grass with Meadow and Grassland when, in fact, it should probably have fallen into the Arable category. It was therefore decided at this point to revisit the 23 complete farms within Barcombe to see if the temporary grass could be picked out and reclassified. A code of 314 was added to the Arable category and polygons which were felt to be temporary grass were reclassified to this code.

A difficulty had also been experienced with identifying the plough up fields as described above. It was felt that it could be useful to add a second plough up code for those polygons where the extent was uncertain for some reason. The code of 313 was therefore added for this purpose. The plough up fields were revisited and reclassified at the same time that the temporary grassland was reassessed. The revised codes for Arable land are shown in Table 19.

Code	Description
310	Arable land – clear on aerial photo
311	Arable land – classified by "best guess"
312	Arable land – ploughed up and extent clear
313	Arable land – ploughed up but extent unclear
314	Temporary Grass

Table 19: The revised codes for the Arable category

Farms XE 218/89/002 and 048 have been entered together on one Primary Return form and so have been effectively treated as one farm. This farm was one of the first to be revisited and, according to the census return, included 31 acres of "clover, sainfoin, and temporary grasses for mowing this season". All the fields classed as Meadow and Grassland were reconsidered and three were identified as temporary grass and reassigned to the Arable category. These are the polygons highlighted in Figure 81.

***Figure 81:** Part of farms XE 218/89/002 and 048 with areas of temporary grass highlighted*
Source: *University of Sussex*

The polygons are slightly lighter in colour than some of the other grassland areas, such as those on the east side of Figure 81 . Also they are surrounded by arable fields and there appears to be no physical boundary between the topmost highlighted field and the adjacent arable field, suggesting that it would be very easy to plough both fields together. Finally the total acreage for these three fields is 26.94 which is reasonably close to the 31 acres listed on the census return. It was not possible to find the remaining 4 acres of temporary grassland.

Farms XE 218/89/002 and 48 also included a number of fields which were ploughed up in 1940 and 41. Where the Primary Return referred to part of a field (such as Pt 863 which was ploughed up for sheep feed in 1940) the classification was amended to 313 to indicate that the extent was unclear.

In 1941 field number 841 was ploughed up and planted with flax. Whilst fields 840 and 842 were identifiable from the NFS map, field 841 was unmarked. The *Digimap* website (University of Edinburgh 2004) was used to access the second revision County series (1:2500) maps which showed the OS parcel numbers. From this field 841 was identifiable, as shown in Figure 82 where it is circled in red, and was suitably coded.

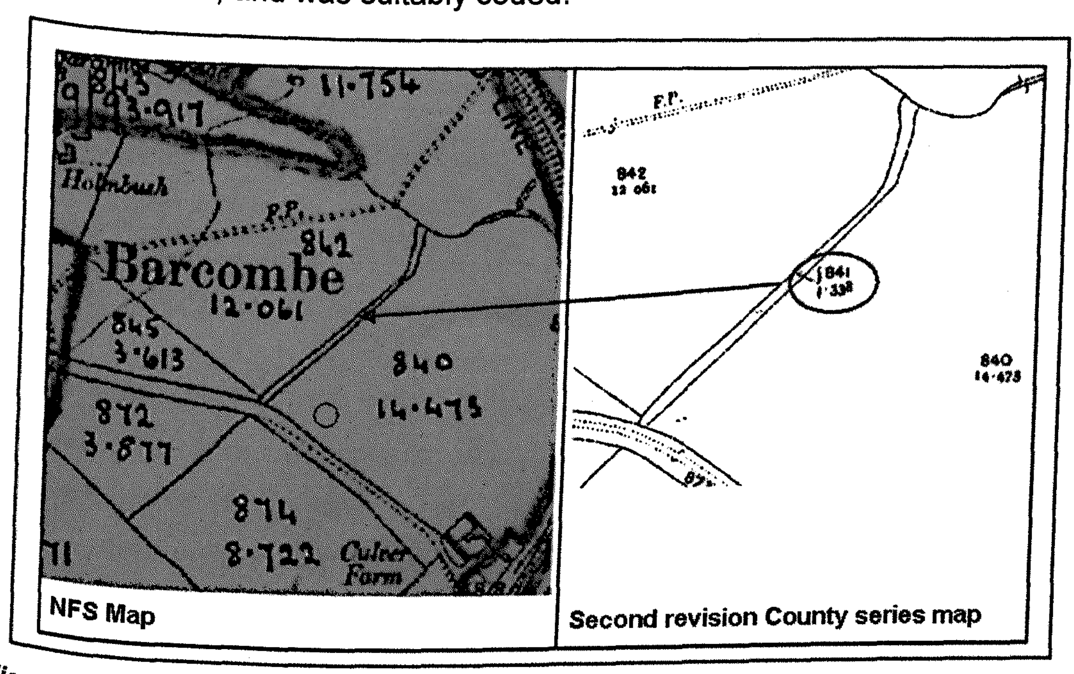


Figure 82:* *Comparison of NFS map and second revision County series map showing missing parcel numbers *Source: TNA MAF 73 and Digimap*

Evaluating the Barcombe Classification

Once the classification for Barcombe parish had been completed this was evaluated. This evaluation was carried out in two stages. The first stage considered the results for the 23 complete farms in Barcombe, and the second stage looked at the whole of Barcombe parish.

Results for the 23 Pilot Farms

The 23 complete farms covered around 2,696 acres which is just under two thirds of the total area of Barcombe. Firstly the NFS data were evaluated for internal consistency as it had become clear that some of the information given on different forms did not match up. Short *et al* (2000) had conducted a number of checks on the NFS data and so similar checks were made so that the results could be compared to their Sussex and National Samples.

The first comparison made was between the acreage shown at the top of the Primary Return and the total for crops and grass and rough grazing on the census return. The results are shown in Table 20:

	Results for Barcombe	**Short et al (p172) Sussex Sample**	**Short et al (p172) National Sample**
Census and Primary Return acreage agree exactly	17.4% (4 farms)	30.2%	33.9%
Census within 10% of Primary Return acreage	69.6% (16 farms)	56%	60.2%
Census within 20% of Primary Return acreage	78.3% (18 farms)	67.5%	71%

Table 20: Comparison of the Primary Return and census return acreages

The percentage of farms with acreages agreeing was low compared to both the National and Sussex samples. However there was a much higher percentage of farms where the census acreage was within 10% of the Primary Return acreage. The largest absolute difference was 28.75 acres which compares favourably with the largest absolute difference in the National Sample which was 1,021.2 acres (Short *et al* 2000, p172).

Secondly the Primary Return and census acreages were compared to the acreages calculated in MapInfo based on the polygons assigned to each farm as shown in Table 21.

Primary Return and MapInfo acreage agree exactly	4.3% (1 farm)	Census and MapInfo acreage agree	None
Primary Return within 10% of MapInfo acreage	91.3% (21 farms)	Census within 10% of MapInfo acreage	73.91% (17 farms)
Primary Return within 20% of MapInfo acreage	95.7% (22 farms)	Census within 20% of MapInfo acreage	91.3% (21 farms)
Primary Return more than 20% different from MapInfo acreage	4.3% (1 farm)	Census more than 20% different from MapInfo acreage	8.7% (2 farms)

Table 21:* *Comparison of the acreages calculated in MapInfo with the census and Primary Return acreages

This indicated a very good agreement between both the census acreage and MapInfo and the Primary Return acreage and MapInfo. In both cases over 91% of farms fell within 20%. The largest absolute difference between the census and MapInfo figures was 18.1 acres.

Another measure of the consistency of the NFS data employed by Short *et al* was within the census return. The total at question 33 should equal the sum of the 32 items that precede it. Of the 23 complete farms in Barcombe, the total was correct in 19 cases (82.6%). The total for one form was 0.5 acre out and the remaining three census returns had some sort of anomaly. For example the return for farm ref XE 218/89/017 has "potatoes" written in under "all other crops" but no acreage has been given. Short *et al* (p 132) found that the National Sample agreed in 83.5% of cases and the Sussex sample 87.4% of the time.

One of the aims of this project is to consider how useful the NFS data are in terms of reconstructing the agricultural landscape of this part of East Sussex. The NFS totals for each farm would be expected to agree reasonably closely with the classification from the 1940 aerial photograph and so the totals for each type of land use were compared next. These are presented in Table 22.

Land Use Class	Category	NFS classification acres	Pilot classification acres	Difference acres
110-112	Forest and Woodland	-	32.1	+32.1
210-212	Meadow and Grassland	1,696.5	1,756.8	+60.3
310-314	Arable including temporary grass	846	759.9	-86.1
410-412	Heath and Rough Grazing	53.8	42.5	-11.3
510-512	Gardens etc.	8.3	59.8	+51.5
610-612	Water	-	16	+16
710-712	Unproductive (derelict fields on Primary Return)	8.8	29.7	+20.9
TOTAL		**2,613.4**	**2,696.8**	**+83.4**

Table 22: Total acreage of each type of land use for the 23 pilot farms

There is a difference in total area of 83.4 acres between the pilot and the NFS classification. Part of this can be accounted for by the 48.1 acres assigned to the Forest and Woodland and Water categories which do not appear in the census. In addition only one derelict (unproductive) field was identified from the Primary Return, which was 8.75 acres belonging to farm XE 218/89/003. In contrast 29.7 acres of unproductive land were identified in the pilot classification.

The largest difference in acreage is in the Arable category where the pilot classification is 86.1 acres less than the NFS classification derived from the June 1941 census return. This is balanced in part by a 60.3 acre difference in the Meadow and Grassland category where the pilot acreage is greater than the NFS total. This may be attributable, at least to some extent, to the difficulty encountered in identifying areas of temporary grass. The census returns for the 23 farms include 119 acres of temporary grass whereas only 84.6 acres were actually located from the aerial photograph.

A further reason could be the time gap between the various datasets. 100.8 acres were classified as Meadow and Grassland in 1940 but ploughed up in 1941 and so became Arable. However only 30.2 of these acres are coded as 312 and are clearly identifiable. The other 70.6 acres are queries where, for example, the Primary Return shows "part" of the field ploughed up. The 1941 plough up is illustrated by Figure 83 with the clearly identifiable areas shown in the solid red colour and the query areas in the paler pink shading.

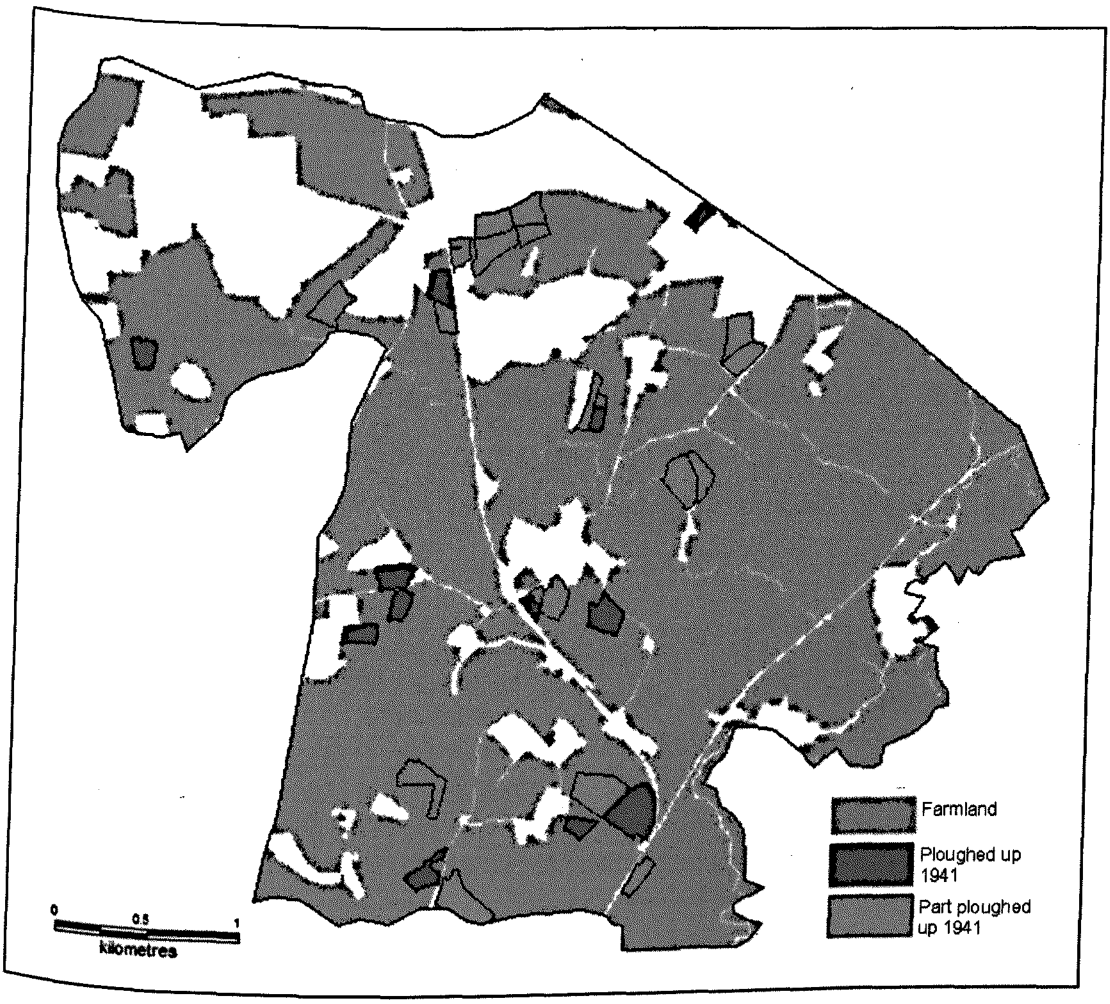


Figure 83: Parts of the 23 pilot farms which were ploughed up in 1941
Source: TNA MAF 32

If 100.8 acres are subtracted from the Meadow and Grassland total and added to Arable to reflect the situation in 1942, this produces a better level of agreement in both categories as shown in Table 23.

Land Use Class	Category	NFS classification acres	Pilot classification acres	Difference acres
210-212	Meadow and Grassland	1,696.5	1,656	-40.5
310-314	Arable including temporary grass and 1941 plough up	846	860.7	+14.7
TOTAL		**2,542.5**	**2,516.7**	**-25.8**

***Table 23:* Meadow and Grassland and Arable totals for 1942 taking the 1941 plough up into account**

The acreage of Gardens etc. is higher in the pilot classification. A few areas of orchards and small fruit were the only "gardens" identified from the census whereas a large number of buildings and gardens would have been picked up from the aerial photograph, hence the much higher total for the pilot farms.

The three broadly comparable categories are Meadow and Grassland, Arable and Heath and Rough Grazing. These can be compared on a farm by farm basis to see how closely they agree and the results are shown in Table 24. Farms with zero values for a particular category in both MapInfo and the census are not included in the figures for that category.

	Meadow and Grassland	**Arable**	**Heath (farms with Rough Grazing only)**
MapInfo classification within 10% of census	65.2% (15 farms)	25% (5 farms)	0 farms
MapInfo classification within 20% of census	82.6% (19 farms)	30% (6 farms)	50% (2 farms)
MapInfo classification more than 20% different to census	17.4% (4 farms)	70% (14 farms)	50% (2 farms)
Total Farms	23 farms	20 farms	4 farms

***Table 24:* Comparison of classifications for Meadow and Grassland, Arable and Heath and Rough Grazing categories**

The best agreement is in the Meadow and Grassland category with the pilot classification for 19 farms (82.6%) lying within 20% of the census figures.

However in the Arable category, 70% of the farms differ by more than 20% and half the farms with rough grazing also differ by more than 20%.

If the acreages for the pilot classification are adjusted for the 1941 plough up this makes very little difference to the levels of agreement, as shown in Table 25. The levels of agreement fall slightly in the Meadow and Grassland class by two farms in the 10% category and one farm in the 20% category. In the Arable class the agreement increases a little with 3 more farms in the 10% category and 2 more in the 20% category.

	Meadow and Grassland adjusted for 1941 plough up	Arable adjusted for 1941 plough up
Pilot classification within 10% of census	56.5% (13 farms)	40% (8 farms)
Pilot classification within 20% of census	78.3% (18 farms)	40% (8 farms)
Pilot classification more than 20% different to census	21.7% (5 farms)	60% (12 farms)
Total farms	23 farms	20 farms

Table 25: ***Comparison of classifications for Meadow and Grassland and Arable categories adjusted for the 1941 plough up***

The figures used for 1941 almost certainly overestimate the actual acreages ploughed up due to the uncertainty in identifying parts of fields which may explain the poor agreement in the Arable category even after adjustment.

Section E of the Primary Return form should, in theory, provide a useful source of additional information as this is where the surveyor's comments were recorded. In some cases the acreage for grass and arable is simply listed, as for farm XE 218/89/003 where the entry reads "arable 9, grass 36, total 45." This agrees exactly with the June 1941 census return. However the entry for farm XE 218/89/007 shows "arable 51, permanent grass 75, total 126." This is different from the census return which shows 50.75 acres arable and 68 acres grass, which together total 118.75 acres. Furthermore the acreage shown on the front of the Primary Return is only 123. Overall for the

23 pilot farms the comments in section E were at variance with the census figures in 8 cases. In the case of farm XE 218/89/034 the Primary Return appears to be at variance with itself. Section E records that the farmer was "compelled to plough up two fields." However there is no information recorded about these fields under Plough Up 1940 or Plough Up 1941.

The classification on a farm by farm basis produced some very mixed results. Whilst the land use totals tended to agree very well overall, there were significant differences when the data were examined on a farm by farm basis. The Arable category proved extremely problematic and this was compounded by difficulties in identifying temporary grass and parts of fields ploughed up. Inconsistencies within the NFS data further exacerbated the problem.

Evaluation of Barcombe Parish

The second stage of the evaluation was to look at every polygon within Barcombe to see how the 1940 land use classification compared with the 1931 totals for the same area (Figure 84). The comparison was made with the 1931 one inch maps as these were the "corrected" version of the field sheets.

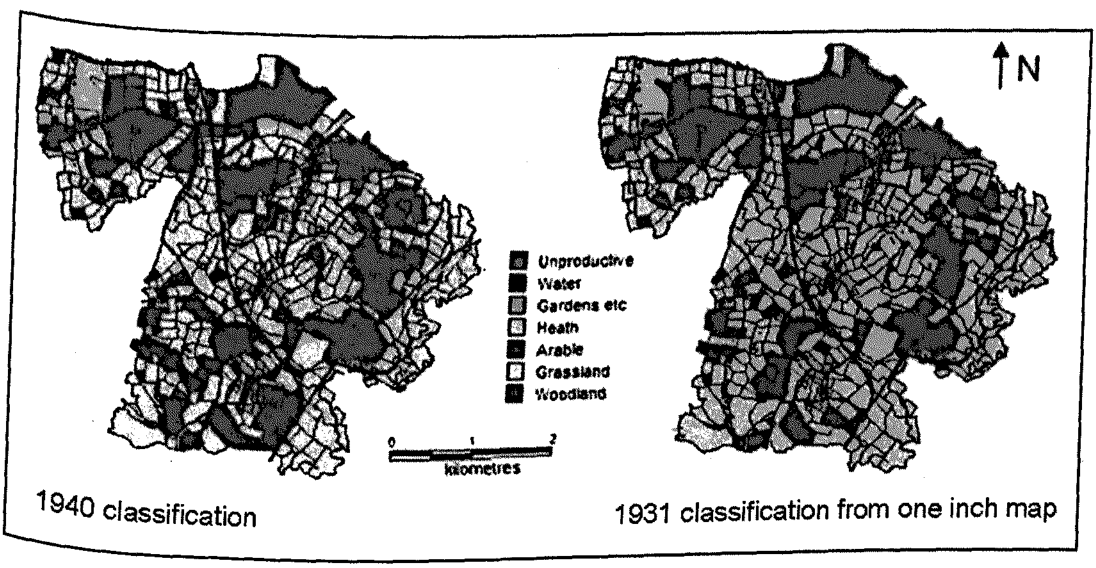


Figure 84: Comparison of the 1931 and 1940 classifications for part of Barcombe

The most obvious change between the two maps is that the amount of Arable has increased at the expense of Meadow and Grassland in 1940. This is borne out by the land use figures shown in Table 26.

Land Use Classification	**Category**	**1931 One Inch Map (Acres)**	**1940 Classification (Acres)**	**Differences (Acres)**
100-112	Forest and Woodland	717.96	711.22	-6.74
200-212	Meadow and Grassland	2,467.03	2,140.62	-326.41
300-314	Arable (including temporary grass)	503.35	756.12	+252.77
400-412	Heath (including rough grazing)	75.12	122.79	+47.67
500-512	Gardens etc.	112.19	139.17	+26.98
600-612	Water	59.9	52.14	-7.76
700-712	Unproductive	119.55	132.84	+13.29
TOTAL		**4,055.1**	**4,054.9**	

Table 26: ***Comparison of land use in 1931 and 1940 for part of Barcombe***

The amount of Arable land has increased by 252.77 acres between 1931 and 1940 with a corresponding drop of 326.41 acres in Meadow and Grassland. The acreage of Heath and Rough Grazing has increased considerably from 75.12 to 122.79. However it is interesting to note that the acreage of Heath and Rough Grazing identified on the 1931 field sheets was 109.22 which is much closer to the 1940 figure.

The results for Barcombe as a whole are much as would be expected given that increased Arable production was being strongly "encouraged" by the time the NFS was conducted. This suggests that the interpretation of the aerial photograph was broadly correct, although the process is necessarily somewhat subjective.

Classifying Land Use for the Whole Study Area in 1940

As with the pilot area, the classification of the whole study area was undertaken in two stages. Firstly each of the remaining farms was classified in turn. Information from the census form and Primary Return was summarised into the spreadsheet in the Farms Masterlist. This allowed the acreages for each type of land use, together with information such as plough up and derelict fields to be seen at a glance. The existence of temporary grass and rough grazing was also noted.

The polygons relating to each farm reference number were then identified in MapInfo using an SQL query. Any plough up polygons were identified and coded first, and the *Digimap* website was used to help to resolve any queries. Derelict fields which had OS parcel numbers associated with them were also located and coded as Unproductive at this stage. However some polygons were still not found. For example, farm XE 218/101/002 has field 199 listed under the 1941 plough up. No field with this number was found within the farm extent either in MapInfo or using the County series maps on the *Digimap* website. There was a field numbered 899 within the farm extent and the number could have been miscopied. However there was also a field 199 within the extent of farm XE 218/101/020 which was nearby. No acreage was given for the plough up and so there were no other clues to allow this field to be identified with any certainty. It was therefore noted as a query in the Farms Masterlist and neither field was coded as a plough up in MapInfo.

As with Barcombe a further difficulty with the plough up for the whole area was that so many farms had part fields noted for plough up with no indication of which part of the field or the acreage ploughed up. Of the 74 farms which ploughed up land in 1940 or 1941 (or both) 48 of these had "part" fields listed. Only 20 farms had plough up fields which could be securely identified as they were complete fields. 6 farms were incomplete and so the plough up polygons fell outside the study area. The plough ups for the whole study area for 1940 and 1941 are shown in Figure 85. Polygons which can be securely identified are shown in the solid colour whereas polygons which were only partly ploughed up are depicted in the paler shading.

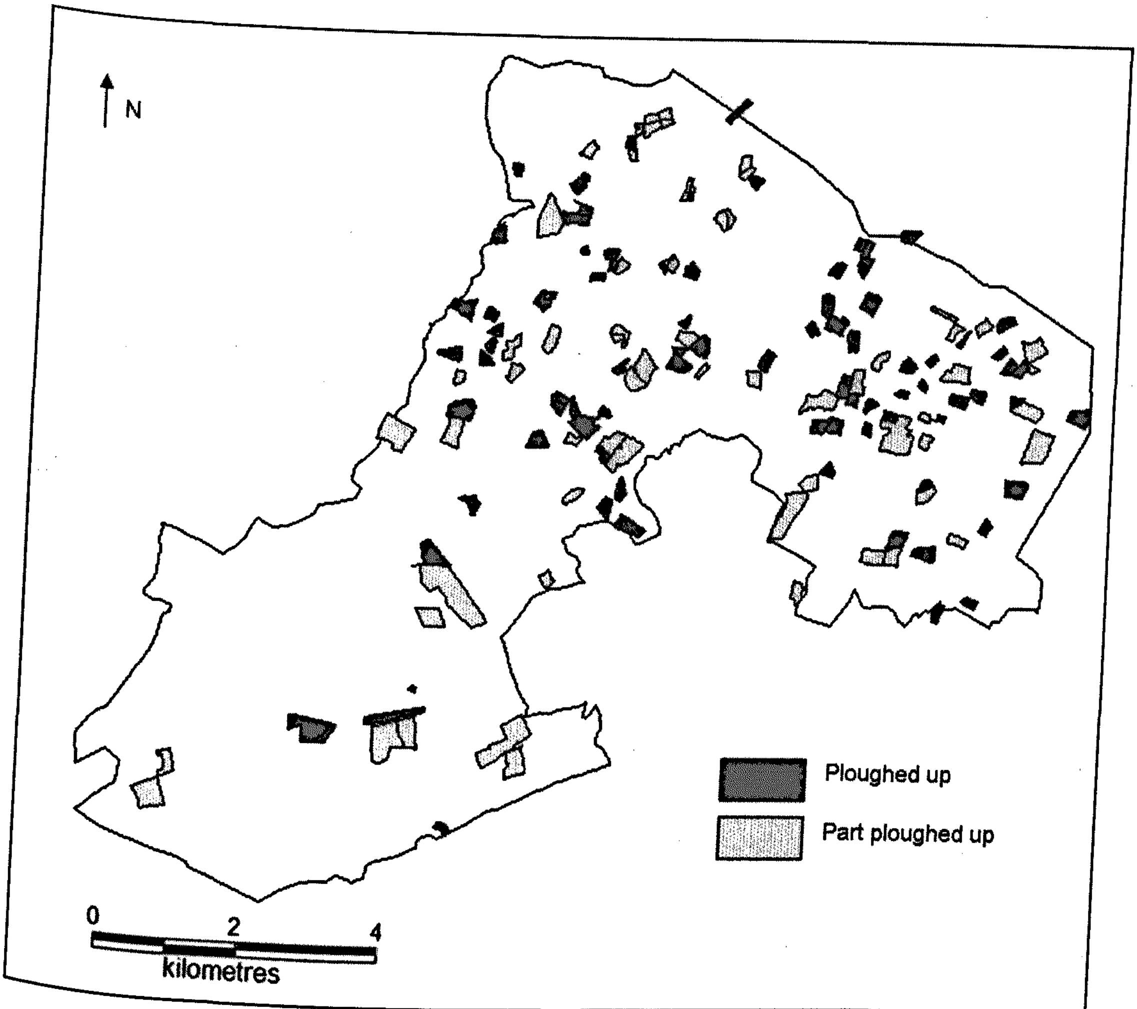


Figure 85: Plough up polygons for the whole study area for 1940 and 1941
Source: TNA MAF 32

Once the plough up and derelict fields had been identified the rest of the farm polygons were coded from the aerial photograph. As with Barcombe the OS base maps and 1931 LUS classifications were used to assist in the "best guess" process if the class was initially unclear. Once every polygon belonging to a particular farm had been coded the farm table (originally identified by SQL query) was exported into Excel as a DBF and saved under the farm reference number. The data were then sorted and totals for each category noted in the Farms Masterlist. These were then compared to the summary information from the NFS. If there were large discrepancies or, for example, areas of temporary grassland had not been found, the classification was rechecked and amended if necessary.

When the farms had all been completed and entered into the Farms Masterlist for evaluation the remaining polygons were identified, again using an SQL query, and coded appropriately.

Finally the entire classification table was exported into Excel. It was sorted by farm reference and all farms were checked against the Farms Masterlist to ensure that they were the same and that no farms were missing. The table was also sorted by land use code to check that no anomalous codes had been entered.

Once the classification had been completed the data were evaluated as for Barcombe and the results calculated.

The Results for the Whole Study Area

In terms of evaluating the internal consistency of the data only the 98 complete farms as shown in Table 16 above were included. As before the Primary Return acreage and the total of crops and grass plus rough grazing from the census form were evaluated first and these were compared to the totals obtained by Short *et al* (2000). The results are shown in Table 27 and are cumulative, so that, for example, the total number of farms within 10% includes all the farms where the totals agree exactly.

	Results for Study Area	**Short *et al* (2000, p172) Sussex Sample**	**Short *et al* (2000, p172) National Sample**
Census and Primary Return acreage agree exactly	30.6% (30 farms)	30.2%	33.9%
Census within 10% of Primary Return acreage	81.6% (80 farms)	56%	60.2%
Census within 20% of Primary Return acreage	87.8% (86 farms)	67.5%	71%

Table 27: ***Primary Return and census acreages compared for the whole study area***

The percentage of farms in the study area where the totals agree exactly is 30.6% which is strikingly similar to the total that Short *et al* obtained for the Sussex sample. However the percentages with 10% and 20% agreement for the study area are considerably higher than those obtained by Short *et al*. One reason for this could be the exclusion of the five farms which lost land to the military. Even if these farms are included in the calculations the percentages drop very little – farms within 10% becomes 79.6% (82 farms) and within 20% changes to 85.4% (88 farms).

There were 12 farms where the discrepancy between acreages was more than 20%. Of these, the farm size as per MapInfo was less than 10 acres for three holdings and between 10 and 49.9 acres for eight holdings. As previously noted a small acreage difference represents a large percentage difference where the total farm size is relatively low and this may account for the high number of smaller farms with large discrepancies.

For the purposes of comparison the size distribution of all 98 complete farms (based on the acreage in MapInfo) is shown in Figure 86. The mean farm size is 87.9 acres, the largest farm occupies 522.1 acres and the smallest holding just 5.69 acres (farms of under 5 acres were not included in the NFS).

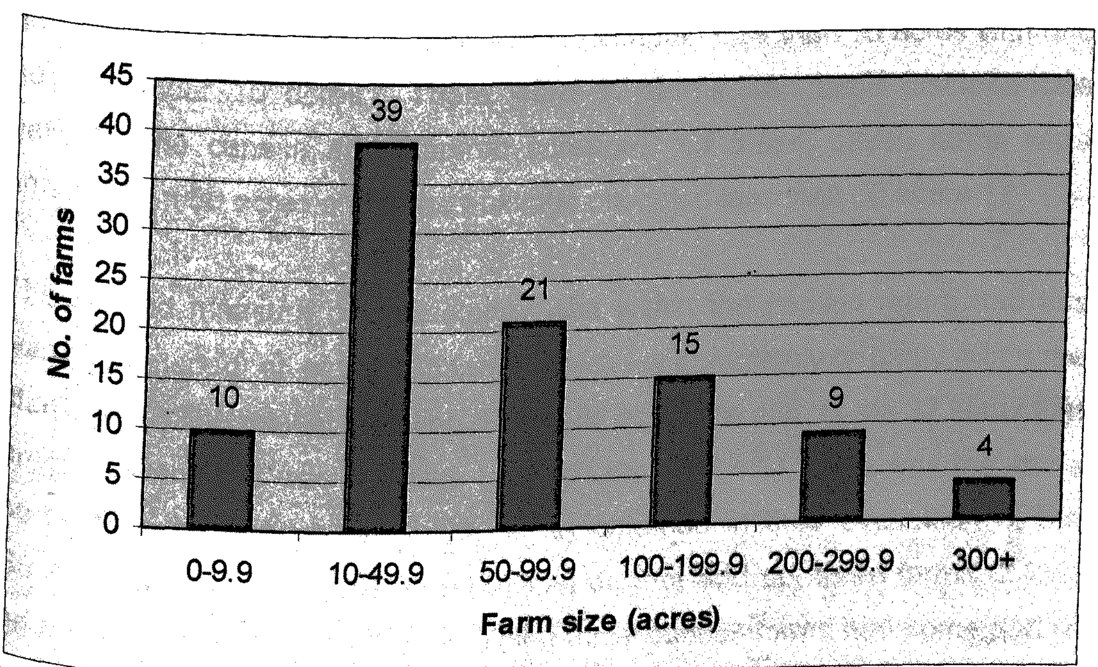


Figure 86: Complete farms in the whole study area by farm size

The largest absolute difference in acreage was farm XE 218/98/001 where the Primary Return showed a total of 364 acres (312 + 52 rough grazing) and the census total was 600 acres (300 + 300 rough grazing). In this case if the rough grazing is disregarded the remaining totals are very close. Secondly, as for Barcombe, the Primary Return and census acreages were compared to the acreages calculated in MapInfo for each of the 98 complete farms as shown in Table 28.

Primary Return and MapInfo acreage agree exactly	1% (1 farm)	Census and MapInfo acreage agree exactly	None
Primary Return within 10% of MapInfo acreage	71.4% (70 farms)	Census within 10% of MapInfo acreage	63.3% (62 farms)
Primary Return within 20% of MapInfo acreage	89.8% (88 farms)	Census within 20% of MapInfo acreage	82.7% (81 farms)
Primary Return and MapInfo acreage differ by over 20%	10.2% (10 farms)	Census and MapInfo acreage differ by over 20%	17.3% (17 farms)

Table 28: ***Comparison of the acreages calculated in MapInfo with the census and Primary Return acreages for the whole study area***

In almost three quarters of cases the Primary Return acreage was within 10% of the MapInfo acreage. The agreement with the census was generally less good with only 63.3% of farms where the acreage was within 10%. 10 farms had large discrepancies between the Primary Return and MapInfo acreage and in terms of size, five of these farms occupied less than 50 acres with one holding under 10 acres. There were 17 farms with large discrepancies between the census and MapInfo acreage. Of these, seven farms were smaller than 50 acres and three holdings occupied less than 10 acres.

The second measure of consistency was within the census return and this was evaluated for all of the 135 farms which lay completely or partly within the study area. The total at question 33 should equal the sum of the 32 items that precede it and this was the case for 118 farms (87.4%). This was the same percentage as Short *et al* (2000, p132) obtained in their evaluation of the Sussex Sample. 11 of the farms (8.1%) did not add up, three farms (2.2%) had no census forms and the remaining three census forms had some sort of anomaly. The next stage was to compare the land use totals as summarised from the NFS forms to the totals obtained by classifying the farms in MapInfo. This analysis was, again, conducted using only the 98 complete farms and the results are shown in Table 29.

Land Use Class	Category	NFS Classification (acres)	MapInfo Classification (acres)	Difference (acres)
120-121	Forest and Woodland	-	79.9	+79.9
220-221	Meadow and Grassland	5,168	5,151.2	-16.8
320-332	Arable including temporary grass	3,046.6	2,579.6	-467
420-421	Heath and Rough Grazing	699.9	338.9	-361
520-521	Gardens etc.	115.9	288.4	+172.5
620-621	Water	-	51.1	+51.1
720-721	Unproductive (derelict fields on Primary Return	27.2	102.6	+75.4
		9,057.6	8,591.7	-465.9

Table 29: Total acreage of each type of land use for the 98 complete farms

The Meadow and Grassland total was a very close match with a difference of only 16.8 acres. The largest difference was in the Arable category with the MapInfo classification having 467 fewer acres than the NFS. The NFS Heath category was also considerably higher than the MapInfo classification with a 361 acre difference. The Gardens etc. and Unproductive classes both had higher acreages in the MapInfo classification than the NFS. The difference in total acreage between the two classifications was 465.9 which represents a difference of 5.1% of the NFS total.

One reason for the large difference in the Arable figure could have been the 1941 plough up. Within the 98 complete farms, 422.4 acres which had been classified as Meadow and Grassland from the 1940 aerial photograph were recorded as ploughed up in 1941. However it must be noted that this acreage figure is almost certainly too high as it does not take account of parts of fields ploughed up – the entire field is included. If the results are adjusted using the figure of 422.4 acres, adding this to Arable and subtracting it from Meadow and Grassland the results are as shown in Table 30.

Land Use Class	Category	NFS Classification (acres)	MapInfo Classification (acres)	Difference (acres)
120-121	Forest and Woodland	-	79.9	+79.9
220-221	Meadow and Grassland	5,168	4,728.8	-439.2
320-332	Arable including temporary grass	3,046.6	3,002	-44.6
420-421	Heath and Rough Grazing	699.9	338.9	-361
520-521	Gardens etc.	115.9	288.4	+172.5
620-621	Water	-	51.1	+51.1
720-721	Unproductive (derelict fields on Primary Return	27.2	102.6	+75.4
		9,057.6	8,591.7	-465.9

Table 30: Total acreage of each type of land use adjusted for the 1941 plough up

In this instance the agreement in the Arable category is much closer whereas the largest difference is now between the NFS and MapInfo classifications for Meadow and Grassland at 439.2 acres. The MapInfo classification identifies 172.5 acres more Gardens etc. than the NFS and this may account for some of the discrepancy in the Meadow and Grassland totals. It is possible that some areas were counted as Meadow and Grassland on the NFS but Gardens in the MapInfo classification. An example of this is farm XE 218/110/069. Section E of the Primary Return describes the farm as "small park divided into paddocks round private residence." The census form shows the whole holding as Meadow and Grassland whereas the MapInfo classification includes 10 acres of Gardens etc.

The Meadow and Grassland, Arable and Heath and Rough Grazing categories were also evaluated on a farm by farm basis to see if just a few farms accounted for the differences or whether they were spread evenly between them. Farms with zero acreage for a category in both the NFS and MapInfo classifications have not been included in that category. The results are shown in Table 31.

	Meadow and Grassland	**Arable**	**Heath and Rough Grazing**
MapInfo classification within 10% of census	39.6% (36 farms)	25% (21 farms)	16.7% (4 farms)
MapInfo classification within 20% of census	68.1% (62 farms)	36.9% (31 farms)	33.4% (8 farms)
MapInfo classification more than 20% different to census	31.9% (29 farms)	63.1% (53 farms)	66.6% (16 farms)
Total number of farms	91 farms	84 farms	24 farms

Table 31: Differences between the MapInfo acreage and the NFS acreage on a farm by farm basis

The MapInfo classification is within 20% of the census classification for just over two thirds of farms in the Meadow and Grassland category. However the 20% agreement level in the Heath and Rough Grazing and Arable categories is much poorer at just over one third of farms. The totals for each farm were then adjusted for the 1941 plough up (polygons which changed from Meadow and Grassland to Arable) to see if this would improve the level of agreement in the Arable category. Again it must be emphasized that this is probably an over-adjustment as much of the plough up cannot be accurately identified. The results are shown in Table 32.

	Meadow and Grassland	Arable
Adjusted MapInfo classification within 10% of census	40.7% (37 farms)	25% (28 farms)
Adjusted MapInfo classification within 20% of census	60.4% (55 farms)	36.9% (38 farms)
Adjusted MapInfo classification more than 20% different from census	39.6% (36 farms)	63.1% (46 farms)
Total number of farms	91 farms	84 farms

Table 32: Differences between the MapInfo acreage and the NFS acreage on a farm by farm basis adjusted for the 1941 plough up

Adjusting the figures for the plough up has improved the 20% level of agreement for Arable by 7 farms. However the Arable figures for almost two thirds of farms still differ by over 20%. The 20% agreement level for Meadow and Grassland falls by 7 farms when the figures are adjusted but is still just over 60%.

It was decided to map the 36 farms with a large discrepancy between the Meadow and Grassland figures (adjusted) to see if any spatial pattern was evident. The results are shown in Figure 87. The farms with a discrepancy of over 20% are shown in blue and the remaining farms are shaded green. The military area is shaded red and the parish boundaries are denoted by a dotted black line.

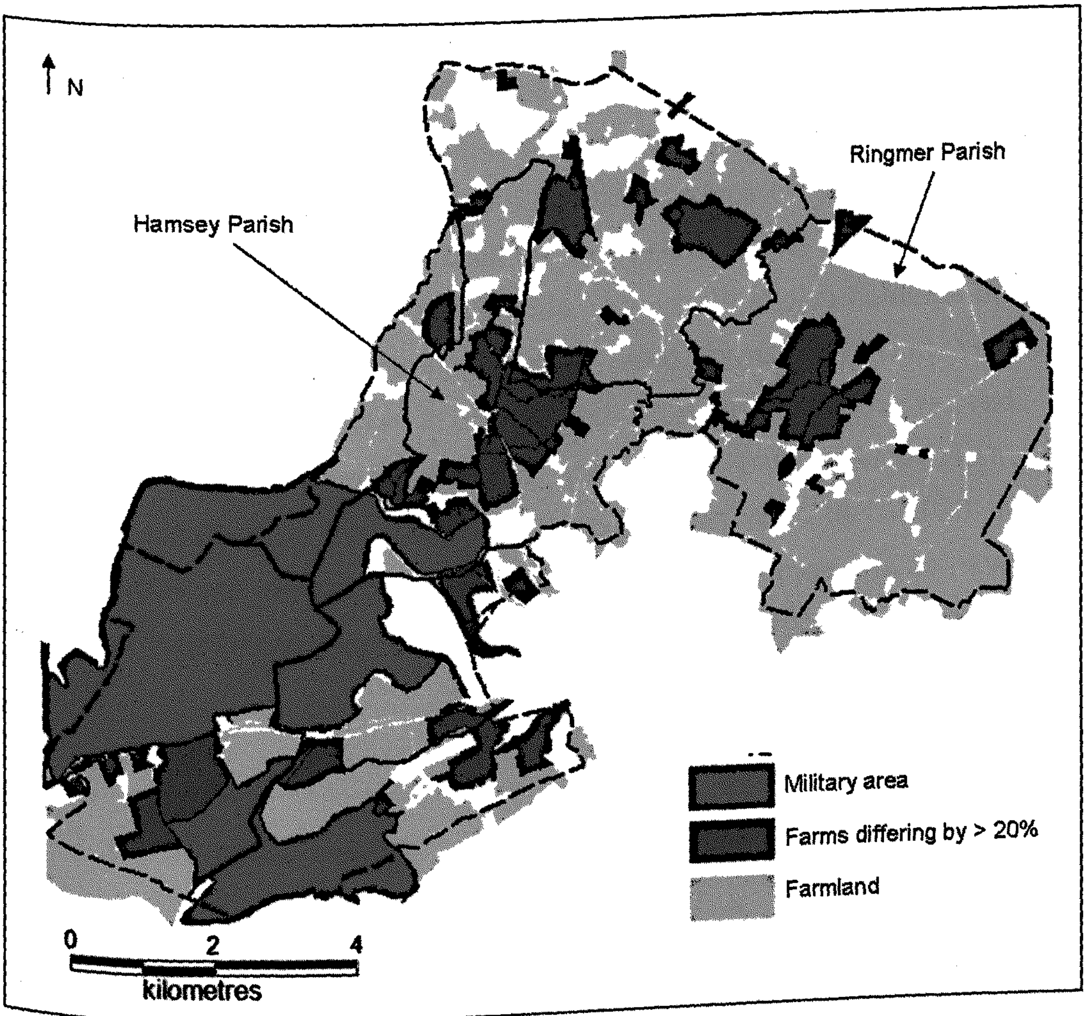


Figure 87:* *Map showing farms shaded in blue where the adjusted Meadow and Grassland total differed by more than 20%
Source (military area): TNA MAF 73

There appear to be two clusters of highly differing farms, the first in Hamsey parish and the second, smaller cluster in Ringmer. J.L. Halliday surveyed much of Hamsey whilst H. Cawley covered most of Ringmer, and so the difficulty does not seem to lie with one particular surveyor. Several of the differing farms also directly abut the military area, which suggests that requisitioned land could be the cause for the discrepancy in acreage.

In the light of the significant discrepancies in acreage in some categories for the 1940 classification it was decided to also evaluate the 1945/7 figures on a farm by farm basis to see if there was better agreement. This will be described in the next chapter.

Farm Grading

One of the most controversial aspects of the NFS was the grading of the management of each farm which is shown in section D of the Primary Return and it was felt that it might be useful to briefly examine this. Within the study area, grades were available for all but two of the farms, where their Primary Returns were missing from the records. Figure 89 shows holdings coloured by their management grading, with A rated farms shown in Yellow, B (including B+ and B-) shown in orange and C graded farms coloured red. The two farms without Primary Returns are shaded blue. Where farms are grouped together on the map (for instance farms XE 218/101/023 and XE 218/101/024 are always grouped together on the NFS map and so have been captured together in MapInfo), the grading for the first listed farm has been used.

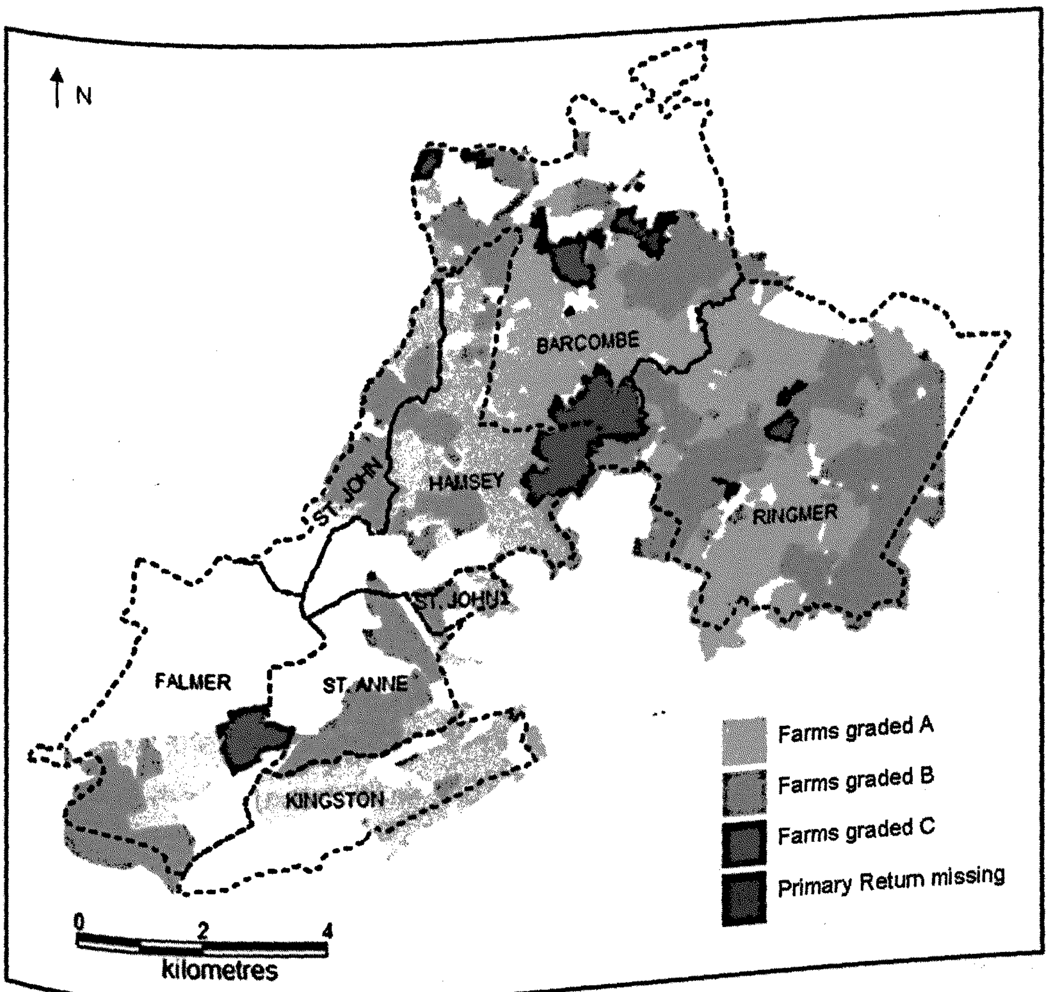


Figure 88: Farms in the study area shaded by their grading
Source: *TNA MAF 32*

Of the 133 farms where the grading is known, 57 were classed as A, 68 were graded B and 8 were classed as C. Of the B graded farms, 14 were classed as B+ and 6 as B-. Three parishes, St John, St Anne and Kingston had no C rated farms at all and Kingston had only two B rated farms. Most of the C graded farms are in the wealden area to the north of the study area with only one failing farm near the Downs in Falmer. This is, perhaps, unsurprising given the poorer quality of the land in the Weald, although the grading should relate to farm management rather than to the quality of the farm itself.

Table 33 shows the relationship between farm grading and farm size.

Farm size	**A graded**	**B graded**	**C graded**
<20 acres	13	15	1
20-50 acres	13	18	3
50-100 acres	7	16	1
100-150 acres	8	6	1
150-300 acres	11	10	1
>300 acres	5	3	1
TOTAL	**57**	**68**	**8**

Table 33: The relationship between farm grading and farm size

Over half of the farms which are A graded are under 100 acres as are three quarters of the B graded farms and over half of the C graded farms.

Land Use for the Whole Study Area

The final stage in processing the results for 1940 was to look at the land use classification for all polygons. The totals are shown in Table 34 and illustrated in Figure 89 .

Land Use Class	**Category**	**1940 classification (acres)**
110-112	Forest and Woodland	1,554.96
210-212	Meadow and Grassland	9,221.04
310-314	Arable including temporary grass	5,445.06
410-412	Heath and Rough Grazing	3,978.03
510-512	Gardens etc.	749.19
610-612	Water	184.28
710-712	Unproductive (derelict fields on Primary Return)	670.67
TOTAL		**21,803.23**

Table 34:* *Land use totals for the whole study area for 1940

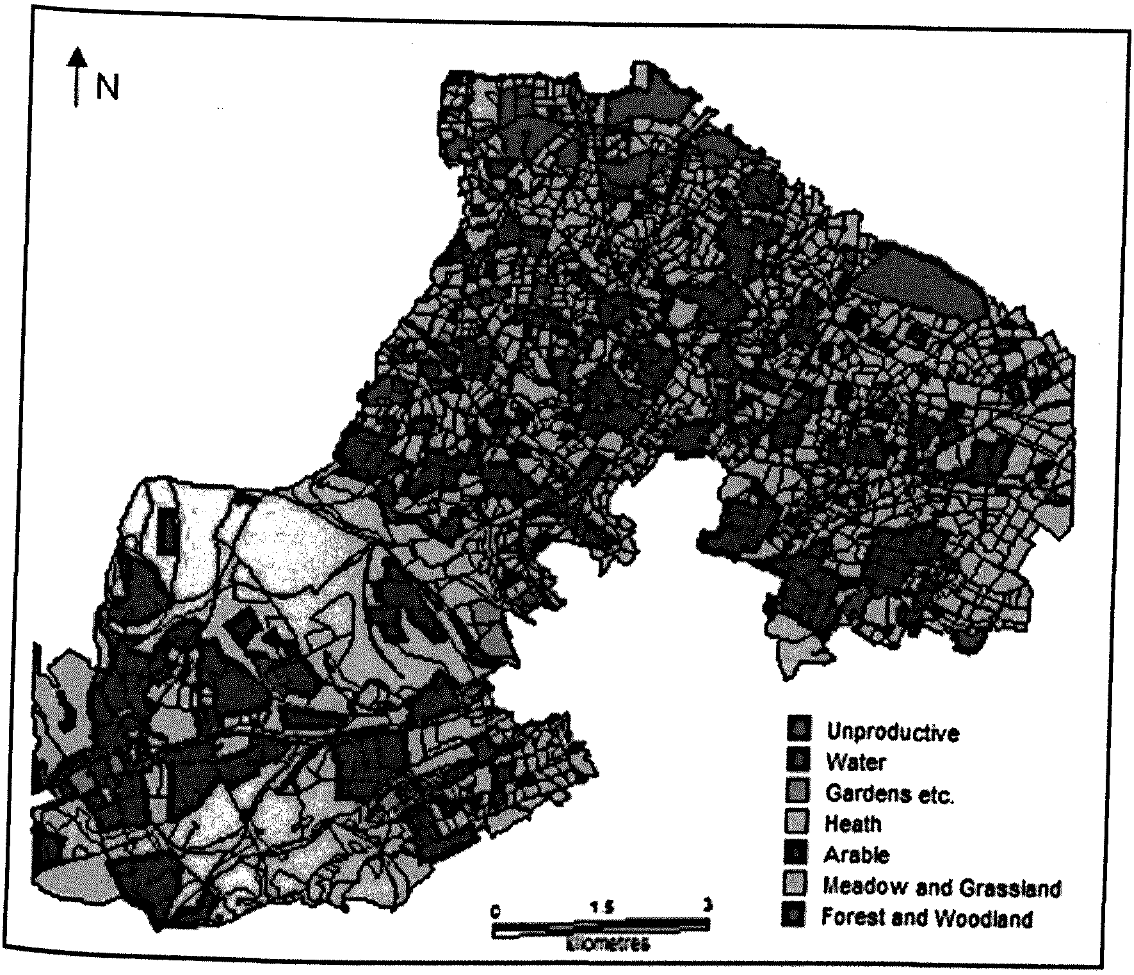


Figure 89: Land use in 1940 for the whole study area

In Chapter 7 changes in land use over time will be discussed and so the results for the whole study area will not be considered further here.

Reconstructing the 98 farms from the NFS data proved to be a major challenge due, at least in part, to inconsistencies within the NFS data themselves. This was compounded by the difficulties of interpreting an historic black and white photograph taken at 20,000 feet. However a good agreement was achieved in farm acreage for many farms, and in land use for some farms.

The next chapter describes the processing of the 1945/7 and the 1959 datasets. The farms are reconstructed again from the 1945/7 data to see if a better agreement in land use types can be achieved. In addition the land use for the whole study area is calculated for both 1945/7 and 1959 so that changes over time can be monitored.

CHAPTER 6: THE RAF AERIAL PHOTOGRAPHS 1945-1959

The 1945/7 and 1959 RAF aerial photographs constitute the final two major datasets used in this project.

1945-7 Aerial Photographs

These images are from the RAF survey of Great Britain. This was undertaken between 1945 and 1954 with the purpose of updating the 1935 OS maps (UK Aerial Photos). Some of the images were mosaiced together to create photo sheets at a scale of 1:10560, or six inches to the mile, corresponding to OS map tiles and it is these photo sheets which are being used in this study.

The photo sheets were photocopied at the East Sussex Record Office. These copies were then scanned in sections and each of the 39 sections was imported into MapInfo and registered to the British National Grid in the same way as the preceding datasets. Most of the photographs were taken in August 1947. However two sections were photographed in July 1945 – these are shaded in red in Figure 90.

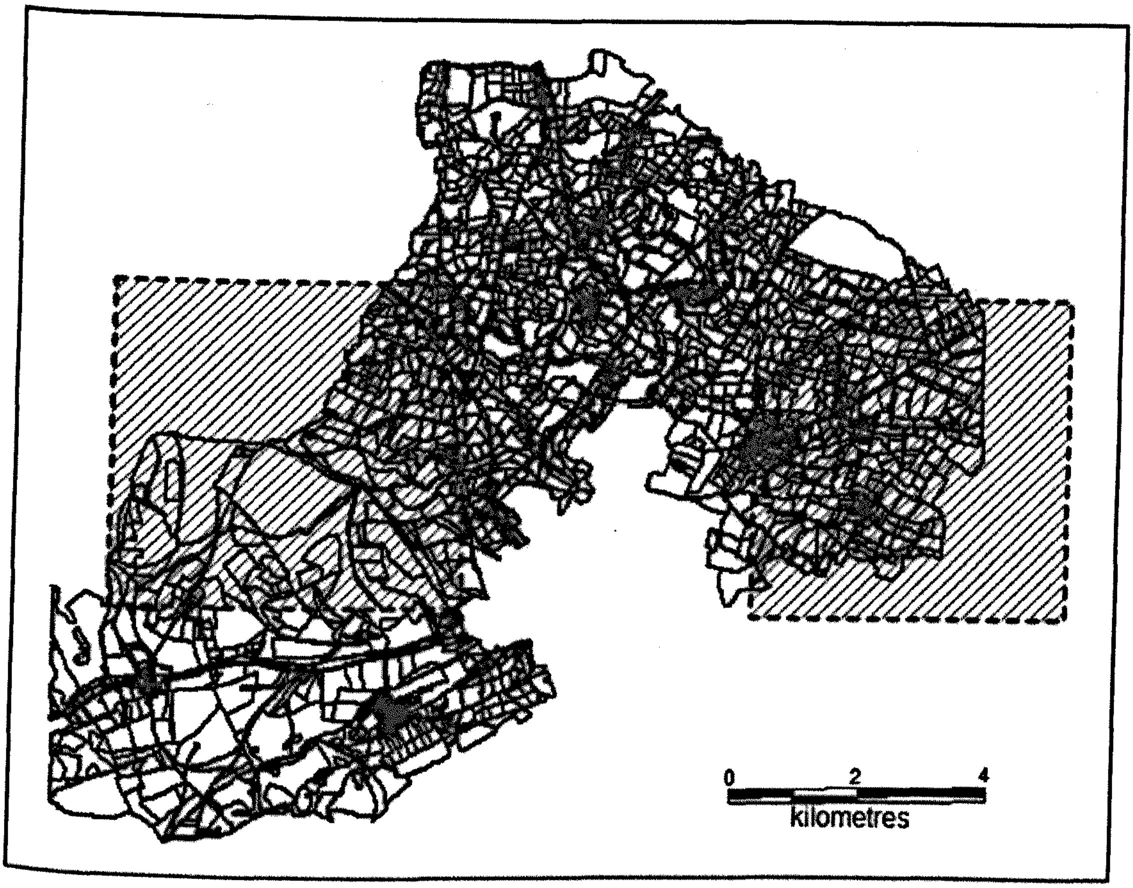


Figure 90: Sections of the study area photographed by the RAF in July 1945 shaded red

As before, the section of Barcombe parish lying within the study area was used as a pilot area and this was evaluated before the whole study area was tackled. In the case of the 1945-7 aerial photographs, codes based around "twenties" were used as shown in Table 35. Again a distinction was maintained between polygons which could be classified clearly from the aerial photograph and those which were a "best guess" where the classification was checked with the OS base map and the land use identified from the Luftwaffe aerial photograph.

Land Use Class	Classified from aerial photo	Classified by "best guess"
Forest and Woodland	120	121
Meadow and Grassland	220	221
Arable	320	321
Heath and Rough Grazing	420	421
Gardens etc	520	521
Water	620	621
Land Agriculturally Unproductive	720	721

Table 35: Codes used for the 1945-7 classification

A copy was created of the 1940 classification and the attribute table was amended for the 1945/7 classification. This meant that the farm references which had been associated with many polygons for 1940 were retained and so each farm extent could be identified. Information recorded for 1945/7 was the field classification, area in acres, area in hectares and comments.

The complete farms in Barcombe parish were classified first. It was felt to be helpful to compare the totals for each farm with the NFS data as had been done with the 1940 classification. The 1940 photograph was taken before the plough up campaign had begun whereas the 1945/7 images were taken after the plough up. There could, therefore, be expected to be better agreement between the later images and the NFS.

Table 36 shows the total acreages for each type of land use for the 23 complete farms in Barcombe compared to the total acreage from the NFS. As with 1940 the largest differences are in the Meadow and Grassland and Arable categories. However this time the Arable total from the aerial photographs is higher whereas the Meadow and Grassland total is lower than the NFS. Very little Heath and Rough Grazing was identifiable from the 1945/7 aerial photograph.

Land Use Class	Category	NFS classification (acres)	Pilot Classification 1945-7 (acres)	Difference (acres)
120-121	Forest and Woodland	-	30.8	+30.8
220-221	Meadow and Grassland	1,696.5	1,595.8	-100.7
320-321	Arable including temporary grass	846	974.2	+128.2
420-421	Heath and Rough Grazing	53.8	6.2	-47.6
520-551	Gardens etc.	8.3	55.1	+46.8
620-621	Water	-	16.6	+16.6
720-721	Unproductive (derelict fields on Primary Return)	8.8	19.3	+10.5
TOTAL		**2,613.4**	**2,698**	**+84.6**

Table 36: Total acreage for each type of land use for the 23 complete farms in Barcombe for 1945/7

Figure 91 shows a comparison of the land use figures from the NFS, 1940 aerial photograph and 1945/7 aerial photographs for Barcombe. It is clear from this that the 1947 Arable totals are higher than both the NFS and 1940 classifications whereas the Meadow and Grassland totals are lower.

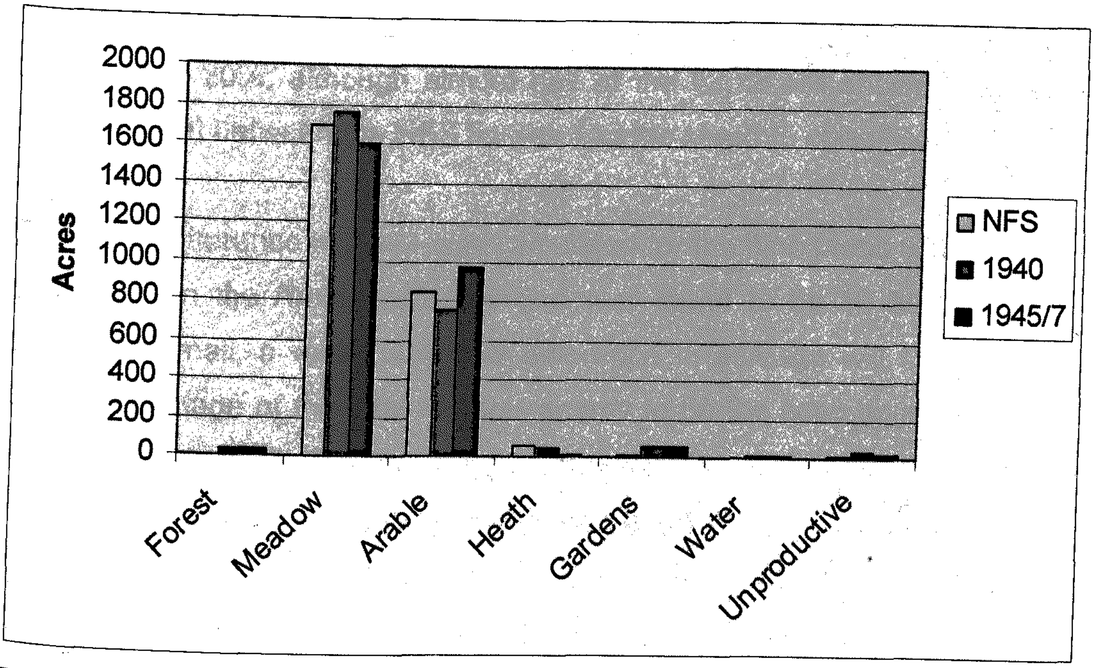


Figure 91: Comparison of acreages for each land use class for Barcombe

The Meadow and Grassland and Arable acreages for each complete farm were compared with the acreages from the NFS to see how well they agreed for 1945/7. The numbers shown are cumulative so that the total of farms with 20% agreement includes farms with 10% agreement. Three farms did not have any Arable recorded by the NFS which is why the comparison only includes the remaining 20 farms.

	Meadow and Grassland	Arable
MapInfo classification within 10% of census	56.5% (13 farms)	35% (7 farms)
MapInfo classification within 20% of census	78.3% (18 farms)	55% (11 farms)
MapInfo classification more than 20% different to census	21.7% (5 farms)	45% (9 farms)
Total Farms	23 farms	20 farms

Table 37: Comparison of classifications for Meadow and Grassland and Arable categories

When the 1940 data were compared to the NFS for Barcombe, 17 farms fell within 20% for Meadow and Grassland but only 6 farms were within 20% for

Arable. In 1947 the agreement in the Arable category almost doubled to 11 farms within 20%, although almost half of the farms still showed significant disagreement between the NFS figures and the MapInfo classification.

The mean difference in acres was calculated for the nine farms with very poor agreement in the Arable category and was found to be 10 acres. Where farms are small, a reasonably low difference in acreage will translate to a large percentage of the total and this seems to be the case here. The mean difference in acres for the poorly agreeing farms in the Meadow and Grassland category was very similar at 10.1 acres.

Whole of Barcombe 1947

Once the complete farms within Barcombe had been classified and evaluated, the remaining polygons within Barcombe were categorised.
Figure 92 is a thematic map showing the 1947 classification compared to the map for 1940.

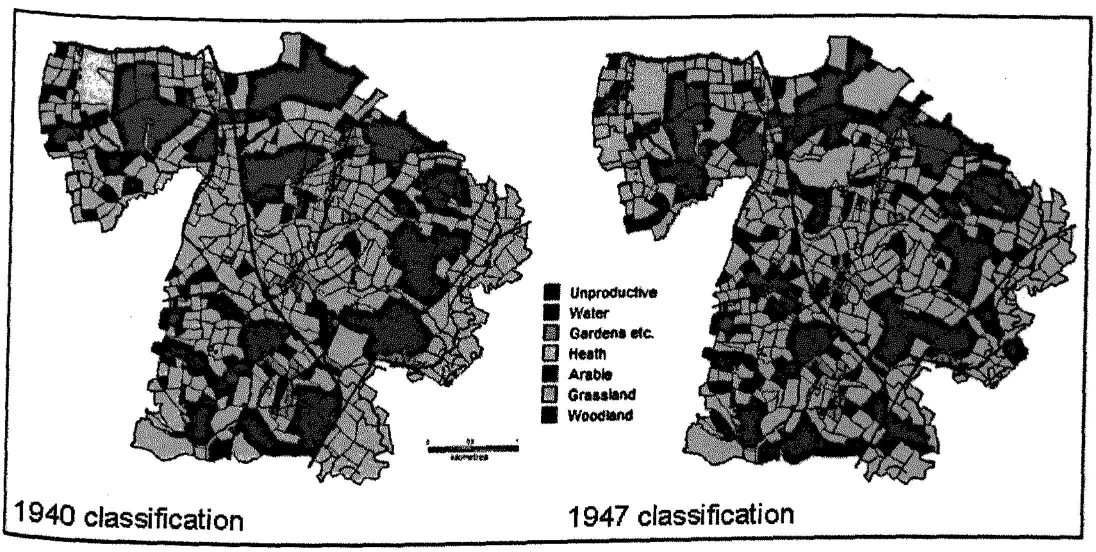


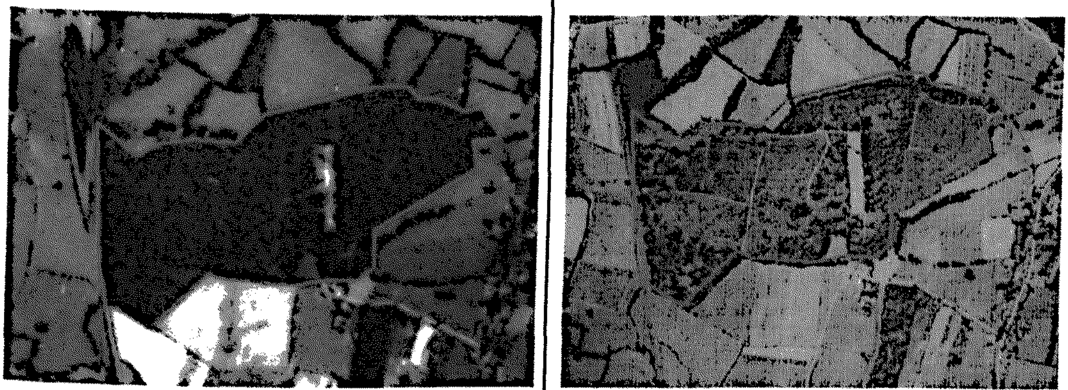
Figure 92: Comparison of the 1940 and 1947 classifications for Barcombe

Table 38 shows the acreage of each type of land use in 1947 and, again, shows the 1940 figures for comparison. The slight differences in area are due to rounding.

Land Use Classification	Category	1940 Classification Acres	1947 Classification Acres	Difference Acres
110-121	Forest and Woodland	711.22	517.18	-194.04
210-221	Meadow and Grassland	2,140.62	1,955.48	-185.14
310-321	Arable (inc. temporary grass)	756.12	1,028.76	+272.64
410-421	Heath and Rough Grazing	122.79	252.2	+192.5
510-521	Gardens etc.	139.17	130.39	-8.78
610-621	Water	52.14	53.02	+0.88
710-721	Unproductive	132.84	120.69	-12.15
TOTAL		**4,054.9**	**4,057.72**	

Table 38: Total area of each type of land use for Barcombe

As with the data for complete farms in Barcombe, there is a substantial rise in Arable land compared with 1940 and a corresponding drop in the area of Meadow and Grassland. Perhaps more surprisingly the amount of Forest and Woodland has decreased by 194.04 acres whilst Heath and Rough Grazing has increased by 192.5 acres. Several of the areas of Forest and Woodland which appeared quite dense on the 1940 image seem to have large patches of more open land within them in 1947. For example, Knowlands Wood, shown in Figure 93, was classified as Forest and Woodland in 1940 whereas in 1947 most of the area was classed as Heath and Rough Grazing. Very little change was found in the remaining land use categories.



Knowlands Wood in 1940 | Knowlands Wood in 1947

Figure 93: Knowlands Wood as shown on the 1940 and 1947 aerial photographs
Source: University of Sussex and East Sussex Records Office

Once the pilot area had been completed and evaluated the remainder of the study area was classified from the 1945 and 1947 aerial photographs.

The Whole Study Area in 1945/7

The study area in 1945/7 was evaluated in two stages, in a similar way to the 1940 and NFS data. Firstly land use totals were calculated for the 98 complete farms, as described in Chapter 5, and these were compared to the NFS data to see if the level of agreement was better than with the 1940 data. Secondly the land use totals for the whole study area were calculated.

The extents for the 98 complete farms were assumed to be the same as those shown on the NFS maps and used for the 1940 comparison. Table 39 presents the totals for each type of land use for these farms in 1945/7 compared to the NFS figures.

Land Use Class	Category	NFS classification acres	MapInfo classification acres	Difference acres
110-112	Forest and Woodland	-	83.75	+83.75
210-212	Meadow and Grassland	5,168	4,269.25	-898.75
310-314	Arable including temporary grass	3,046.6	3,679.28	+632.68

410-412	Heath and Rough Grazing	699.9	183.27	-516.63
510-512	Gardens etc.	115.9	272.14	+156.24
610-612	Water	-	49.94	+49.94
710-712	Unproductive (derelict fields on Primary Return)	27.2	56.91	+29.71
TOTAL		**9,057.6**	**8,594.54**	**-463.06**

Table 39: Totals for each type of land use for the 98 complete farms in 1945/7

The largest differences are in the Meadow and Grassland and Arable categories, with a substantial difference also occurring in the Heath and Rough Grazing category. In 1940 the unadjusted Arable total from the aerial photograph was substantially lower than the NFS totals whereas the 1945/7 Arable total from the aerial photographs is much higher than the NFS, as was the case for Barcombe. This is illustrated by the graph in Figure 94 which shows both the 1940 and 1945/7 totals as compared to the NFS.

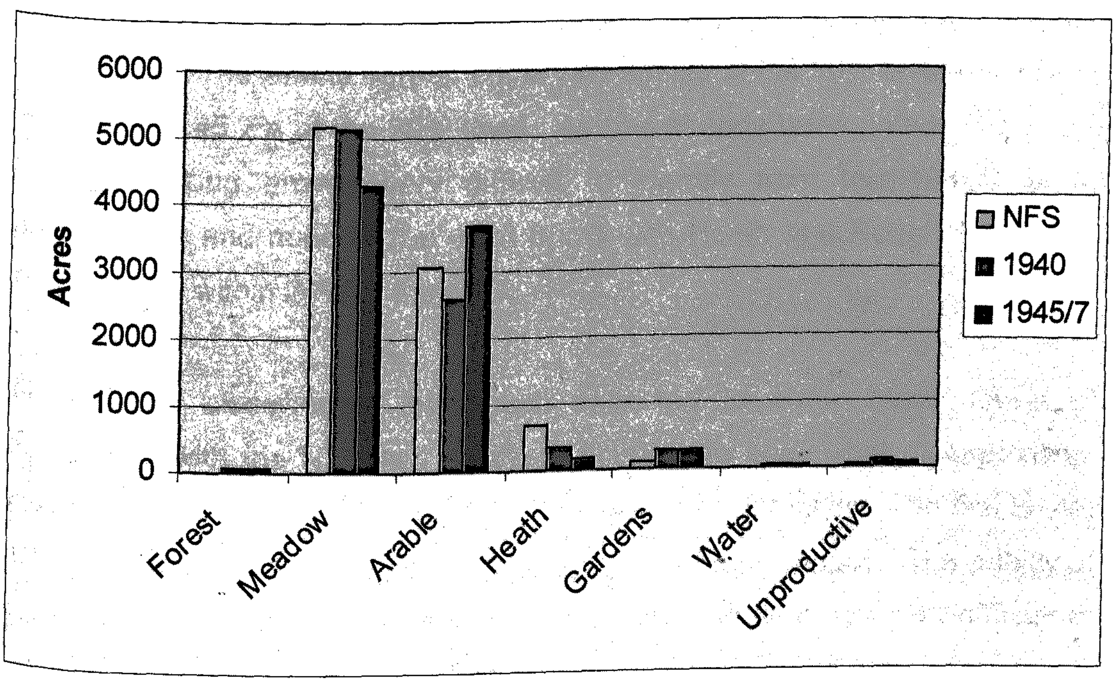


Figure 94: Comparison of acreages for each land use class for the 98 complete farms

If the levels of agreement between the 1945/7 data and the NFS are considered on a farm by farm basis for the three main categories, the results are as shown in Table 40. As before the totals are cumulative and the unadjusted 1940 figures are included for comparison.

	Meadow/ Grassland 1940	**Meadow/ Grassland 1945/7**	**Arable 1940**	**Arable 1945/7**	**Heath 1940**	**Heath 1945/7**
MapInfo classification within 10% of census	39.6% (36 farms)	31.7% (26 farms)	25% (21 farms)	24.7% (18 farms)	16.7% (4 farms)	-
MapInfo classification within 20% of census	68.1% (62 farms)	57.3% (47 farms)	36.9% (31 farms)	45.2% (33 farms)	33.4% (8 farms)	-
MapInfo classification more than 20% different to census	31.9% (29 farms)	42.7% (35 farms)	63.1% (53 farms)	54.8% (40 farms)	66.6% (16 farms)	100% (8 farms)
Total number of farms	91 farms	82 farms	84 farms	73 farms	24 farms	8 farms

Table 40: Differences between the MapInfo acreage and the NFS acreage on a farm by farm basis for 1945/7 and 1940

The 1945/7 classification shows poorer agreement than the 1940 classification in the Meadow and Grassland category at both the 10% and 20% levels. The Arable agreement is very similar at the 10% level but slightly improved to 45.2% at the 20% level. As has already been noted, Heath and Rough Grazing proved very difficult to identify from the 1945/7 aerial photographs and none of the eight farms with Heath and Rough Grazing in 1945/7 were within 20% of the NFS.

The 1945/7 classification had been expected to show better levels of agreement with the NFS and so these figures are somewhat disappointing. However two issues may account for some of the differences. The first is that 1945/7 was classified using photocopies of the original images. The quality of these copies was unfortunately somewhat poor, and so it was very difficult to distinguish between some land use types, especially in the Downland areas. This may account for the particularly poor level of agreement in the Heath and Rough Grazing category.

Secondly, it has already been argued that the Second World War was a time of exceptionally rapid change in agriculture. Significant changes in land use may well have occurred between the time that the NFS was undertaken in 1942/3 and the end of the war when the RAF aerial photographs were taken. Perhaps it is therefore unsurprising that the discrepancy between the NFS data and the aerial photographs remains so high.

Turning to the whole study area in 1945/7, Table 41 shows the land use classifications for all polygons. This is also illustrated by the thematic map in Figure 95.

Land Use Class	**Category**	**1945/7 classification acres**
120-121	Forest and Woodland	1,324.35
220-221	Meadow and Grassland	7,509.13
320-321	Arable including temporary grass	7,022.56
420-421	Heath and Rough Grazing	4,381.05
520-521	Gardens etc.	776.88
620-621	Water	179.52
720-721	Unproductive (derelict fields on Primary Return)	609.68
TOTAL		**21,803.17**

Table 41:* *Land use totals for whole study area for 1945/7

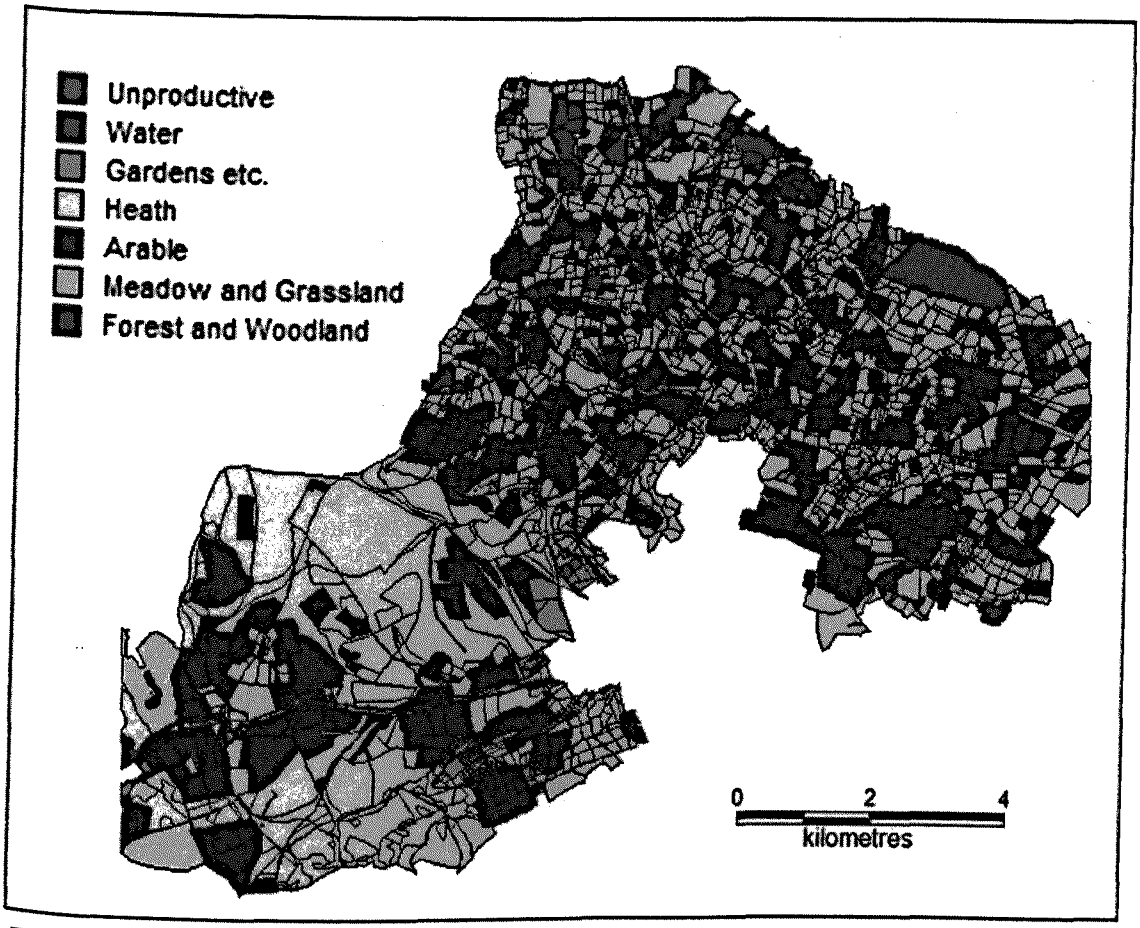


Figure 95: Land use in 1945/7 for the whole study area

The results for the whole study area will be discussed further in Chapter 7.

In the light of the particular difficulties encountered with the 1945/7 aerial photographs, the land use classes for this dataset were double checked for consistency when the 1959 data were classified. Each polygon was revisited with the 1940, 1945/7 and 1959 land use codes visible. If the polygon had the same land use type in 1940 and 1959 but a different classification in 1945/7, the polygon was rechecked and amended if necessary. The figures presented in the section above represent the checked and corrected results.

1959 Aerial Photographs

The final dataset used in this project consists of a series of 1959 RAF aerial photographs. These are oblique photographs taken as a series of strips in June and July 1959. The images were mainly obtained from the Geography Resource Centre at the University of Sussex with five missing photographs covering the centre of the study area being purchased from English Heritage. All the images were already scanned. Two small areas of land at the extreme edges of the study area were not covered by the images held. These are shown edged and hatched in red in Figure 96. In the very few cases where a complete polygon was outside the area covered by the aerial photographs, the 1947 land use was assumed to have continued to 1959 but the polygon was coded as a "best guess."

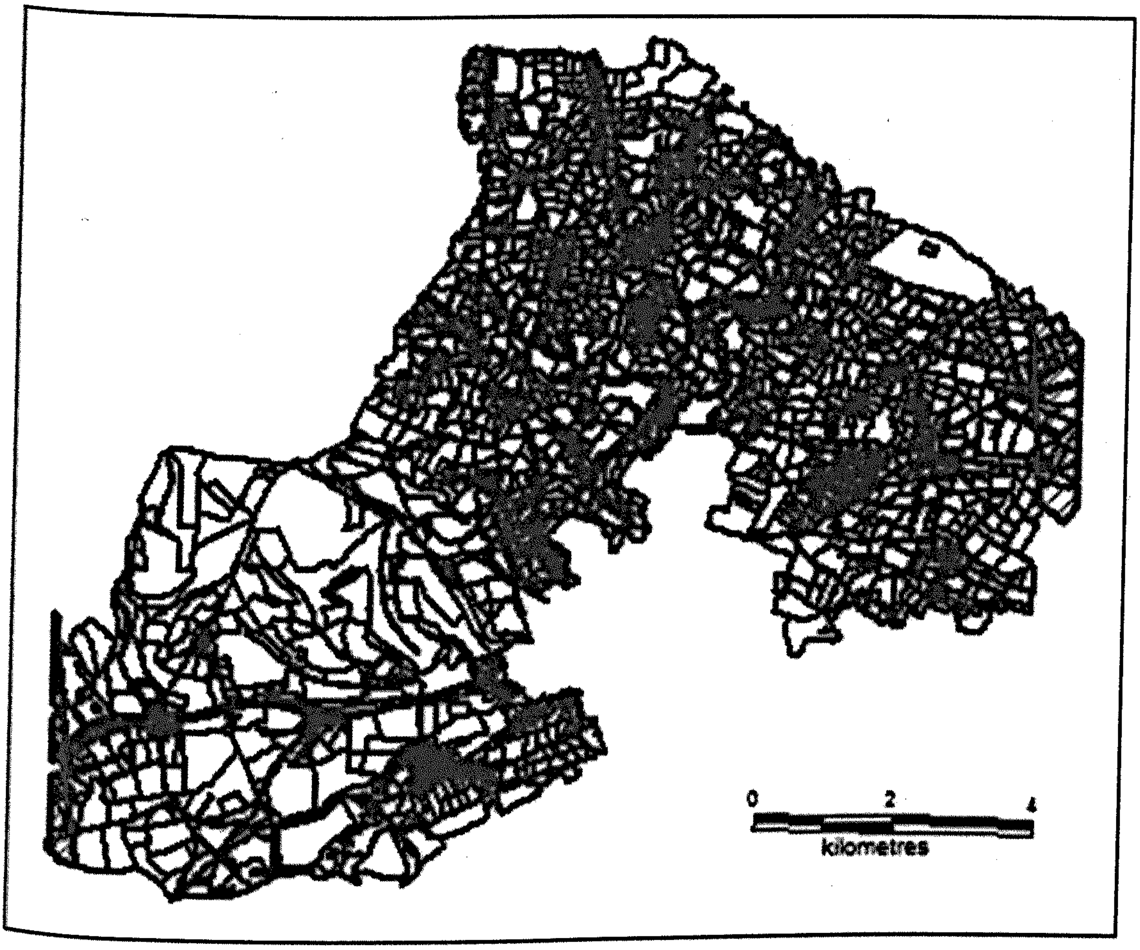


Figure 96: Areas of land not covered by the 1959 aerial photographs

Each scanned image was imported into MapInfo and registered to the British National Grid. A copy was created of the 1945/7 polygon layer as this was the most nearly contemporary and so the field shapes were likely to be most similar to 1959. The associated attribute table was modified to include the 1959 land use classification, area in acres and in hectares. Land use codes for 1959 were based around "thirties" as shown in Table 42 and, once again, included a "best guess" code where the classification was less certain.

Land Use Class	**Classified from aerial photo**	**Classified by "best guess"**
Forest and Woodland	130	131
Meadow and Grassland	230	231
Arable	330	331
Heath and Rough Grazing	430	431
Gardens etc	530	531
Water	630	631
Land Agriculturally Unproductive	730	731

Table 42: Codes used for the 1959 classification

As usual the pilot area, comprising part of the parish of Barcombe, was classified and evaluated first. The results are shown in Table 43 below with the 1945/7 figures included for comparison. The slight difference in acreage between the two classifications is due to rounding.

Land Use Classification	Category	1945/7 Classification Acres	1959 Classification Acres	Difference Acres
120-131	Forest and Woodland	517.18	639.91	+122.73
220-221	Meadow and Grassland	1,955.48	1,316.69	-638.79
320-331	Arable	1,028.76	1,622.37	+593.61
420-431	Heath and Rough Grazing	252.2	149.59	-102.61
520-531	Gardens etc.	130.39	156.84	+26.45
620-631	Water	53.02	52.70	-0.32
720-731	Unproductive	120.69	117.41	-3.28
TOTAL		**4,057.72**	**4,055.5**	

Table 43: Comparison of land use for part of Barcombe in 1945/7 and 1959

The largest drop between 1945/7 and 1959 was in the acreage of Meadow and Grassland with a correspondingly large rise in the acreage of Arable land. The increase in Arable land is quite striking when the thematic maps for 1945/7 and 1959 are compared.

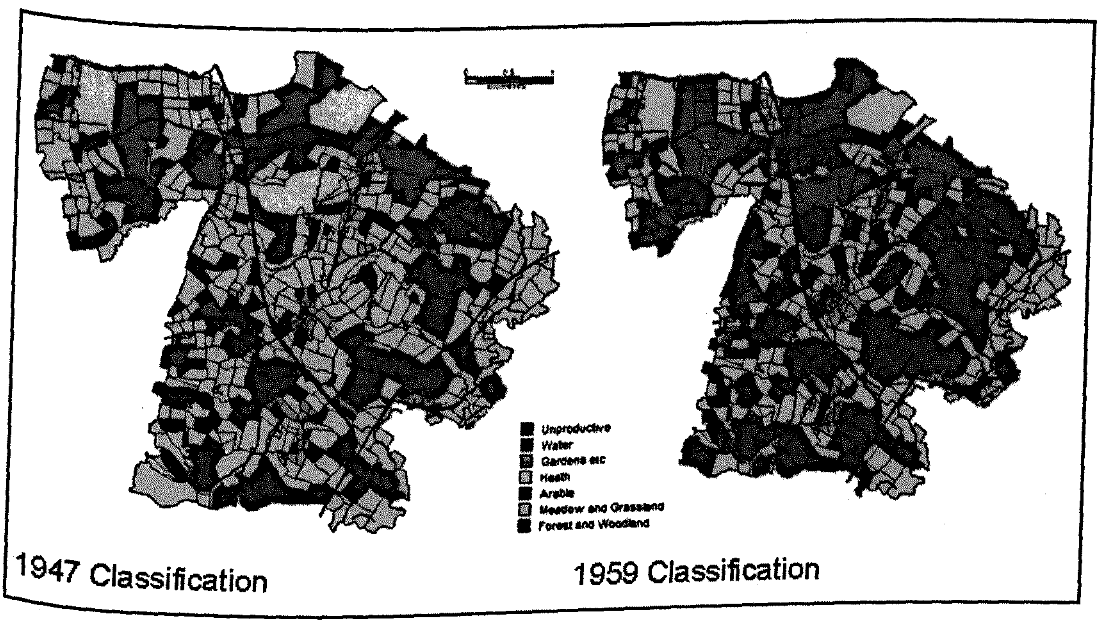
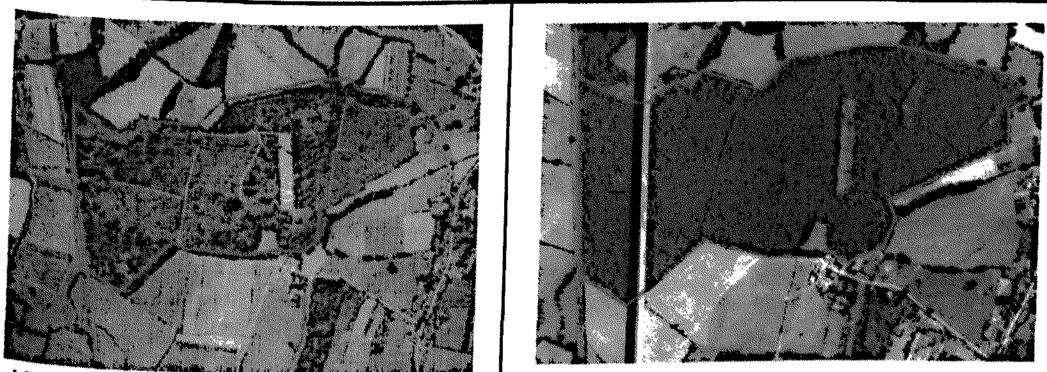


Figure 97: Comparison of the 1947 and 1959 classifications for Barcombe

The acreage of Heath and Rough Grazing has declined between 1947 and 1959 but there has been a corresponding increase in the acreage of Forest and Woodland suggesting that this has regenerated, perhaps as timber ceased to be taken for the purposes of the war, although this could simply be due to the normal cycle of harvest and recovery. This may be illustrated with reference to Knowlands Wood where the tree cover had become very patchy in 1947 and the area was classified as Heath and Rough Grazing. In 1959 the tree cover appears thicker as shown in Figure 98 and so the area was once again classed as Forest and Woodland.



Knowlands Wood in 1947 | Knowlands Wood in 1959

Figure 98: Knowlands Wood in 1947 and 1959
Source: East Sussex Records Office and University of Sussex

The 1959 classification was not evaluated on a farm by farm basis or compared to the NFS data as it was felt to be too far removed in time for this to be a useful exercise.

Once the evaluation of Barcombe had been completed the remaining polygons were classified and the land use totals for the whole study area were calculated. These are shown in Table 44.

Land Use Class	Category	1959 classification acres
130-131	Forest and Woodland	1,469.87
230-231	Meadow and Grassland	5,795.51

330-331	Arable including temporary grass	9,450.63
430-431	Heath and Rough Grazing	3,334.79
530-531	Gardens etc.	979.05
630-631	Water	181.92
730-731	Unproductive	592.70
TOTAL		**21,804.47**

Table 44: Land use totals for the whole study area in 1959

The distribution of land use types is illustrated by the thematic map in Figure 99. This will be discussed further in the next chapter.

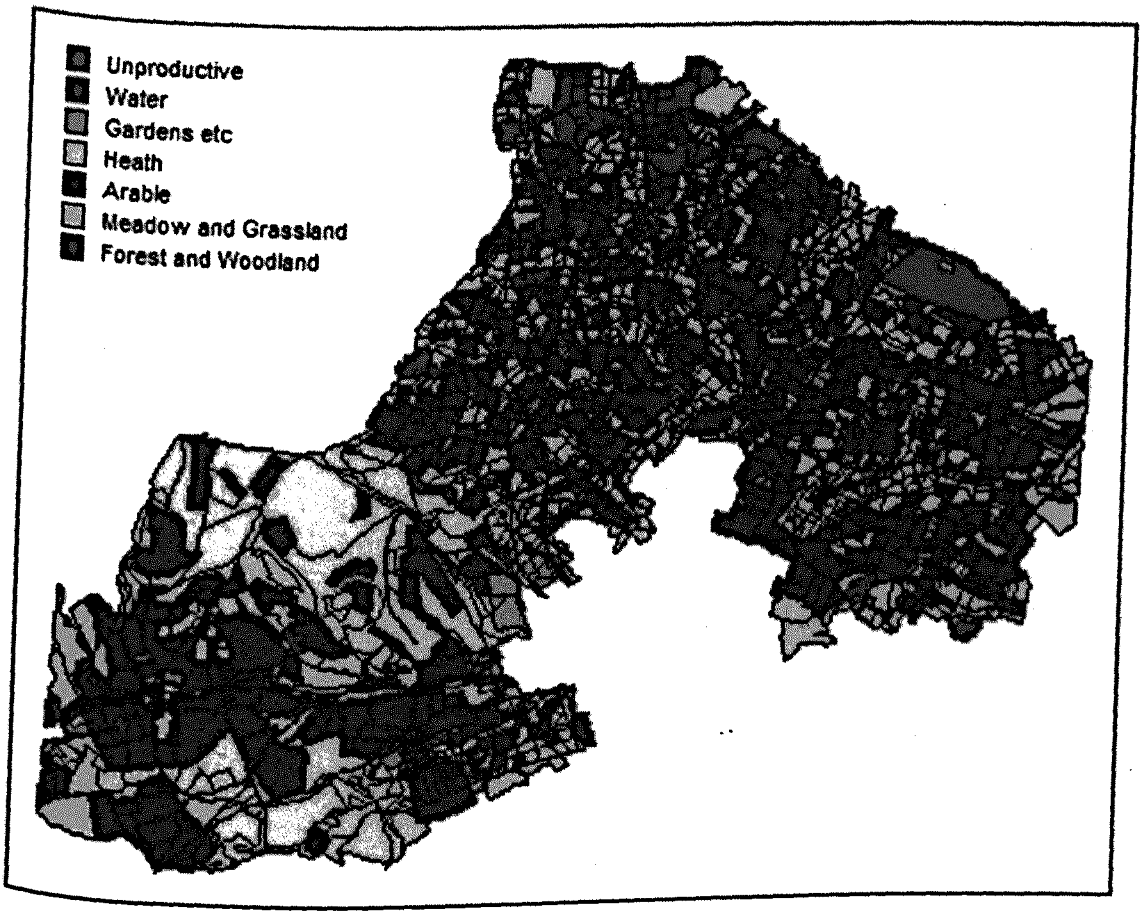


Figure 99: Thematic map showing land use for the whole study area in 1959

Conclusions

Chapters 4-6 have presented the steps undertaken to analyse each of the five main datasets in MapInfo. The stages in the process have been described together with any particular difficulties encountered. The results for the pilot area have been evaluated and discussed. In addition the NFS data have been evaluated for internal consistency and also in relation to the 1940 and 1945/7 datasets.

The land use totals for the whole study area for 1931, 1940, 1945/7, and 1959 have each been presented individually. However the results as a whole have not yet been evaluated. The next chapter will therefore consider the process of change over time.

CHAPTER 7: RESULTS

The first section of this chapter will present data from the agricultural census from 1931 to 1959 for the seven parishes which fall, at least partly, within the study area. This will enable the results of this study to be examined in the context of existing data. The second section considers land use change over time by looking in turn at each of the land use categories identified in this study. The third section examines the results for two parishes, Barcombe and Kingston near Lewes, in more detail.

The Agricultural Census 1931-1959

The main agricultural census has been taken annually since 1866 (The National Archives 2006). For the period 1931-59 it included information on Crops and Grass, Labour and Livestock and also farm size. Parish summaries are available at the National Archives in Kew under the reference MAF 68, and it is these which have been used to compile the information in the next section.

Census Data

The parish summaries for 1931-1959 include a figure for the acreage of Total Crops and Grass. The totals for the seven parishes included in the study area are shown in Table 45 and also in Figure 100.

	Barcombe	Falmer	Hamsey	Kingston	Ringmer	St Anne	St John
1931	3347.75	1654.75	1871	1061	5360	755.5	857
1932	3352.25	1703.75	1870	1056.75	5346.75	755.5	857
1933	3343.25	1703.75	1878	1062.75	5350.75	747.5	792
1934	3317.5	1695	1916.5	1061.5	5355.25	751.5	599.5
1935	3294.5	1698.5	1895.5	1063.25	5339	769.5	542.5
1936	3402	1584.5	2088.5	890.25	5106.5	720	370.5
1937	3400	1582.5	2065	875.75	5109.5	720	370.5
1938	3400.75	1649.25	2038.25	912.25	5152.25	720.5	390.5
1939	3402.75	1633.5	2028	755.25	5304.5	859.5	396
1940	3434.75	1467	2038.25	742	5329.75	1158	401
1941	3385.75	1440.5	2008.5	818.5	5420	1331.75	401.25
1942	3377.5	636.25	2063.75	793	5279.5	504.75	360.25

1943	3409.5	659.5	2062.75	756	5249.5	535.5	355.25
1944	3401.5	658.25	2059.75	756.5	5208.75	548.25	359.75
1945	3389.5	662.5	2072.75	756.5	5220.5	552.5	360.5
1946	3384.5	667	2103.75	949	5224.75	359	360
1947	3337.25	691.25	2123.75	940.25	5225.25	357	375.75
1948	3354.75	826	2126.5	967.25	5237.75	363.75	367.5
1949	3430.5	829.25	2112.75	1055.5	5146	388.5	416.25
1950	3427	863.5	2192.5	1168.75	5201	387.75	416.75
1951	3433.5	1855.25	2217	1145.75	5199	388.5	411.5
1952	3438.5	2076	2232	1186.75	5192.25	408.5	411.5
1953	3442.5	2149.25	2267.25	1303.5	5307	406	410.75
1954	3440.75	2337.75	2274	1482.5	5307.25	390.5	411
1955	3429	2361.25	2471.5	1531.75	5286.75	386.5	173.5
1956	3434.75	2526.25	2486.75	1531.75	5246.75	380	156
1957	3455.75	2529.5	2667	1530	5270	380	156
1958	3412.75	2517	2683	1774	5280.75	380	156.5
1959	3178.25	2550.75	3013	1804.5	5265.75	380	92

Table 45: Total Crops and Grass for the seven parishes in the study area, 1931-1959
Source: *TNA MAF 68*

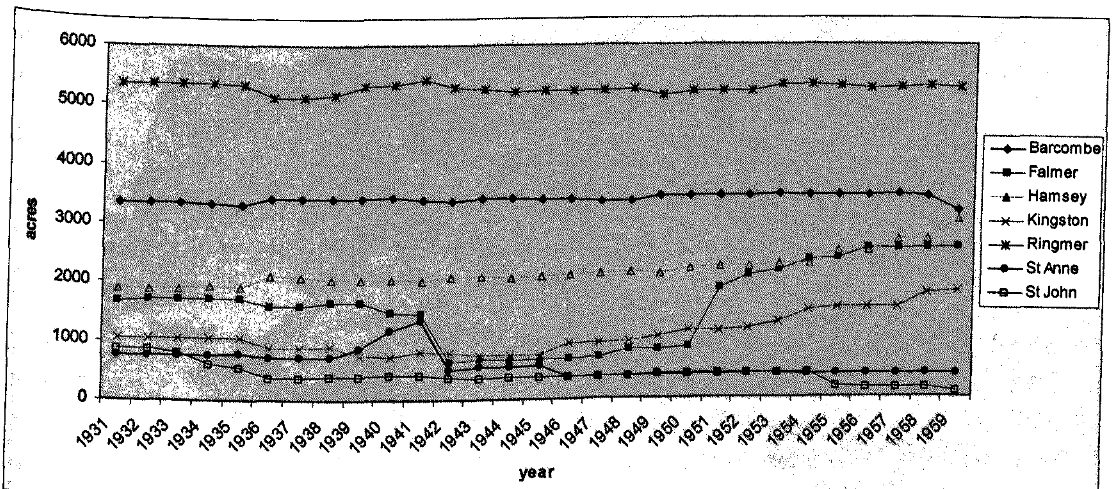


Figure 100: Total crops and grass 1931-1959
Source: *TNA MAF 68*

In Barcombe and Ringmer the total acreage appears relatively stable between 1931 and 1959, whereas all other parishes experience some fluctuation. St Anne peaks between 1939 and 1942 before dropping back to below pre-war levels. On the other hand, Hamsey and Kingston show a slow, steady increase in the acreage of crops and grass in the post-war period. In Falmer the acreage drops dramatically in 1941 and only recovers in 1950. The reason behind some of these fluctuations may lie in the requisitioning of agricultural land by the military from 1939 onwards. In East Sussex in 1944, between 0.300 and 0.749% of the county agricultural area was requisitioned by the War Office (Foot 2006, p140). Figure 101 shows military areas in red with parish boundaries depicted in blue and the study area outline in green and Table 46 lists the approximate acreage of land lost to the military by parish.

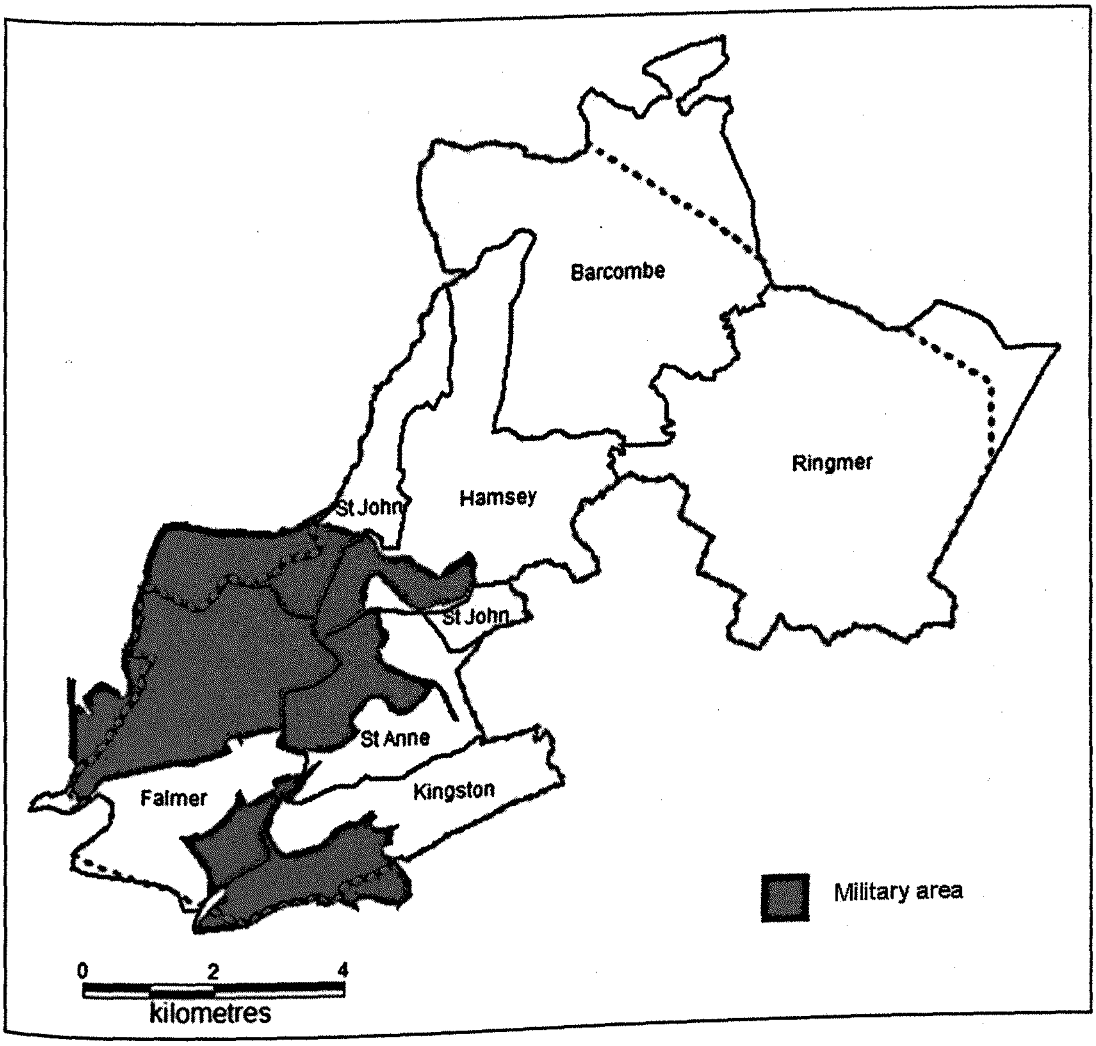


Figure 101: Land lost to the military by parish
Source: Military area, TNA MAF 73   Parish boundaries, UK Borders

Parish	Approximate acreage lost to the military
Falmer	2,022
Hamsey	434
Kingston	596
St Anne	628
St John	238

Table 46: Land lost to the military by parish
Source: TNA MAF 73

It is clear that only Barcombe and Ringmer parishes lost no land to the military, and these were the two parishes with relatively stable acreages of crops and grass. Falmer lost over 2,000 acres and this is likely to account for the significant drop in acreage of crops and grass during the Second World War.

A further reason for the fluctuations in acreage may be parish boundary changes between 1931 and 1959. This may be illustrated with reference to Figure 102 which shows the changes between the 1931 and 1951 parish boundaries, according to census data supplied by *UK Borders*.

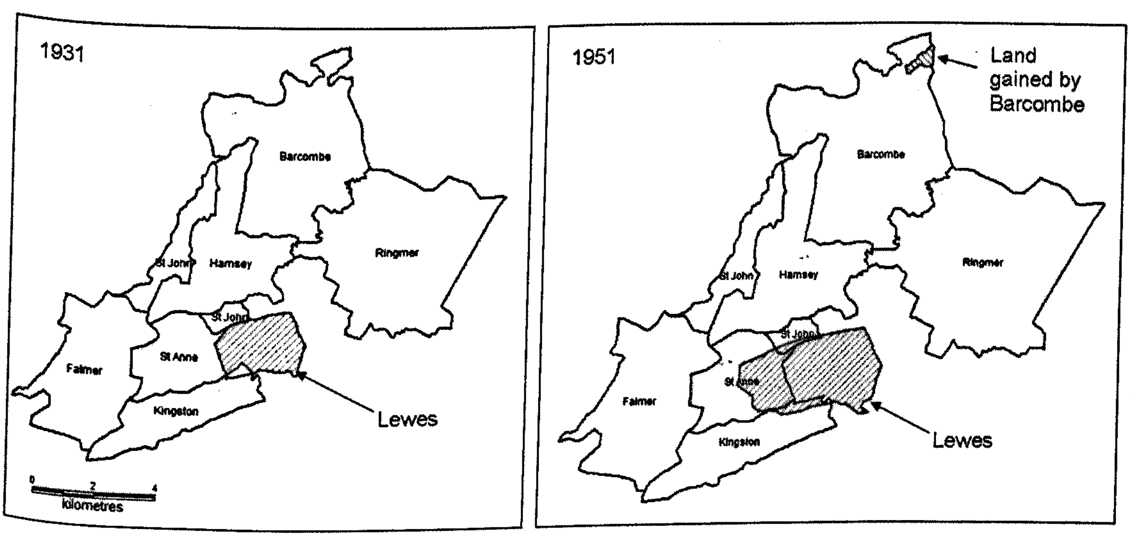


Figure 102: Parish boundary changes 1931-1951
Source: UK Borders

St Anne, St John and Kingston all lose land to Lewes Borough between 1931 and 1951. The acreage of crops and grass in St Anne and St John falls over the course of the study period whereas in Kingston the total acreage of crops and grass in 1959 is higher than in 1931. Conversely, whilst Barcombe has gained a small section of land by 1951, the total crops and grass in 1959 is almost 170 acres lower than in 1931.

Figure 103 compares the crops and grass totals for 1939 and 1945 for the seven parishes. Only Hamsey parish has experienced a reasonable increase (52.75 acres) and the only other parish to have increased its productive area during the war years is Kingston with a 1.25 acre growth in crops and grass. The area of crops and grass in Falmer parish drops by almost 1,000 acres between 1939 and 1945, and St Anne and Ringmer fall by 307 and 84 acres respectively.

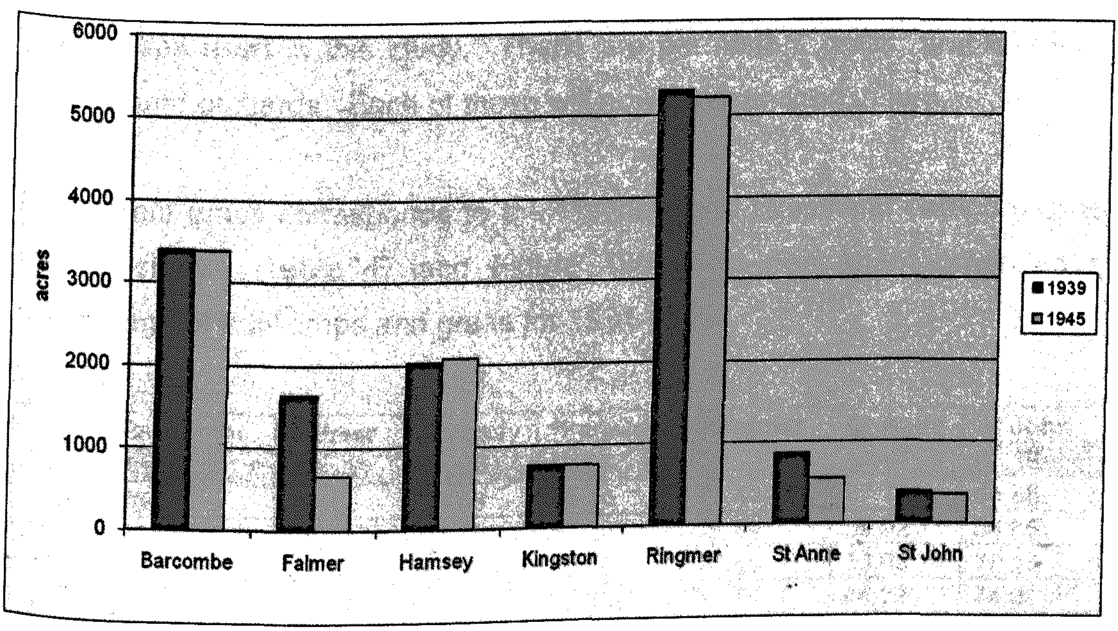


Figure 103: Differences in acreage of crops and grass in 1939 and 1945
Source: TNA MAF 68

Figure 104 shows the acreage of crops and grass at the beginning and the end of the study period, in 1931 and 1959. The picture, again, is mixed, with growth in Falmer, Hamsey and Kingston, and decline in the remaining four parishes.

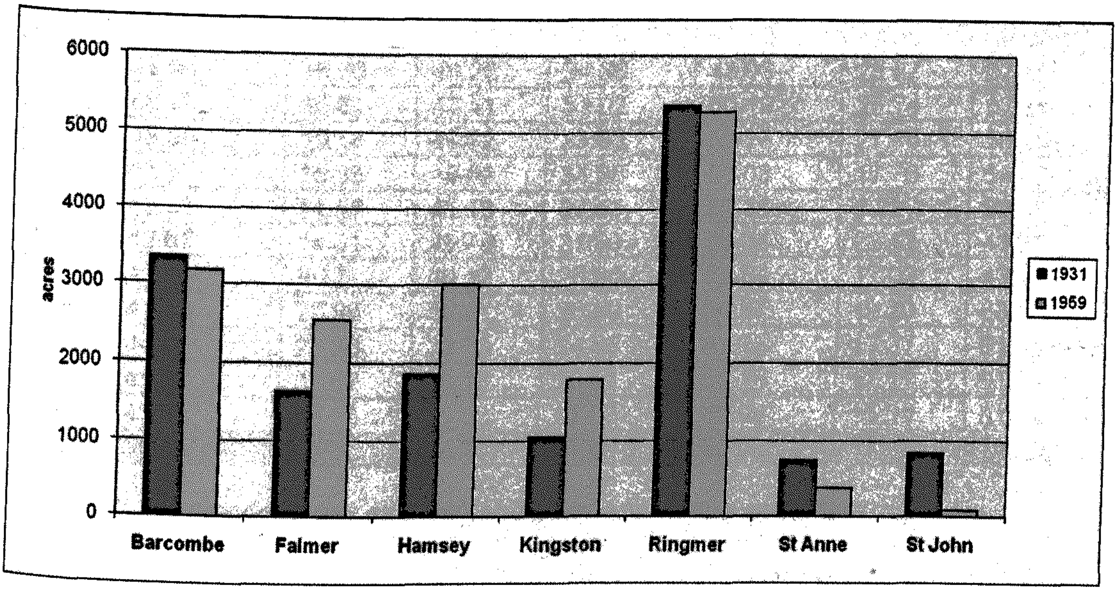


Figure 104: Total crops and grass for 1931 and 1959
Source: TNA MAF 68

The total crops and grass figures can be broken down to give a more detailed picture of land use. Four categories can be picked out which correspond to the classes used in this study. These are permanent grass, arable, rough grazing and orchards. Each of these will now be examined in turn.

Permanent grass corresponds to the Meadow and Grassland category used in this study. Table 47 and Figure 105 show permanent grass as a percentage of total crops and grass for 1931-1959.

	Barcombe	Falmer	Hamsey	Kingston	Ringmer	St Anne	St John
1931	75.91	44.45	76.62	66.19	75.19	57.61	63.19
1932	76.37	46.62	76.08	65.18	75.49	57.71	64.88
1933	76.94	48.48	75.72	67.63	76.84	55.92	64.65
1934	76.38	44.84	75.31	68.09	75.88	53.03	72.06
1935	75.10	45.42	75.69	69.36	75.71	44.38	74.01
1936	76.57	46.39	71.79	67.12	78.59	39.38	82.73
1937	76.75	54.63	76.48	67.43	76.95	56.63	82.19
1938	77.35	59.66	78.09	65.74	78.02	62.04	81.56
1939	76.81	66.48	80.05	56.77	77.87	73.18	83.84
1940	69.36	55.44	71.80	43.83	74.01	84.02	68.89
1941	64.11	37.28	59.68	40.87	66.62	63.98	55.20
1942	60.90	20.31	53.76	36.60	62.81	36.06	49.41
1943	52.02	16.60	45.69	38.03	51.70	26.14	41.38
1944	48.49	13.67	38.03	30.96	42.12	22.07	33.84
1945	47.02	14.26	38.38	29.05	43.82	20.09	36.89
1946	45.18	15.44	42.10	35.35	45.18	17.06	36.11

1947	43.58	13.78	42.41	35.84	46.30	26.89	38.92
1948	42.60	19.70	40.28	34.35	48.03	28.87	37.55
1949	46.79	16.61	43.41	33.02	50.19	25.74	52.25
1950	48.09	19.14	46.42	33.60	50.73	27.98	50.15
1951	46.87	16.06	48.58	34.26	55.06	17.76	54.43
1952	43.72	14.58	45.13	32.53	52.36	7.22	39.98
1953	42.67	14.31	39.78	31.99	53.38	22.72	43.21
1954	40.18	9.12	40.12	26.66	52.04	17.03	43.92
1955	41.93	23.98	39.31	26.59	56.67	13.20	68.88
1956	44.06	23.26	39.78	24.55	51.23	17.37	61.54
1957	41.32	32.67	38.18	28.01	52.18	17.11	61.54
1958	43.03	30.15	35.85	37.03	50.95	15.00	61.34
1959	39.70	9.31	32.10	31.68	53.02	13.68	100.00

***Table 47:* Permanent grass as a percentage of total crops and grass**
Source: TNA MAF 68

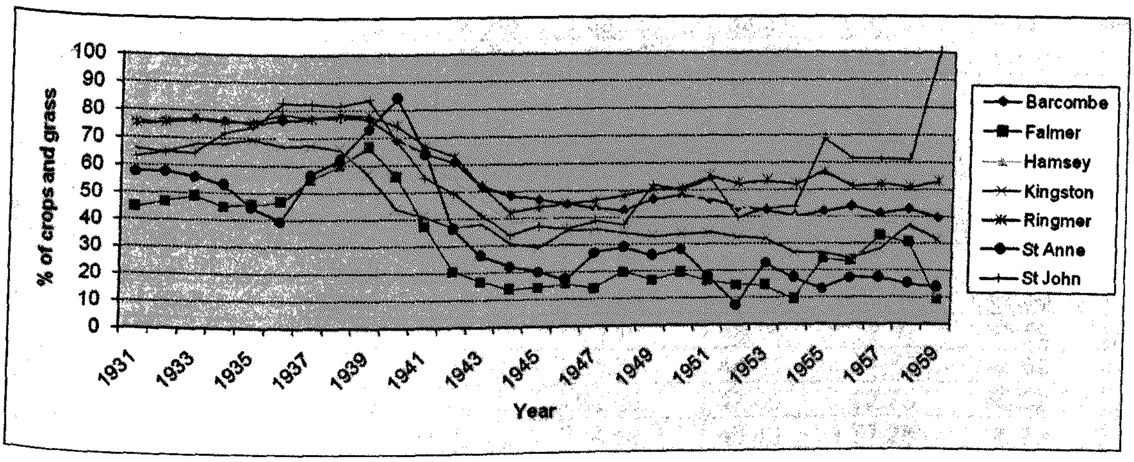


***Figure 105:* Permanent grass as a percentage of total crops and grass 1931-1959**
Source: TNA MAF 68

The proportion of permanent grassland has decreased in every parish except for St John between 1931 and 1959. There is a particularly noticeable decrease in grassland from 1940, presumably as a result of the plough up campaign in combination with the requisitioning of land by the military. In St Anne, which lost approximately 628 acres to the military, the decrease is most striking with a fall from 63.98% in 1941 to just 26.14% in 1943. The proportion of permanent grass also fell by 20% in Ringmer between 1942 and 1944. Ringmer lost no land to the military and so this is likely to be due to the effects of the plough up.

In contrast to the decline in permanent grassland, the arable acreage would be expected to increase and this is, indeed the case. Table 48 and Figure

106 show arable as a percentage of total crops and grass. The acreages of arable are in Appendix 1. The arable total calculated from the census forms includes the acreages given for temporary grassland and also bare fallow.

	Barcombe	Falmer	Hamsey	Kingston	Ringmer	St Anne	St John
1931	23.37	55.40	23.29	30.44	24.36	36.40	36.81
1932	22.91	53.25	23.82	31.20	24.25	37.89	35.12
1933	22.46	51.39	24.17	29.24	22.92	30.57	35.35
1934	22.81	54.91	24.60	28.40	22.30	35.46	27.94
1935	24.18	54.45	23.85	28.38	24.09	53.80	25.99
1936	22.76	53.09	28.07	30.27	21.25	57.36	17.27
1937	22.64	45.23	23.46	30.00	22.83	37.81	17.81
1938	22.15	40.12	21.75	30.36	21.77	36.43	18.44
1939	22.64	33.39	19.80	38.86	21.95	26.82	16.16
1940	29.59	44.48	28.04	51.72	25.85	15.98	31.11
1941	35.33	62.65	40.09	53.27	33.21	35.50	44.80
1942	38.53	79.61	46.03	58.26	36.96	61.37	50.59
1943	47.50	83.36	54.25	57.90	48.01	63.59	58.62
1944	51.04	86.37	61.90	64.94	57.72	66.07	66.16
1945	52.74	85.66	61.50	66.49	56.00	47.51	63.11
1946	54.40	84.48	57.81	61.85	54.63	82.94	63.89
1947	55.88	86.22	57.46	60.97	53.41	73.11	59.61
1948	56.80	79.75	59.62	61.98	51.69	71.13	62.11
1949	52.80	82.85	56.41	62.84	49.43	70.91	47.63
1950	51.52	79.53	53.49	63.19	48.96	72.02	45.59
1951	52.73	83.48	51.21	61.75	44.81	81.72	45.50
1952	55.90	84.89	54.85	64.00	47.40	92.78	60.02
1953	56.96	85.25	60.14	64.50	46.40	77.28	56.79
1954	59.51	90.48	59.86	71.48	47.68	82.91	56.08
1955	57.74	75.69	60.69	70.80	43.04	86.80	31.12
1956	55.63	76.50	60.20	72.76	48.34	82.63	38.46
1957	58.42	67.08	61.44	71.09	47.54	86.84	38.66
1958	56.96	69.59	64.00	61.47	48.78	85.00	38.66
1959	60.03	90.48	67.94	66.46	46.94	86.32	0.00

***Table 48:* Arable as a percentage of total crops and grass 1931-1959 for the seven parishes in the study area**
Source: TNA MAF 68

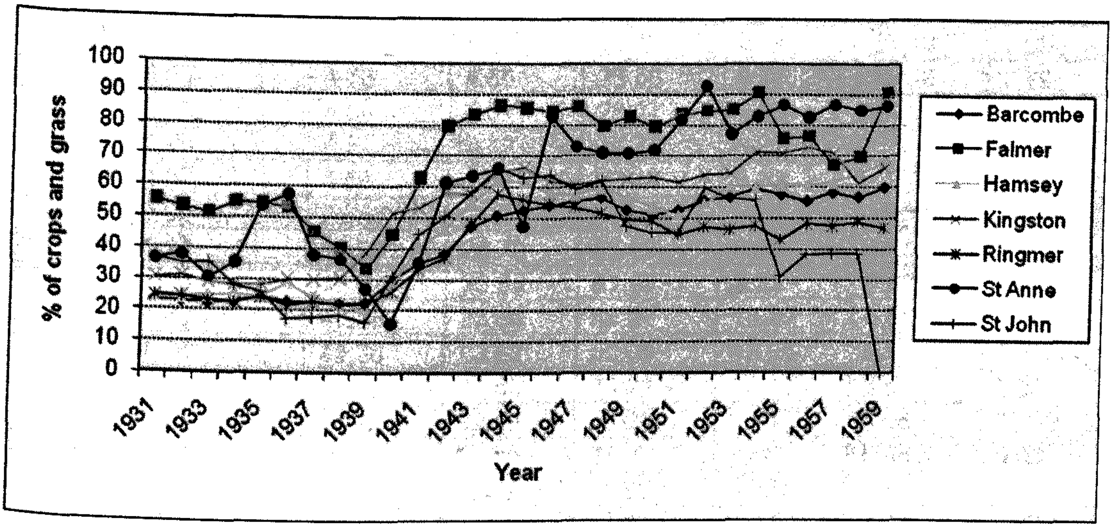


Figure 106: Arable acreage as a percentage of total crops and grass 1931-1959
Source: TNA MAF 68

The proportion of arable for all parishes except St John is significantly higher in 1959 than in 1931. As will be seen later, St John lost a significant amount of land to urban expansion in the course of the study period, particularly the Landport estate on the outskirts of Lewes, which may account for this fall. The greatest percentage increase between 1931 and 1959 was in St Anne parish which gained 49.9%. The increase in arable land was particularly marked after 1940 – between 1939 and 1945 the proportion of arable land doubled in five of the seven parishes.

Land shown as rough grazing on the census falls within the Heath and Rough Grazing category used in this study. Table 49 and Figure 107 show rough grazing as a percentage of total crops and grass plus rough grazing.

	Barcombe	Falmer	Hamsey	Kingston	Ringmer	St Anne	St John
1931	2.47	46.39	2.30	45.10	8.86	45.90	54.95
1932	2.13	48.29	2.30	45.36	9.02	45.90	54.95
1933	2.11	48.29	2.29	45.05	8.85	46.55	56.89
1934	2.39	48.58	2.24	45.06	8.85	46.19	64.18
1935	1.41	48.48	2.27	44.83	8.78	44.90	66.44
1936	2.29	48.71	7.85	49.31	8.37	46.55	71.73
1937	2.22	48.78	7.98	50.09	8.37	46.55	71.73
1938	2.28	45.20	8.07	47.98	8.40	49.53	70.65
1939	2.43	45.43	8.85	53.20	8.45	45.13	69.87
1940	1.51	51.77	8.25	54.74	8.62	49.19	2.79
1941	2.33	52.32	8.37	51.85	8.92	40.96	0.00

1942	2.53	13.70	4.30	25.14	8.95	21.10	7.69
1943	1.11	4.63	4.30	26.06	8.77	10.08	7.79
1944	1.23	4.64	4.31	29.27	8.99	8.05	7.70
1945	1.06	4.61	3.62	27.75	8.92	7.99	7.68
1946	1.67	4.58	1.03	23.41	8.93	11.79	7.69
1947	2.06	29.43	25.32	48.06	8.87	15.20	31.28
1948	1.17	18.98	26.79	55.92	8.93	14.56	11.98
1949	1.50	18.92	25.85	51.97	9.23	6.83	2.40
1950	1.62	47.36	23.66	48.97	13.07	6.85	2.40
1951	1.44	42.20	23.62	50.09	13.08	6.16	3.52
1952	1.21	35.40	23.50	48.23	13.10	6.52	0.00
1953	1.25	33.14	22.08	43.21	8.44	6.56	21.12
1954	1.22	26.04	21.88	34.07	8.64	5.68	0.00
1955	1.33	24.83	20.49	31.66	9.02	6.64	4.93
1956	0.87	19.81	20.39	29.94	9.39	8.21	0.00
1957	0.86	19.79	17.70	29.96	8.87	8.21	0.00
1958	0.52	19.87	17.89	18.70	8.70	11.83	0.00
1959	0.76	18.76	15.78	17.43	8.58	11.83	0.00

Table 49: Land used for rough grazing as a percentage of crops and grass plus rough grazing 1931-1959
Source: TNA MAF 68

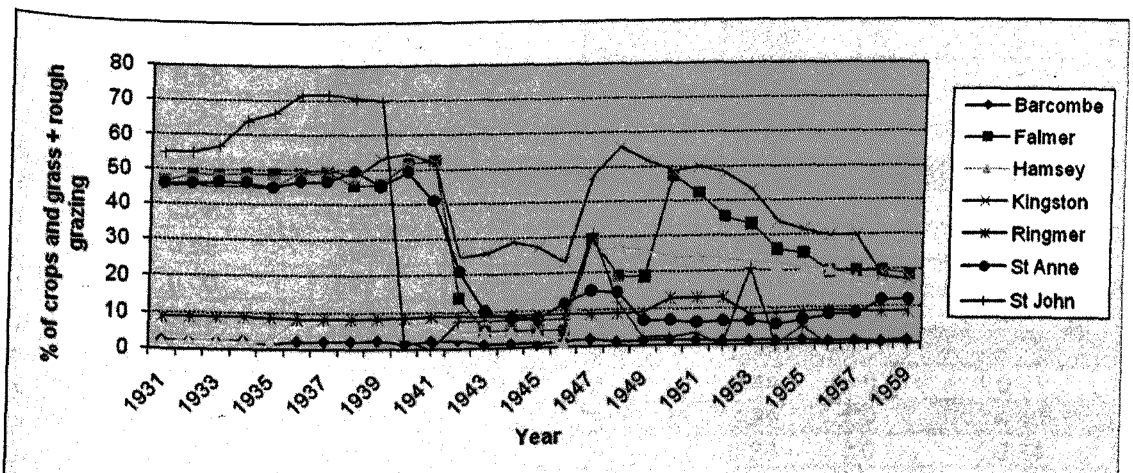


Figure 107: Proportion of rough grazing 1931-1959
Source: TNA MAF 68

The proportion of rough grazing dropped significantly between 1939 and 1945 for six of the seven parishes, with only Ringmer gaining 0.47%. Ringmer was one of the two parishes which lost no land to the military. Between 1945 and 1959, rough grazing percentages recovered somewhat for Falmer, Hamsey and St Anne, although the proportion of rough grazing in 1959 was significantly lower than in 1931 for Falmer and St Anne parishes. Only

Hamsey had a higher percentage of rough grazing in 1959 than in 1931. Parishes which included some downland, such as Falmer and Kingston, generally experienced far more fluctuation in the proportion of rough grazing, whereas wealden parishes such as Barcombe had a low but reasonably stable proportion of rough grazing throughout the study period.

The final relevant category which can be extracted from the census data is orchards which fall into the Gardens etc. category in the LUS. The proportion of orchards as a percentage of total crops and grass for the seven parishes between 1931 and 1959 is shown in Table 50 and Figure 108. The acreages are in Appendix 1.

	Barcombe	Falmer	Hamsey	Kingston	Ringmer	St Anne	St John
1931	0.74	0.15	0.12	3.37	0.27	0	0
1932	0.72	0.13	0.09	3.62	0.26	0.30	0
1933	0.60	0.13	0.11	3.13	0.24	0.27	0
1934	0.81	0.25	0.09	3.51	0.18	0	0
1935	0.71	0.13	0.07	2.07	0.21	0	0
1936	0.68	0.14	0.14	2.61	0.16	0	0
1937	0.55	0.14	0.06	2.57	0.22	0	0
1938	0.50	0.09	0.16	3.89	0.21	0	0
1939	0.54	0.12	0.14	4.37	0.18	0	0
1940	0.52	0.09	0.16	4.45	0.13	0	0
1941	0.56	0.07	0.15	4.64	0.17	0	0
1942	0.58	0.08	0.21	4.13	0.23	0	0
1943	0.00	0.11	0.06	4.46	0.30	0	0
1944	0.47	0.08	0.07	4.10	0.16	0	0
1945	0.24	0.08	0.12	4.46	0.18	0	0
1946	0.42	0.07	0.08	2.79	0.18	0	0
1947	0.46	0.00	0.13	3.19	0.29	0	0.40
1948	0.60	0.54	0.11	3.72	0.28	0	0.34
1949	0.39	0.54	0.15	4.03	0.35	0	0.12
1950	0.38	1.10	0.05	3.08	0.31	0	0.00
1951	0.39	0.46	0.23	3.99	0.13	0	0.06
1952	0.39	0.53	0.02	3.39	0.26	0	0
1953	0.36	0.44	0.08	3.51	0.23	0	0
1954	0.33	0.40	0.02	1.85	0.29	0	0
1955	0.34	0.33	0.00	2.61	0.29	0	0
1956	0.31	0.25	0.02	2.69	0.24	0	0
1957	0.25	0.27	0.01	0.90	0.28	0	0
1958	0.31	0.26	0.16	1.49	0.27	0	0
1959	0.28	0.22	0.03	1.90	0.06	0	0

Table 50: Orchards as a percentage of total crops and grass for the seven parishes in the study area 1931-1959
Source: TNA MAF 68

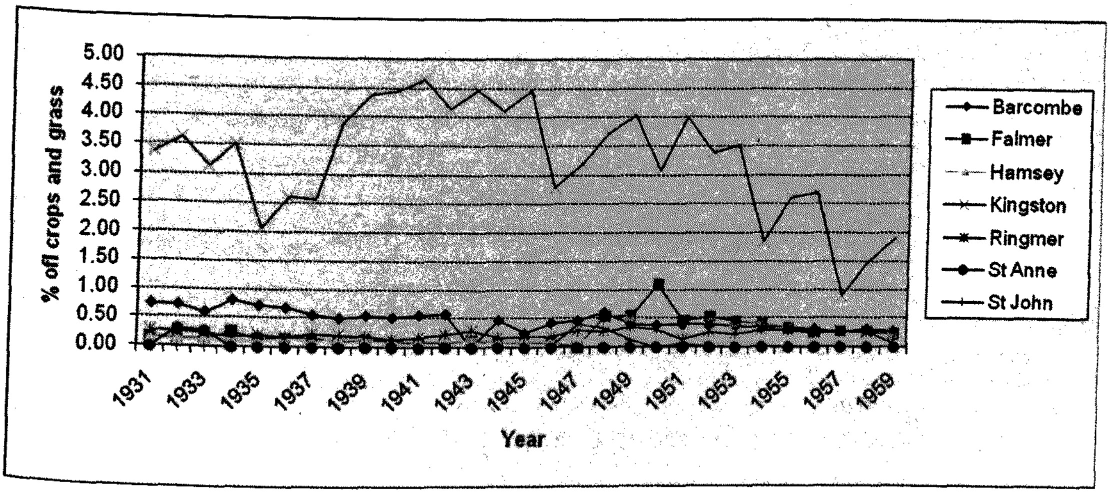


Figure 108: Proportion of Orchards 1931-1959
Source: TNA MAF 68

Only Kingston has a significant percentage of orchards, which peaks during the war years and then declines to below 1931 levels by the end of the study period.

The next section considers trends in farm size between 1931 and 1958. The census figures for farm size are patchy and no data are available for several years including 1959. Therefore only selected years are shown, but it is possible to see the general trend in size from this.

Figure 109 shows the total number of farms for the seven parishes by acreage for a selection of years between 1931 and 1958. This does not include farms with rough grazing only, as the acreage for these is not always given. The number of farms over 300 acres has increased from 9 to 14 by 1958 and very small farms (<5 acres) have declined from 40 in 1931 to 28 in 1958. The number of very small farms also dips noticeably during the war years, whereas farms between 20-100 acres increase over the same period.

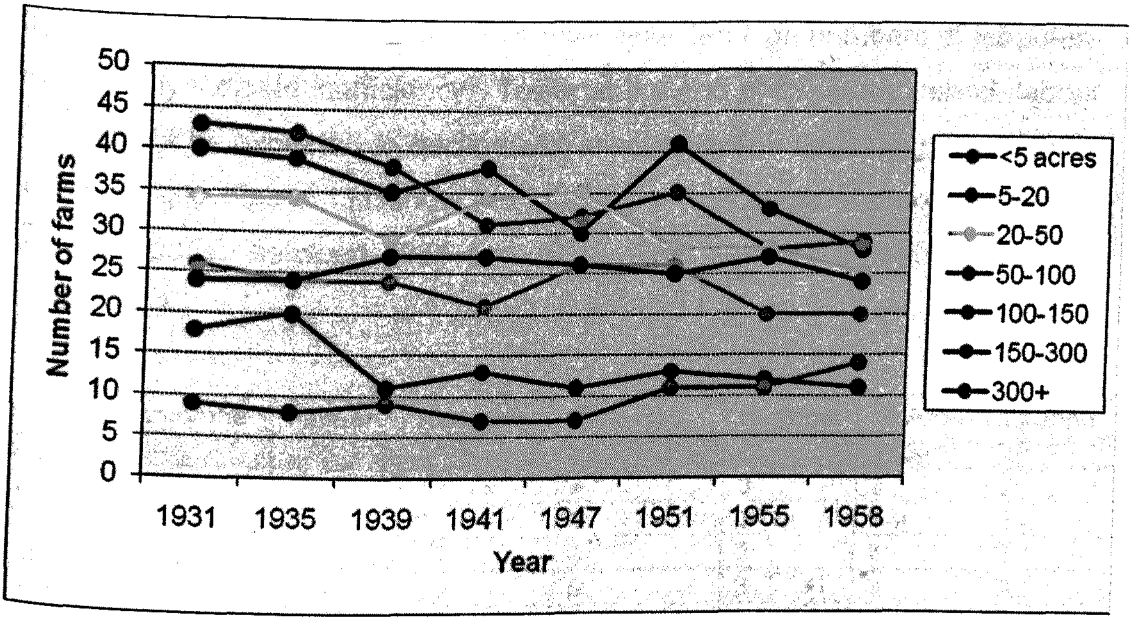


Figure 109: Number of farms by size, 1931-1958
Source: TNA MAF 68

Figure 110 is a comparison of farm size in 1931 and 1958 (figures are unavailable for 1959). It is notable that there are fewer farms in all categories under 150 acres in 1958 than in 1931. Only farms with 300+ acres have increased in number.

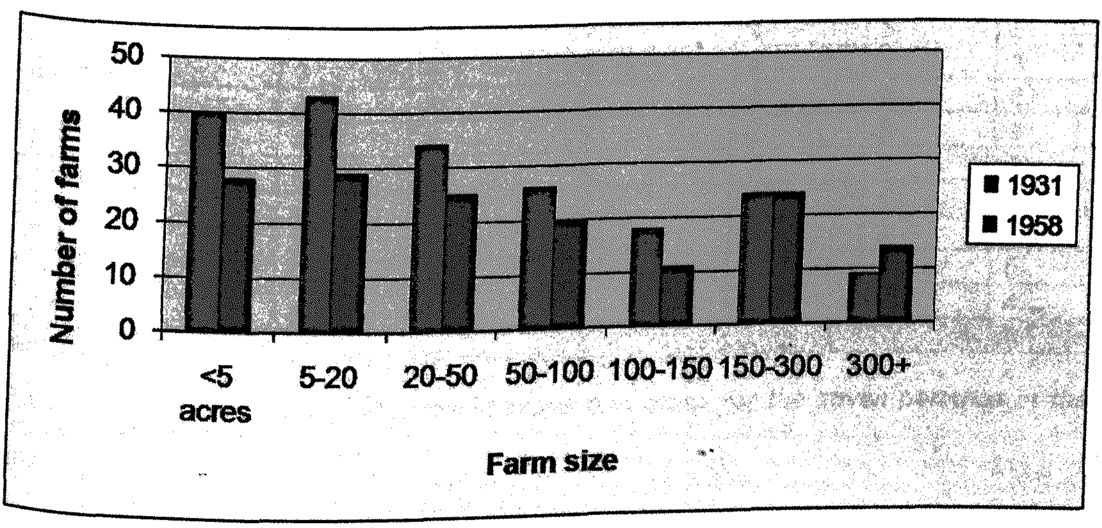


Figure 110: Farm size in 1931 and 1958
Source: TNA MAF 68

The next census statistic to be considered is total labour. The number of labourers may act as a useful indicator of the prosperity of a holding, although this is not necessarily the case. In some instances high numbers of labourers may simply indicate inefficiency. Towards the end of the study period, labour rates might be expected to decline with mechanisation beginning to increase. Table 51 and Figure 111 show the labour per 100 acres of crops and grass for each parish between 1931 and 1959. The numbers of labourers are in Appendix 1.

	Barcombe	Falmer	Hamsey	Kingston	Ringmer	St Anne	St John
1931	4	3	3	4	3	3	2
1932	4	3	3	4	3	3	2
1933	4	3	3	5	3	3	2
1934	4	3	3	6	3	4	2
1935	4	2	3	5	3	3	3
1936	4	3	3	5	3	3	2
1937	4	3	3	5	3	2	3
1938	4	3	3	5	3	2	4
1939	4	3	3	9	3	2	2
1940	4	4	3	9	3	2	2
1941	4	4	3	7	3	2	2
1942	5	6	4	8	3	4	4
1943	5	7	3	7	4	4	5
1944	4	7	4	9	4	3	4
1945	5	9	4	8	4	5	5
1946	5	9	4	8	4	4	6
1947	6	8	4	9	4	4	5
1948	5	7	4	8	4	5	5
1949	5	7	5	7	4	5	3
1950	5	6	4	7	4	3	5
1951	4	3	4	6	4	3	3
1952	5	4	3	5	3	3	4
1953	4	4	3	5	3	3	4
1954	4	4	3	4	3	4	5
1955	4	4	3	3	3	4	5
1956	4	3	3	3	3	3	6
1957	3	3	2	2	3	3	5
1958	3	3	3	2	3	3	4
1959	3	3	2	2	3	3	9

***Table 51:* Labourers per 100 acres of crops and grass for the seven parishes in the study area 1931-1959**
Source: TNA MAF 68

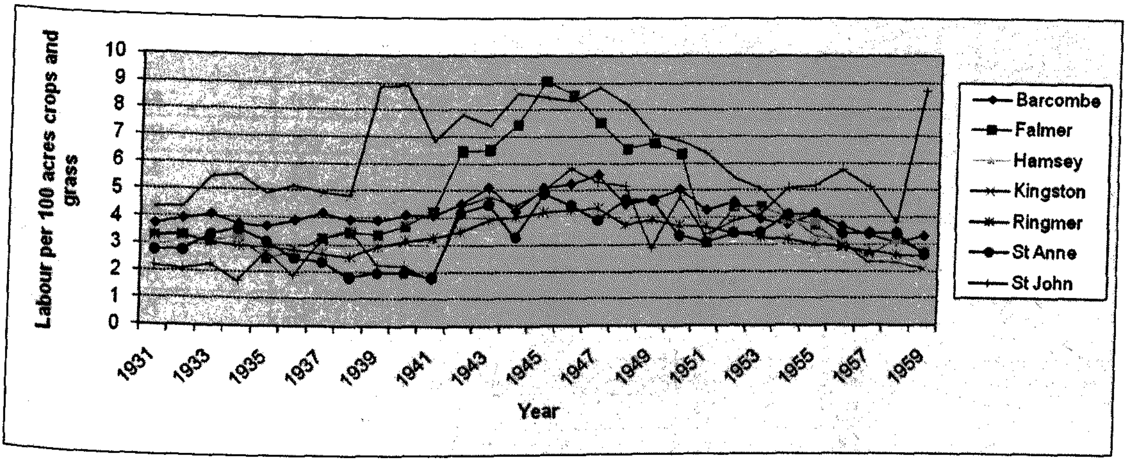


Figure 111:* *Labour per 100 acres of crops and grass 1931-1959
Source: TNA MAF 68

Labour from the Women's Land Army (WLA) and Prisoners of War (PoWs) was included in the census from 1944. PoWs last appeared on the form in 1948 and the WLA were shown until 1950. This may account for the peak in labour during the war years and just after. Six of the seven parishes in the study area, with the exception of Kingston, gained labour between 1939 and 1945. Looking at the whole study period, three parishes had less labour in 1959 than in 1931, three parishes had the same number, and just one parish, St John, saw a significant increase.

Finally, livestock numbers are available in the parish summaries of the census data and these provide another insight into land use, as livestock require grazing land, temporary grassland (classed as Arable) which can be mowed to provide winter feed stocks, and also root crops for fodder. With the decline in grassland and rough grazing between 1931 and 1959, livestock levels could be expected to drop as well. The figures for cattle, sheep and horses are considered here – numbers of pigs and poultry are also available but have not been included.

Table 52 and Figure 112 show the total numbers of cattle per hundred acres of temporary and permanent grass for the seven parishes in the study area between 1931 and 1959. Cattle numbers are in Appendix 1.

	Barcombe	Falmer	Hamsey	Kingston	Ringmer	St Anne	St John
1931	44	29	38	33	38	8	25
1932	134	33	39	47	42	12	26
1933	169	30	45	57	43	14	35
1934	154	34	44	55	43	11	25
1935	134	30	45	51	41	13	23
1936	143	24	40	47	38	12	21
1937	145	26	39	40	39	16	23
1938	165	32	38	54	41	10	26
1939	142	27	40	62	42	22	27
1940	128	47	49	72	45	29	31
1941	138	40	56	74	47	25	30
1942	124	38	49	47	51	15	41
1943	108	40	62	66	61	42	54
1944	93	49	67	69	64	29	72
1945	89	63	60	84	63	31	59
1946	72	70	59	87	61	32	64
1947	76	82	55	92	58	23	50
1948	86	58	58	107	61	23	59
1949	93	71	58	100	61	57	40
1950	93	144	63	97	65	46	43
1951	86	81	60	104	63	103	30
1952	77	79	57	96	60	177	31
1953	82	61	56	72	57	69	38
1954	66	61	63	74	56	102	55
1955	69	65	57	65	52	125	23
1956	89	70	60	86	54	96	41
1957	71	59	57	71	54	98	29
1958	78	60	55	56	52	109	40
1959	76	61	64	61	57	142	78

Table 52: Cattle per 100 acres of temporary and permanent grass in the seven parishes in the study area 1931-1959
Source: TNA MAF 68

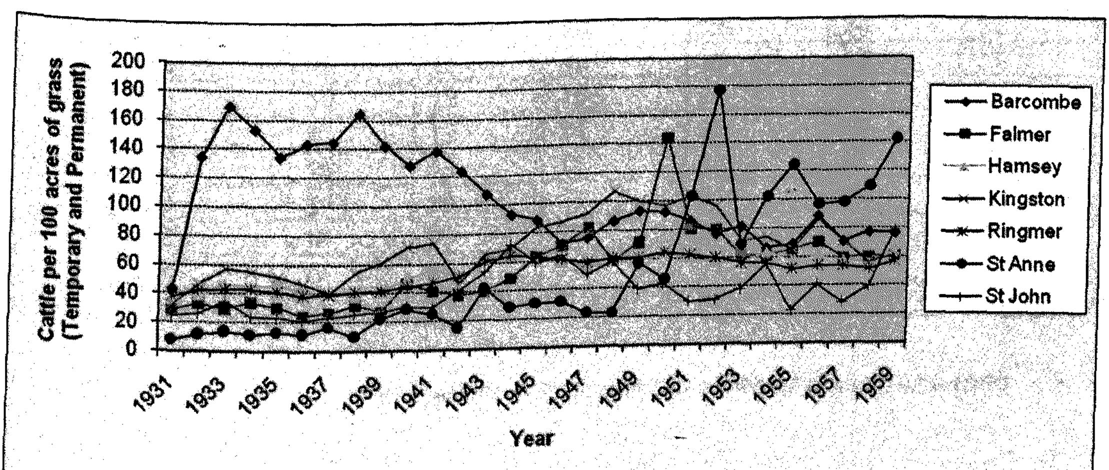


Figure 112: Cattle per 100 acres of grass 1931-1959
Source: TNA MAF 68

There is a general upward trend, with all seven of the parishes having more cattle per 100 acres of grass in 1959 than in 1931. Cattle density peaks in Barcombe in 1933 and then declines. Kingston and Ringmer parishes reach their highest numbers just after the war in 1948 and 1950 respectively, and St Anne peaks in 1952.

Table 53 and Figure 113 show cows and heifers in milk per 100 acres of grass for 1931-1959.

	Barcombe	Falmer	Hamsey	Kingston	Ringmer	St Anne	St John
1931	21	16	15	14	19	4	8
1932	72	13	14	16	19	4	10
1933	85	13	17	18	20	5	11
1934	82	14	17	19	21	5	11
1935	70	13	18	18	21	8	12
1936	79	13	15	14	20	8	11
1937	76	13	18	14	20	6	11
1938	82	13	16	16	20	7	6
1939	74	16	17	20	19	4	8
1940	63	22	17	21	20	6	9
1941	69	21	21	25	21	8	12
1942	56	6	19	2	23	10	14
1943	53	17	25	23	28	16	22
1944	44	19	23	21	29	21	28
1945	40	16	20	23	27	20	24
1946	32	11	22	18	26	23	24
1947	32	20	20	17	25	17	24
1948	32	22	21	17	26	17	33
1949	32	20	20	22	24	24	17
1950	34	11	21	20	25	24	27
1951	32	13	19	23	26	34	12
1952	28	19	17	19	20	52	13
1953	26	18	13	10	22	28	15
1954	23	8	19	14	22	39	15
1955	22	15	13	11	18	47	0
1956	22	8	16	13	21	40	14
1957	22	18	16	10	20	40	15
1958	27	17	16	8	21	41	21
1959	24	16	20	9	21	42	29

Table 53: Numbers of cows and heifers in milk per 100 acres of grass 1931-1959
Source: TNA MAF 68

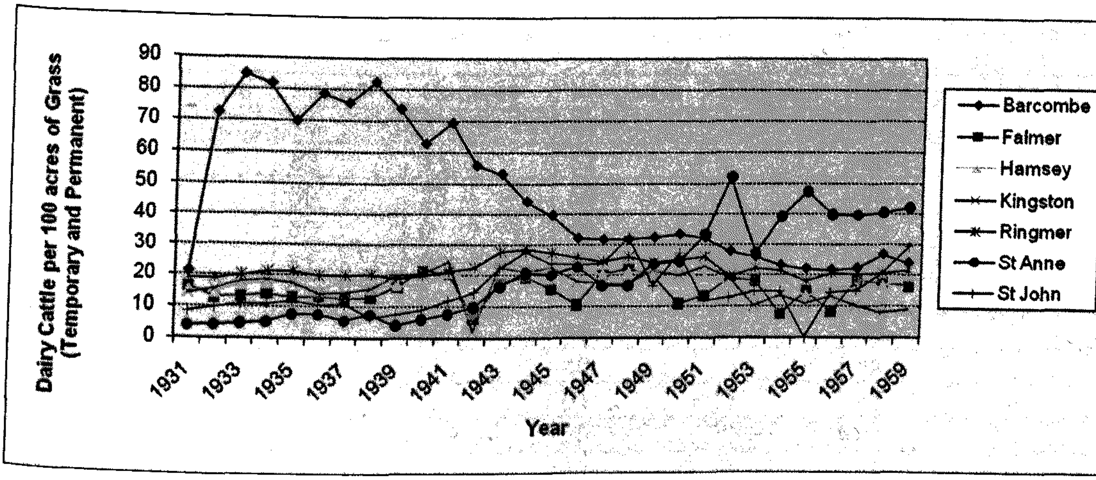


Figure 113: Number of cows and heifers in milk per 100 acres of grass 1931-1959
Source: TNA MAF 68

Five of the parishes have more cows and heifers in milk per 100 acres of grass in 1959 than in 1931. Falmer has the same number in 1959 as in 1931 and Kingston has declined by a third.

A peak in numbers is still evident in Barcombe in 1932 and in St Anne in 1952. However the peaks in total cattle numbers per 100 acres which were evident for Kingston and Ringmer in 1948 and 1950 are not reflected here. This suggests there was an increase in numbers of beef cattle in these parishes.

Brandon writing about post-war changes on the South Downs notes that "The Southdown flocks, adapted to folding and turf-grazing, have been largely replaced by beef cattle" (Brandon 1974, p268). This is borne out by the figures for Falmer parish, which contains a significant proportion of downland. Falmer has the same number of cows and heifers in milk in 1959 as in 1931, but the total number of cattle per 100 acres has more than doubled from 29 to 61, suggesting a growth in numbers of beef cattle.

Turning to the numbers of sheep, these have been calculated per 100 acres of temporary and permanent grassland *plus* rough grazing and are shown in Table 54 and Figure 114. A table showing the numbers of sheep is in Appendix 1.

	Barcombe	Falmer	Hamsey	Kingston	Ringmer	St Anne	St John
1931	32	78	6	49	15	67	46
1932	105	83	11	52	5	56	48
1933	94	89	23	56	20	98	41
1934	82	80	0	46	14	43	0
1935	117	51	0	35	14	87	0
1936	106	41	6	35	22	93	0
1937	77	29	23	49	21	78	0
1938	89	20	27	40	15	82	0
1939	87	40	27	51	13	38	0
1940	17	18	20	30	22	21	0
1941	43	17	2	60	22	11	0
1942	73	0	2	146	23	161	0
1943	72	0	9	134	24	52	0
1944	56	0	1	107	24	12	0
1945	44	0	0	130	24	9	0
1946	4	0	0	124	20	0	0
1947	6	0	0	34	22	0	0
1948	4	0	1	31	14	0	0
1949	1	0	1	30	13	0	0
1950	3	9	0	33	13	0	0
1951	6	0	0	36	12	0	0
1952	5	0	0	38	14	0	0
1953	2	0	0	42	20	0	0
1954	2	14	1	72	21	0	0
1955	4	17	21	72	27	0	0
1956	25	24	35	41	29	0	0
1957	40	19	38	59	22	0	0
1958	53	34	32	63	25	0	0
1959	48	38	50	62	32	0	0

Table 54:* *Numbers of sheep per 100 acres of grass and rough grazing in the seven parishes in the study area 1931-1959
Source: TNA MAF 68

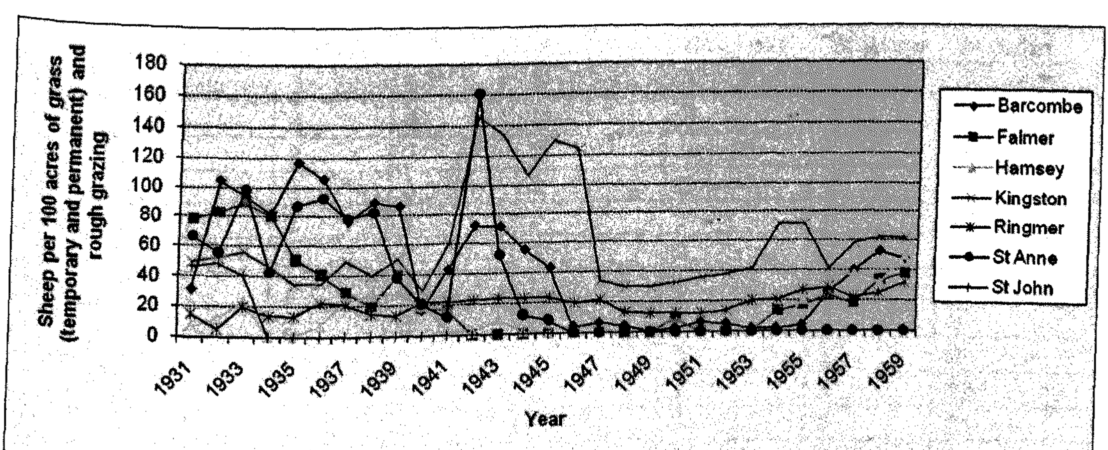


Figure 114:* *Numbers of sheep per 100 acres of grass and rough grazing 1931-1959
Source: TNA MAF 68

Perhaps the most striking aspect of Figure 114 is the peak in numbers of sheep per 100 acres in Kingston and St Anne in 1942. It is difficult to account for this peak from these data alone. However it may perhaps be due to sheep being moved from other areas which were requisitioned by the military. In general sheep numbers decline during and just after the war years and show signs of recovery in the 1950s. Four parishes (Barcombe, Hamsey, Kingston and Ringmer) have more sheep per 100 acres in 1959 than in 1931. Falmer has fewer sheep in 1959 than in 1931, and sheep disappear from St John after 1933 and from St Anne after 1946. As already noted, Falmer had considerably more cattle per 100 acres in 1959 than in 1931 and this may account for the fall in sheep numbers.

Martin notes that "the number of calves, sheep and lambs slaughtered rose sharply in the second year of the war" (Martin 2000, p52). This would have been due to the requirements for food as well as the rationing of animal foodstuffs. Falmer parish began the war with 40 sheep per 100 acres, and Hamsey with 27 sheep per 100 acres. In 1945 both parishes had no sheep at all, although numbers recovered later.

Finally, Table 55 and Figure 114 show the number of horses in the seven parishes per 100 acres of crops and grass. The total numbers of horses are in Appendix 1. No figures are available for 1940 and 1959 and so these two years have been omitted.

	Barcombe	Falmer	Hamsey	Kingston	Ringmer	St Anne	St John
1931	3	3	3	2	3	8	2
1932	3	3	3	2	3	5	3
1933	3	3	3	2	3	3	4
1934	3	3	3	2	3	5	2
1935	3	2	4	2	2	6	6
1936	2	2	4	2	3	2	1
1937	3	2	4	3	3	2	8
1938	2	2	3	2	2	1	8
1939	2	2	3	1	3	3	9
1941	2	4	3	2	3	3	13
1942	2	4	2	2	2	4	11
1943	2	3	2	2	2	3	9
1944	2	3	2	1	2	3	11
1945	2	3	2	1	2	4	10

1946	2	3	3	1	2	2	7
1947	2	4	3	1	2	2	9
1948	2	3	3	1	2	1	8
1949	1	3	3	1	1	1	7
1950	1	2	2	1	1	1	7
1951	1	1	2	1	1	1	2
1952	1	1	3	1	1	0	8
1953	1	1	1	1	1	0	8
1954	1	1	1	1	1	0	8
1955	1	0	1	1	1	0	17
1956	0	0	1	1	1	0	38
1957	0	0	1	0	1	0	22
1958	0	1	1	1	1	0	21

Table 55: Numbers of horses per 100 acres of crops and grass in the seven parishes in the study area 1931-1958
Source: TNA MAF 68

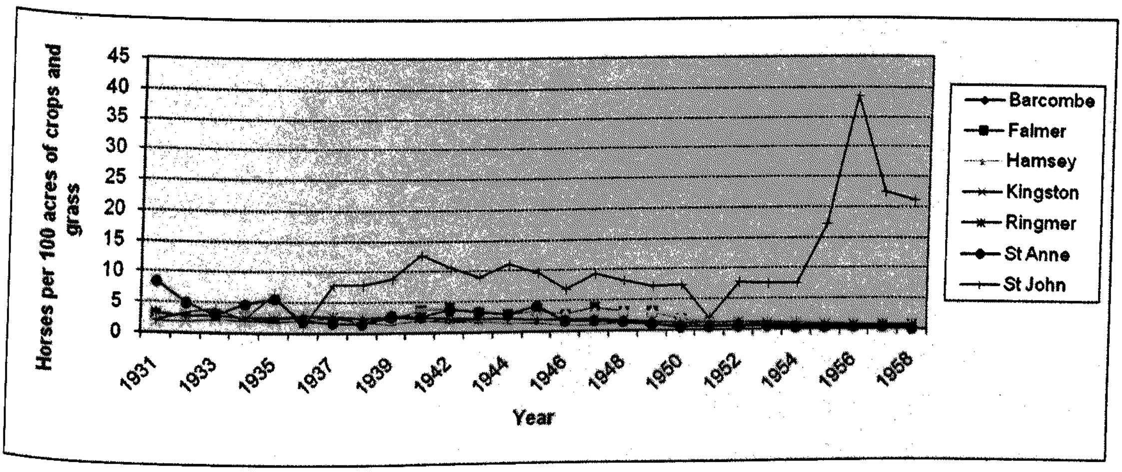


Figure 115: Horses per 100 acres of crops and grass 1931-1958
Source: TNA MAF 68

The general trend over the study period is downwards with six of the seven parishes having fewer horses per 100 acres in 1959 than in 1931. The exception is St John where horse numbers have increased considerably over the study period. This suggests that there may have been some sort of business such as a riding stables or horse breeding establishment in the parish.

These results will be discussed more fully in Chapter 8. The next section of this chapter looks at land use change over time in the study area.

Overview of Land Use Change in the Whole Study Area

The data for the LUS, 1940, 1945/7 and 1959 aerial photographs have already been presented as a series of thematic maps for the whole study area. However it may now be useful to look at all four of these thematic maps together in order to gain an impression of the outcome of the process of change over time (Figure 116). The LUS data are from the one inch (published) maps and the date is shown as 1931 as this appears to be the date when the fieldwork for East Sussex was completed.

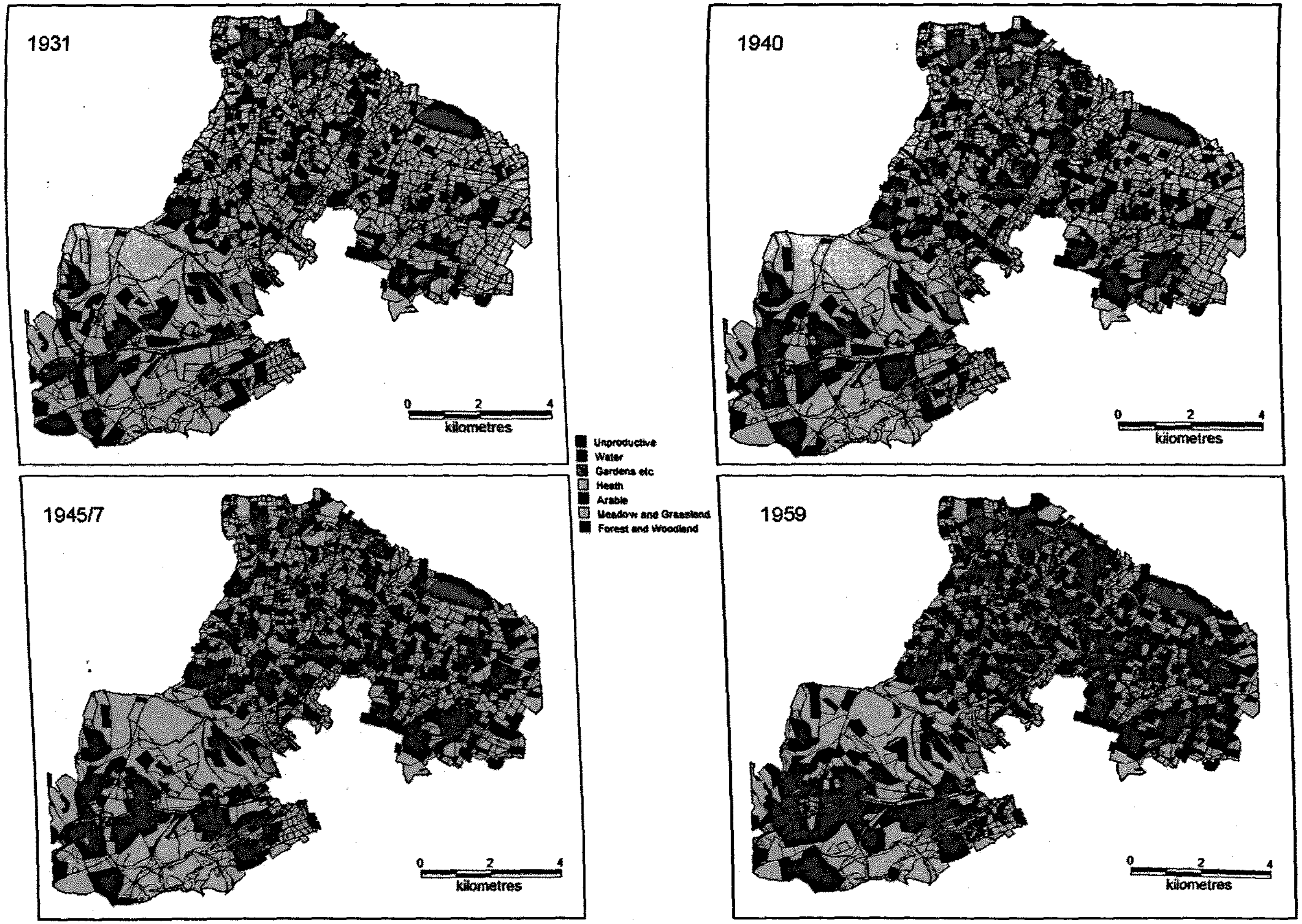


Figure 116: Thematic maps showing land use for the four main datasets

In 1931, Meadow and Grassland was the predominant land use type whereas by 1959 the balance has clearly shifted in favour of Arable. The increase in density of Arable on the wealden clay is perhaps most noticeable, along with the spread of Arable across the centre of the Downs in the south west corner of the maps and the corresponding loss of Heath and Rough Grazing and Meadow and Grassland.

Land Use Change by Category

Whilst it is very useful to gain an overall impression of the changes which have occurred during the study period, it is also helpful to consider each land use category in more detail in order that less obvious underlying changes are not missed. Each major type of land use will therefore now be examined in turn.

Forest and Woodland

The total acreages for the Forest and Woodland category from 1931-59 are shown by the graph in Figure 117. Thematic maps illustrating the distribution of Forest and Woodland are in Figure 118.

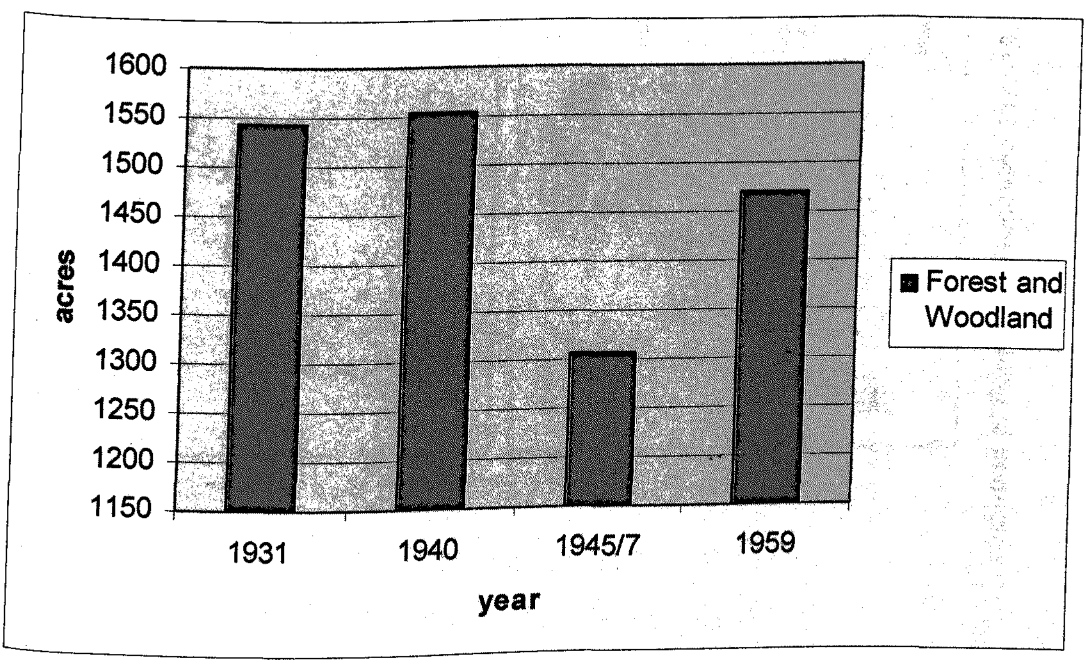


Figure 117: Changes in acreage of Forest and Woodland 1931-1959

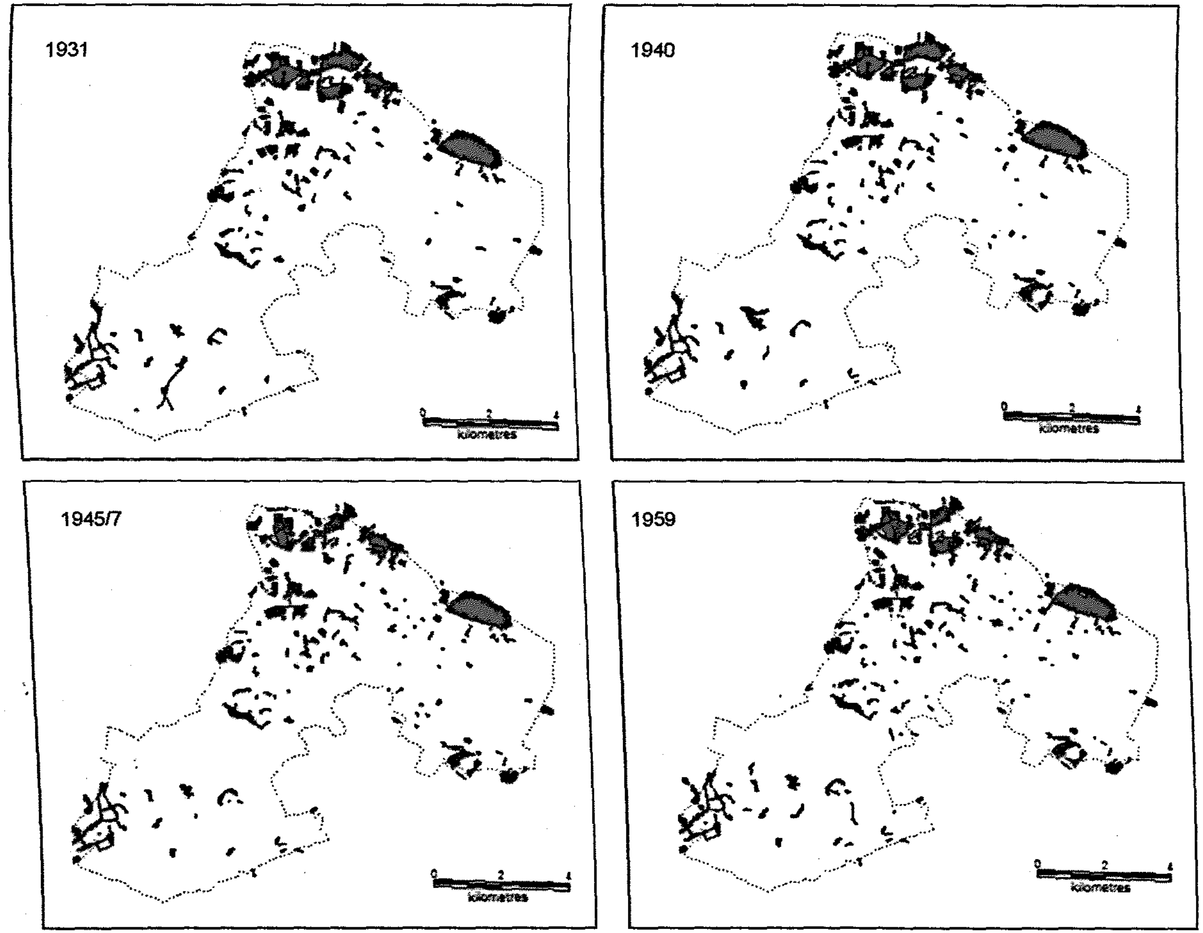


Figure 118: The distribution of Forest and Woodland 1931-1959

The acreage of Forest and Woodland remains reasonably stable between 1931 and 1940 and then drops markedly in 1945/7. This was illustrated in the previous chapter with reference to Knowlands Wood which was categorised as Heath and Rough Grazing in 1945/7 due to the sparseness of the tree cover. In 1959 there is a slight increase, suggesting that the tree cover was beginning to regenerate. The overall decrease between 1931 and 1951 Forest and Woodland totals is 72.23 acres.

The most plausible explanation for the drop in Forest and Woodland is that the timber was being used for the war effort and so a considerable amount was felled particularly during the years 1940-1947. The recovery in acreage in 1959 bears this out, as it suggests that timber had ceased to be taken after the war.

Figure 119 shows the number of polygons of Forest and Woodland for 1931–1959. The number of polygons has increased from 227 in 1931 to 349 in 1959. However the mean polygon size has decreased from 6.80 acres to 4.21 acres. This tends to suggest that the areas of Forest and Woodland have become smaller and more fragmented in the course of the study period.

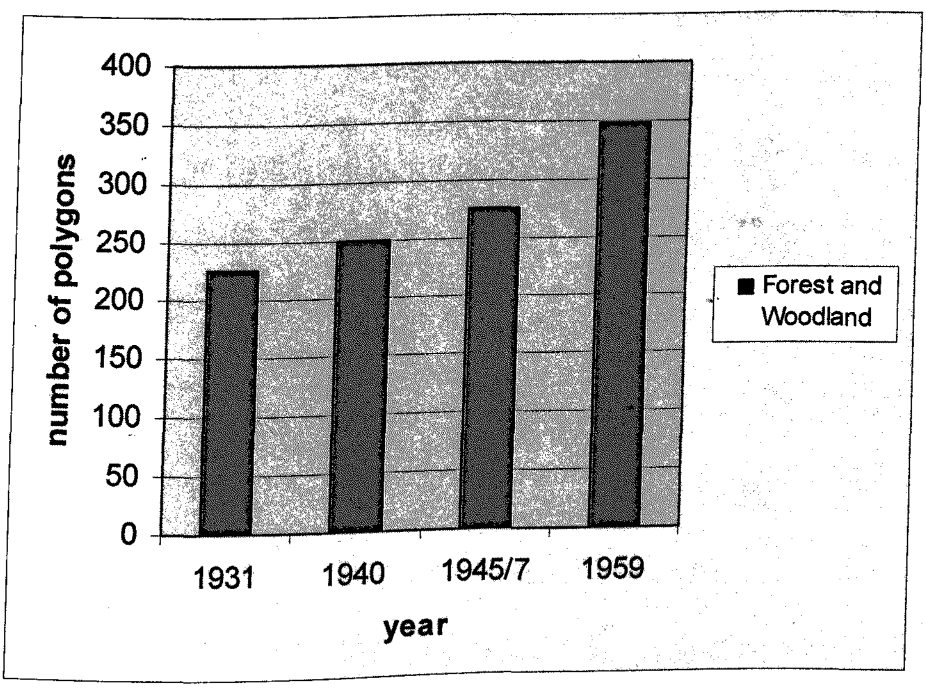


Figure 119: Number of polygons of Forest and Woodland 1931-1959

Meadow and Grassland

Figure 120 shows the acreages of Meadow and Grassland for the study area from 1931-59. It is clear that there has been a dramatic decline and that the acreage of Meadow and Grassland in 1959 is less than half the acreage in 1931, with a total loss of 6,233.53 acres.

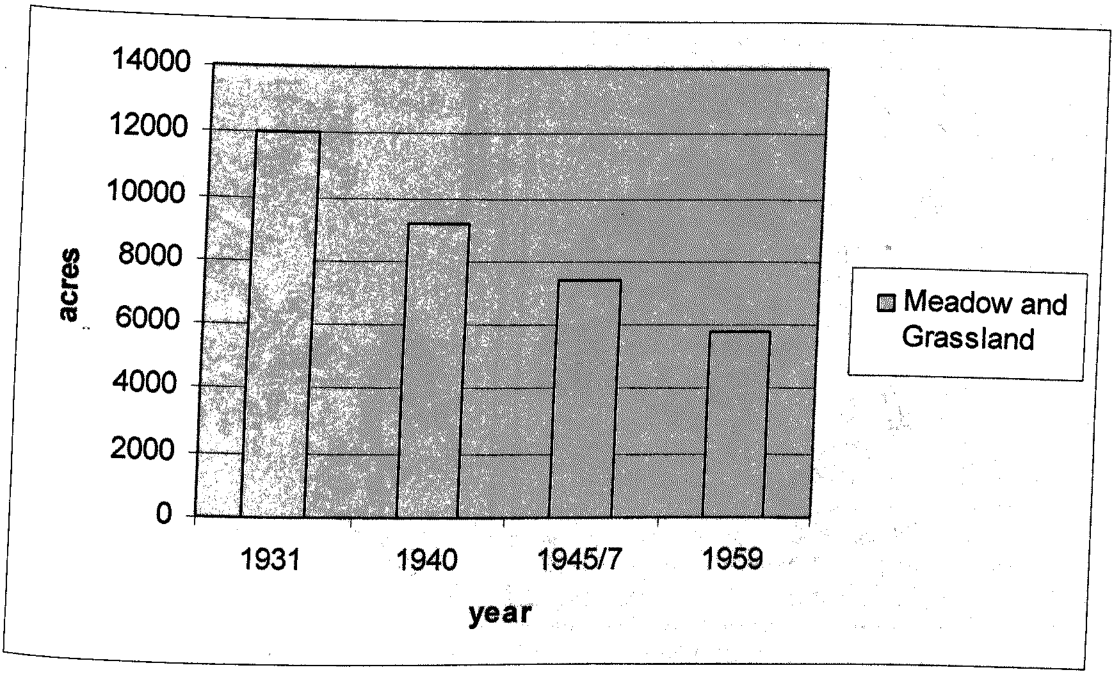


Figure 120: Acreage of Meadow and Grassland 1931-1959

Figure 121 shows the distribution of Meadow and Grassland across the study area.

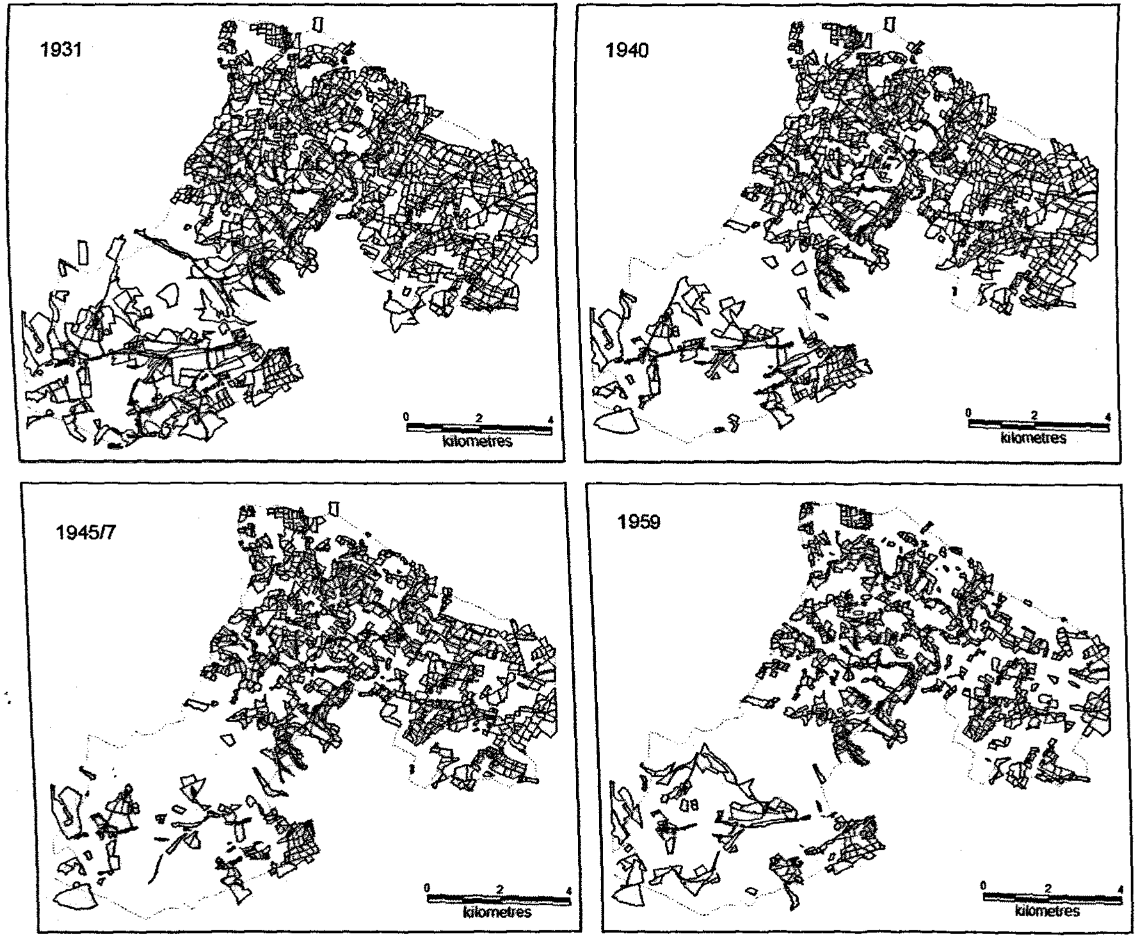


Figure 121: Distribution of Meadow and Grassland, 1931-1959

The loss of Meadow and Grassland is not confined to one location, but is generalised across the entire study area. However, the decline in grassland across the South Downs stands out on the map, perhaps due to the larger polygon sizes.

The number of polygons of Meadow and Grassland is shown in Figure 122. As the total acreage has dropped, there has been a corresponding decrease of over 800 polygons between 1931 and 1959. The mean polygon size has also declined from 6.34 to 5.38 acres. This may be attributable to the loss of grassland across the Downs referred to in the previous paragraph.

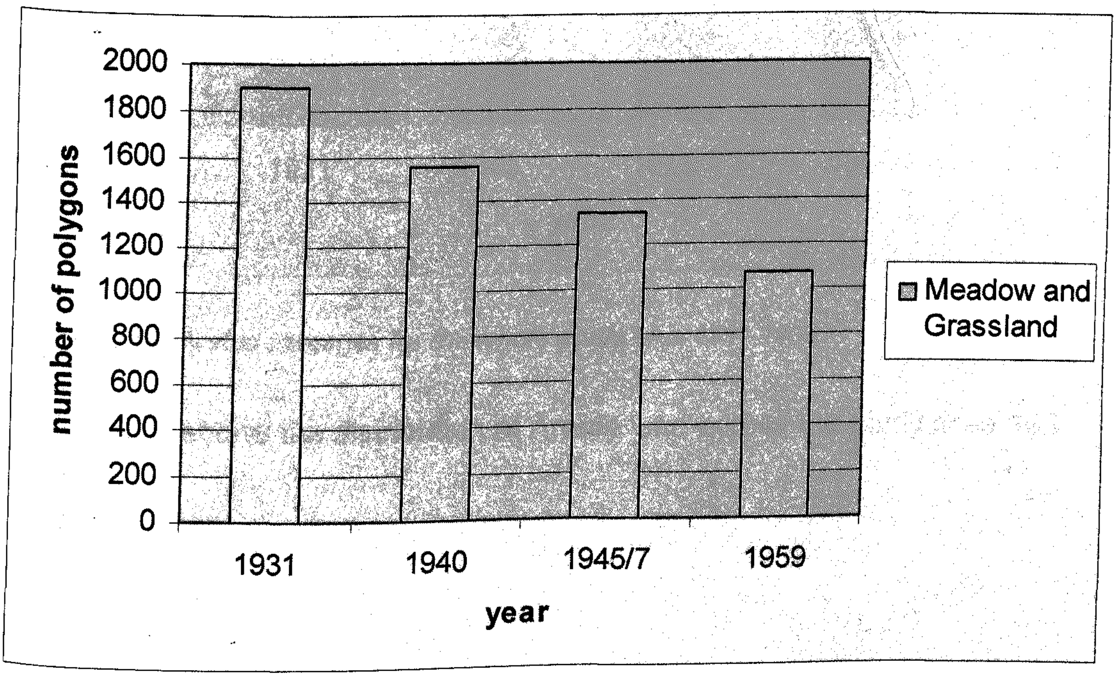


Figure 122: Number of polygons of Meadow and Grassland 1931-1959

In the results presented in Chapter 6 it appeared that Meadow and Grassland was being lost to Arable land and so the Arable results would be expected to show the reverse of the Meadow and Grassland figures.

Arable and Temporary Grass

The graph in Figure 123 does, indeed, show an increase over time in the acreage of Arable land with the area of Arable more than doubling between 1931 and 1959. The total gain in Arable is 5,145.23 acres between 1931 and

1959. This is 1,088.3 acres less than the total loss of Meadow and Grassland, which means that a considerable amount of Meadow and Grassland changed to a land use other than Arable during the study period.

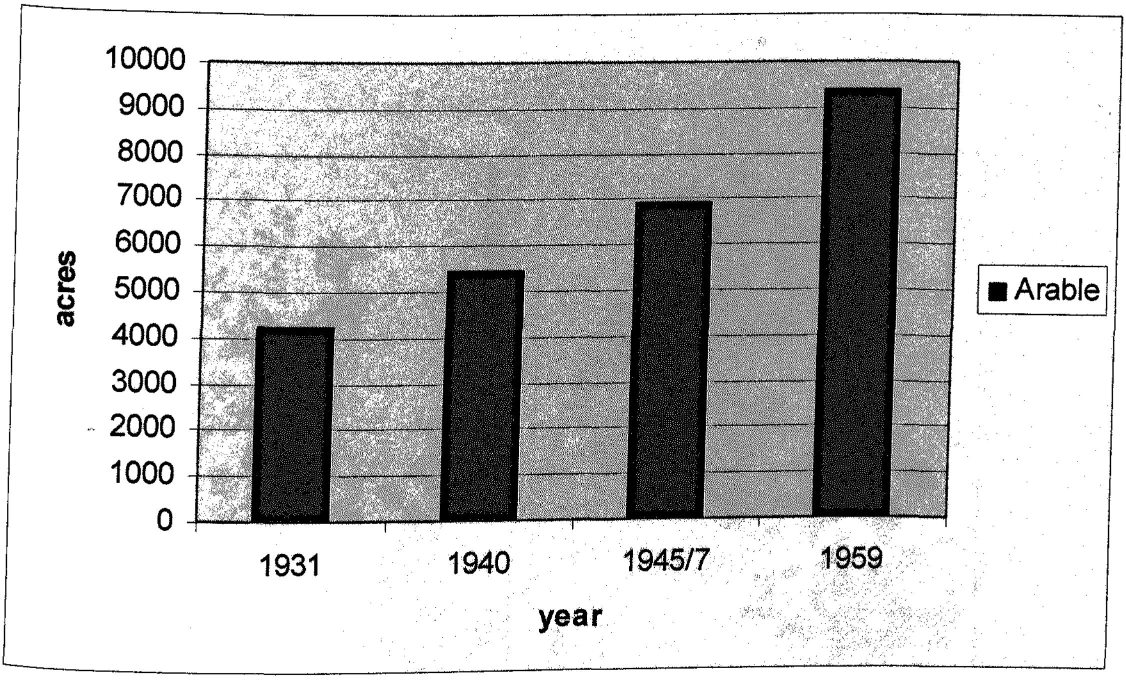


Figure 123: Arable acreages for the whole study area 1931-1959

Figure 124 shows the distribution of Arable land across the study area 1931 – 1959.

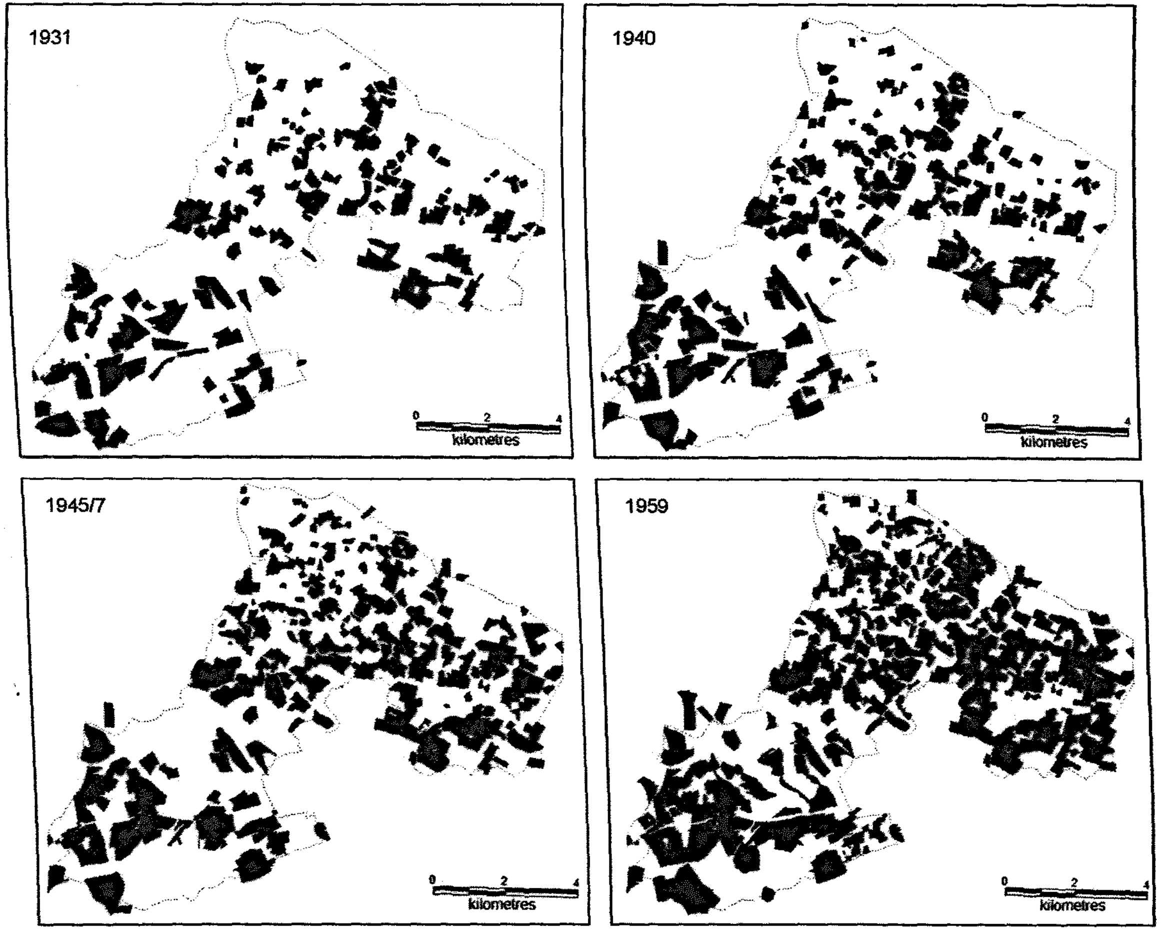


Figure 124: Distribution of Arable land 1931-1959

The pattern of growth in Arable land shown in Figure 124 is interesting. In 1940, just prior to the first harvest of the war, the increase in numbers of Arable fields appears concentrated in a few areas, seeming to "fill in the gaps" between tracts of Arable land. This can be seen in Figure 125 which "zooms in" on the southern part of Ringmer parish.

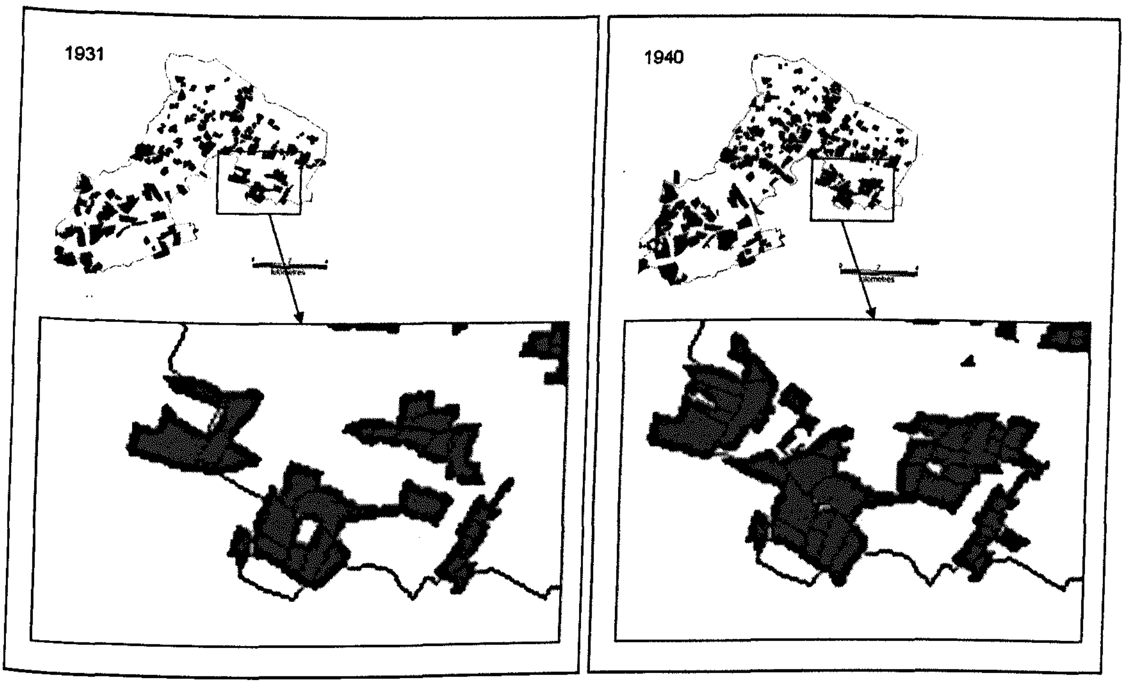


Figure 125: The spread of Arable land in part of Ringmer parish 1931-1940

Almost all of the new Arable areas are adjacent to existing Arable. This is even more evident if 1931 is compared to 1959 for the same small area, as shown in Figure 126.

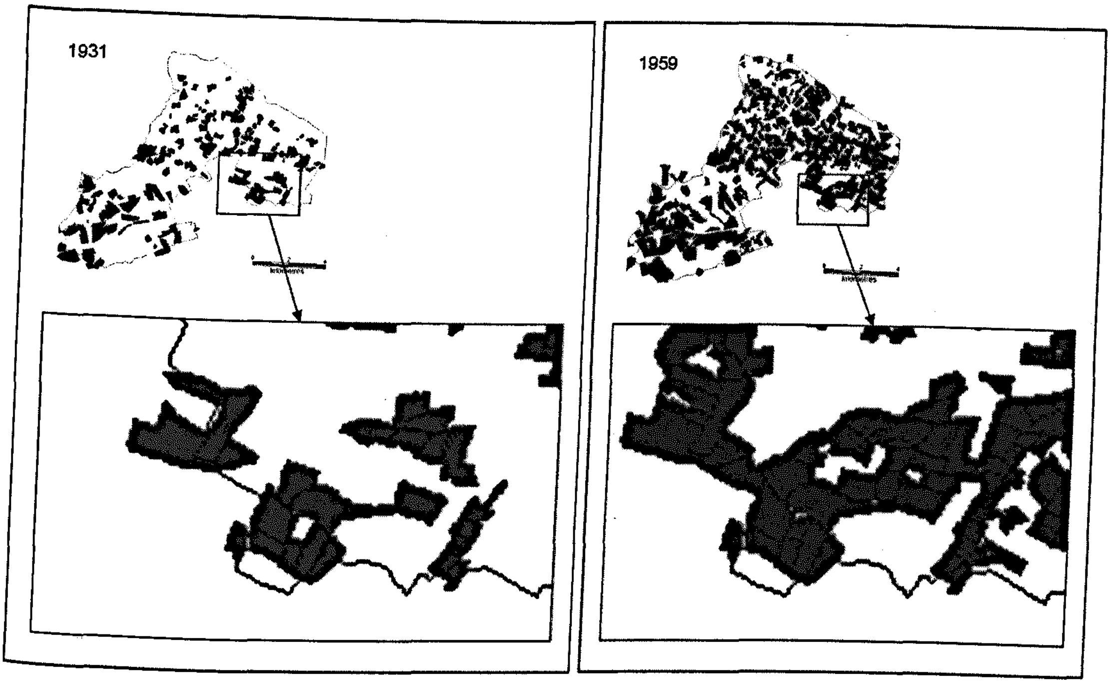


Figure 126: The spread of Arable land in part of Ringmer parish 1931-1959

Here the Arable areas of 1931 have clearly grown to fill many of the gaps between them. It is tempting to surmise that this is as a result of poorer land being brought back into cultivation. However, Martin argues that in the late 1930s:

> "A common practice was to allow outlying fields, or those furthest from the farmsteads, which had traditionally been used for cash-cropping, to fall into decay...The land that fell out of cultivation was not always the most marginal from a productivity point of view. Frequently it was strong, fertile land that had the highest potential yields" (Martin 2000, p11).

It may be, then, that the deciding factor was not the quality of the land but the proximity to the farmhouse.

However this argument may also be insufficient to explain the pattern of growth of Arable land. Walford argues that:

> "As part of the process of agricultural restructuring involving enlargement of agricultural holdings and a reduction in the farmer population, some farmhouses that are surplus to requirements may have been sold off to people from outside agriculture. In these

circumstances the agricultural land connected with the farmhouse may well become disassociated from it" (Walford 2006, p220).

It is clear from the census data presented earlier in this chapter (Figure 110) that the number of smaller farms had declined in the course of the study period and the number of large farms increased. It is therefore highly likely that by 1959 farmers were cultivating land which was further from their homes than before as they farmed larger tracts of land, perhaps made up of land acquired from various smaller holdings. Walford notes that:

> "Looking at the question of occupation change over time forces recognition of the fact that what might be treated as a single farm business at one point in time may be the result of the accumulation of formerly separately registered agricultural holdings or parcels of land into an economic unit or business" (Walford 2006, p220).

Moving on to consider the number of Arable polygons in the study area between 1931 and 1959 it is clear that these have more than doubled as shown in Figure 127.

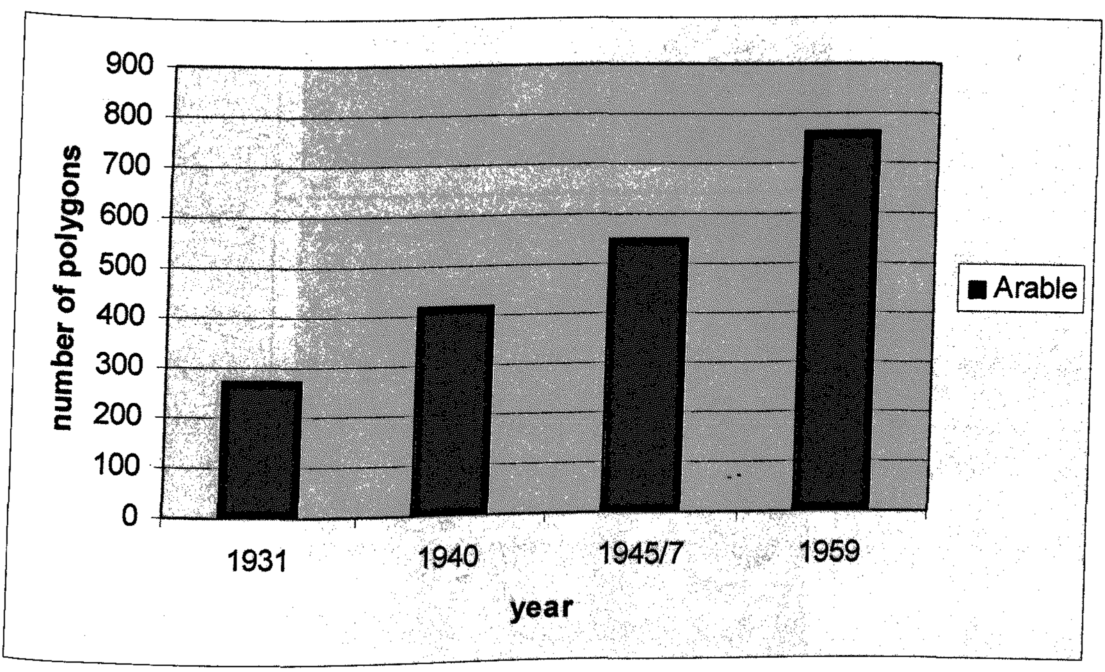


Figure 127: Number of Arable polygons in the study area 1931-1959

The mean polygon size has dropped from 15.52 acres in 1931 to 12.34 acres in 1959. This decrease in polygon size is perhaps surprising, as Arable field size would be expected to increase as cultivation became more mechanised and holdings became larger.

It is clear, however, from visual inspection of the 1959 aerial photographs that hedgerows are thinning and beginning to disappear. Figure 128 shows the area around Norlington in Ringmer parish in 1940 and 1959 (no aerial photographs are available for 1931). The field boundary circled in red has disappeared except for three trees and the hedgerow circled in green has become much sparser. The field boundary circled in blue has completely disappeared and it is not difficult to imagine the fields in the centre of the picture merging into one large Arable field.

Figure 128: The area around Norlington in 1940 and 1959

Source: University of Sussex

On visiting the same area in January 2009, it became clear that the field boundary had indeed disappeared, with the whole area being cultivated as one large arable field. Only a few isolated trees remained, as shown in Figure 129.

Figure 129: The area around Norlington in January 2009

There are at least two possible reasons for the disappearance of hedgerows. The first is the availability of grants from the 1950s to encourage this, allied to the growth of mechanisation. The second reason stems from the 1930s depression. Westmacott and Worthington argue that:

> "During the depression of the 1930s, hedge maintenance was a luxury few could afford and hedges often became overgrown. In the war years, with the emphasis on maximum production, the 'niceties' tended to be overlooked...On stock farms the neglect of the 1930s and 1940s led to large numbers of internal hedges being browsed with the result that weak places were created. The typical run-down hedge became a line of leggy bushes with crowns for shade but no firm bottom...Replanting of hedges was rarely entertained as a possibility and, coupled with the need for better grassland management, removal

and replacement with post and wire took place" (Westmacott and Worthington 1974, p41).

Some of the disappearance of hedgerows towards the end of the study period may therefore be connected more with earlier neglect than with the active inducements to hedgerow removal offered by the grant schemes of the 1950s.

Heath and Rough Grazing

The graph in Figure 130 suggests that the level of Heath and Rough Grazing has fluctuated between 1931 and 1959 with an overall gain of 764.09 acres. Some of this gain may have been at the expense of the Meadow and Grassland which was not lost to Arable use.

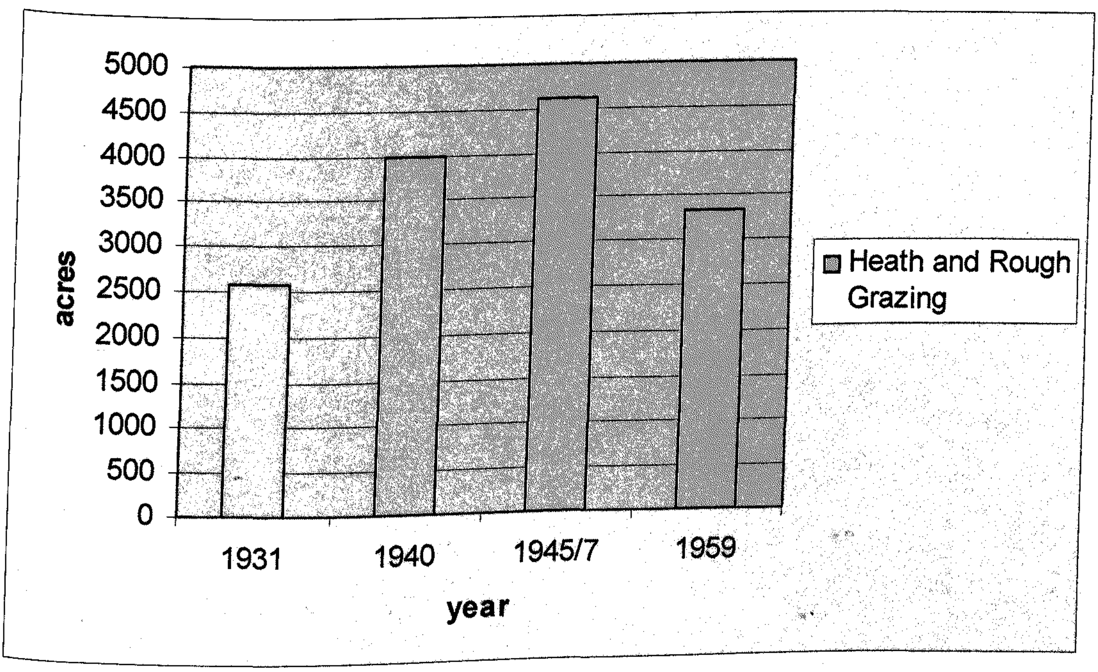


Figure 130: Heath and Rough Grazing acreages for the whole study area 1931-1959

Figure 131 shows the changing distribution of Heath and Rough Grazing between 1931 and 1959. Stamp defined Rough Grazing as "uncultivated" or "unimproved" land (Stamp 1950, p29). Chapter 4 included a discussion about the difficulties encountered in distinguishing between different types of grassland, and this difficulty may well account for some of the fluctuation in the Heath and Rough Grazing acreage.

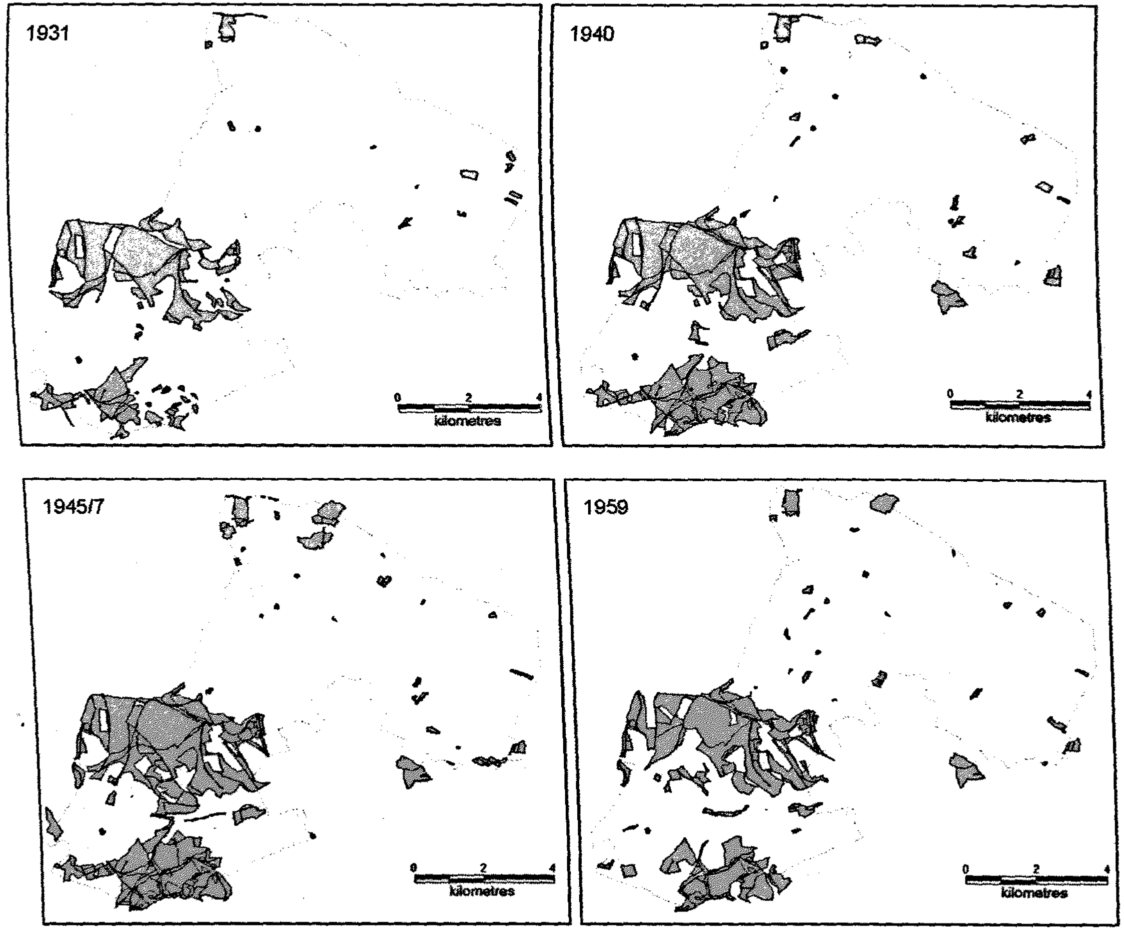


Figure 131: Distribution of Heath and Rough Grazing 1931-1959

Figure 132 shows part of the South Downs close to Kingston near Lewes. The area outlined in red was categorised as Meadow and Grassland on the LUS one inch maps. However most of the same area was marked as Heath and Rough Grazing on the LUS field sheets (shaded in yellow on Figure 132). By 1940 about half of the area was designated as Heath and Rough Grazing with the remainder being Arable and in 1959 the acreage of Heath and Rough Grazing had shrunk even more.

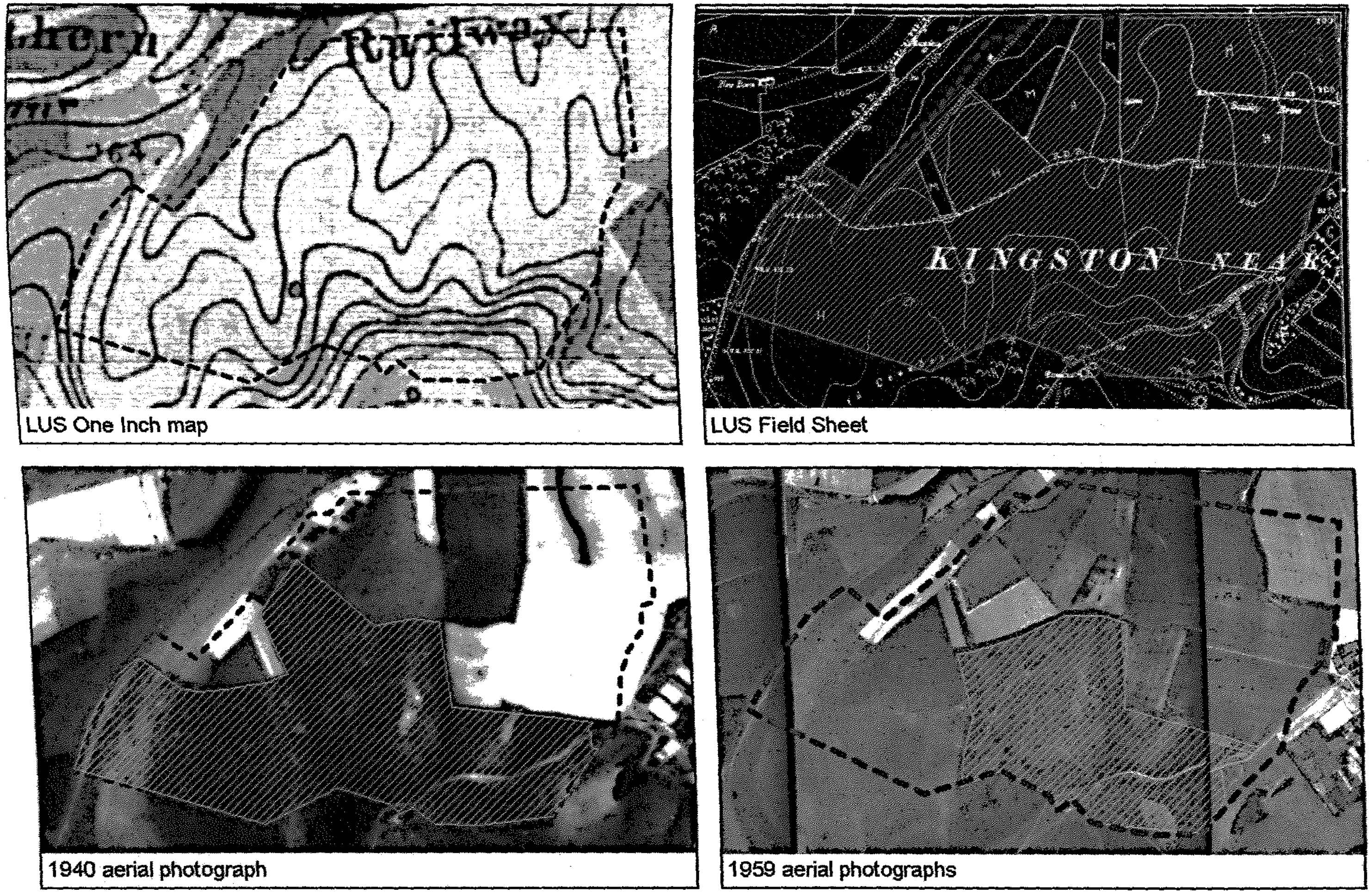


Figure 132: Changing areas of Heath and Rough Grazing on the South Downs
Source: University of Sussex, London School of Economics

The expected scenario for the period 1931-1959 was that the acreage of Heath and Rough Grazing would show a decline over time. According to the figures given in the census returns, all of the parishes except for Hamsey had less rough grazing in 1959 than in 1931. However the census figures also show a dip in rough grazing during the war years as land was taken over by the military. A possible reason for the gain in Heath and Rough Grazing as identified from the aerial photographs is that the requisitioned land which remained uncultivated would appear as rougher land and not as Meadow and Grassland. It would therefore be classified as Heath and Rough Grazing during the war years and just after, and would only revert to its former use once the land had been returned to the farmer, hence the lower acreage for Heath and Rough Grazing in 1959.

A further possible explanation for the unexpected overall growth in Heath and Rough Grazing is the difficulty in distinguishing this category from Meadow and Grassland, which has already been discussed at length. Given the significant differences which were found between the LUS field sheets and one inch map as described in Chapter 4 and illustrated in Figure 132 above, it may be that the baseline figure for Heath and Rough Grazing taken from the one inch map is actually too low. The total area of Heath and Rough Grazing identified on the Field Sheets is much higher at 3,676 acres as opposed to 2,570 acres from the one inch map. If this is compared with the data for 1940-1959 as shown in Figure 133 the fluctuation in acreage is much less and there is an overall decline in Heath and Rough Grazing between 1931 and 1959 of 342.16 acres. This corresponds better with the census figures which show a total decrease in rough grazing of over 2,500 acres between 1931 and 1959.

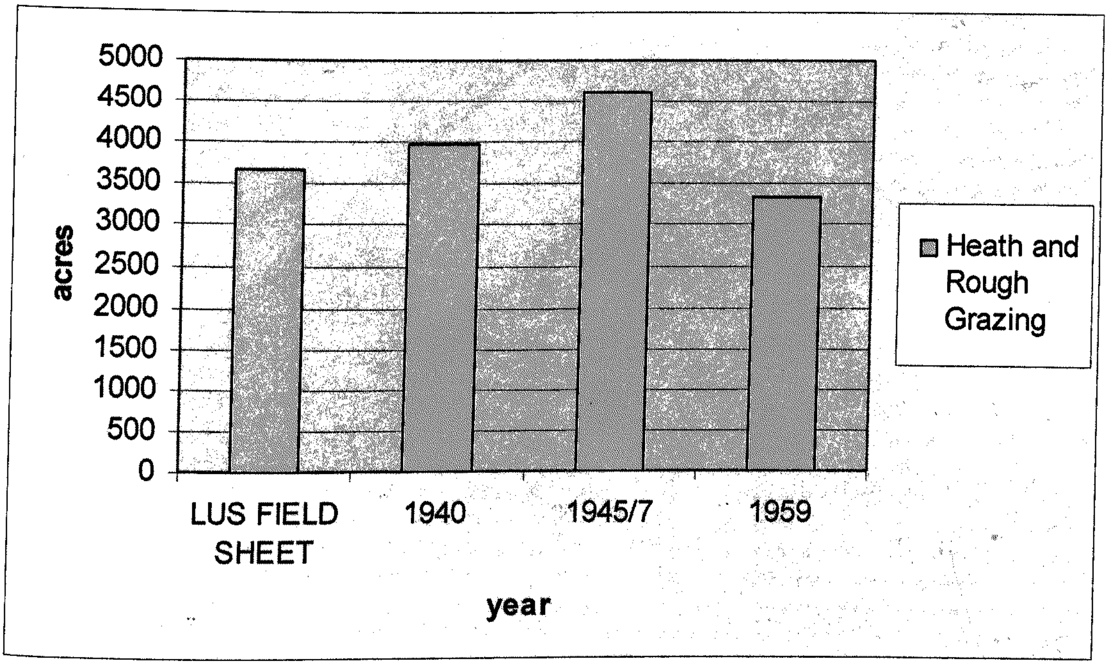


Figure 133: Heath and Rough Grazing acreages from the LUS Field Sheets compared to Heath and Rough Grazing acreages for 1940-1959

Gardens etc.

The Gardens etc. category has two main components. The first is houses with "gardens sufficiently large to be productive of at least some garden produce" (Stamp 1950, p30). Stamp notes that "it was not possible to lay down an exact size of garden for inclusion in this category, but it corresponds at least roughly to 12 or fewer houses to the acre" (Stamp 1950, p31). In terms of this project, anything that looked like a house and garden, including the building itself, was assigned to the Gardens etc. category and no attempt was made to estimate the housing density.

The second component of this category is allotments, orchards and nurseries. These can usually be distinguished from Arable land as there are a number of smaller sections of different crop type within each field, as shown by the example in Figure 134, which is a smallholding close to Kingston near Lewes. It is the orchards section of this component which is comparable to the census data presented earlier in this chapter.

Figure 134: Smallholding close to Kingston near Lewes in 1959

As expected the Gardens etc. category showed a gradual increase in acreage over the study period, as shown in Figure 135, with a total increase of 364.67 acres between 1931 and 1959. The largest jump is, unsurprisingly, between 1945/7 and 1959, as there was an increased need for housing immediately post-war. The number of polygons shows a steady increase over the study period as well, growing from 1,012 in 1931 to 1,168 in 1959.

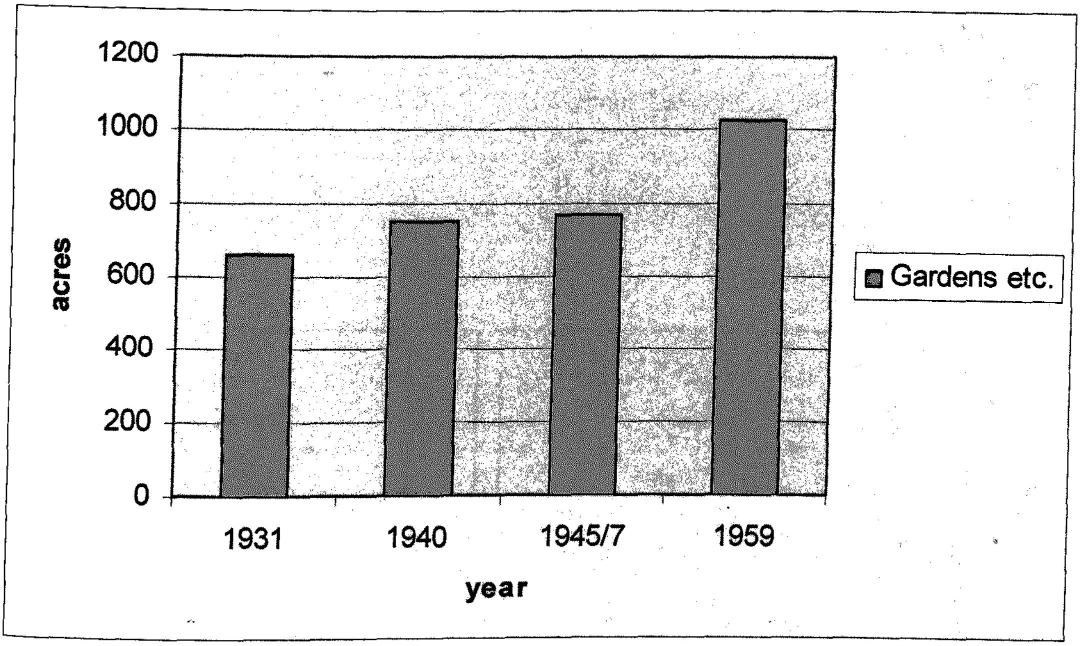


Figure 135: Acreage of Gardens etc. 1931-1959

Figure 136 shows the distribution of Gardens etc. from 1931-1959.

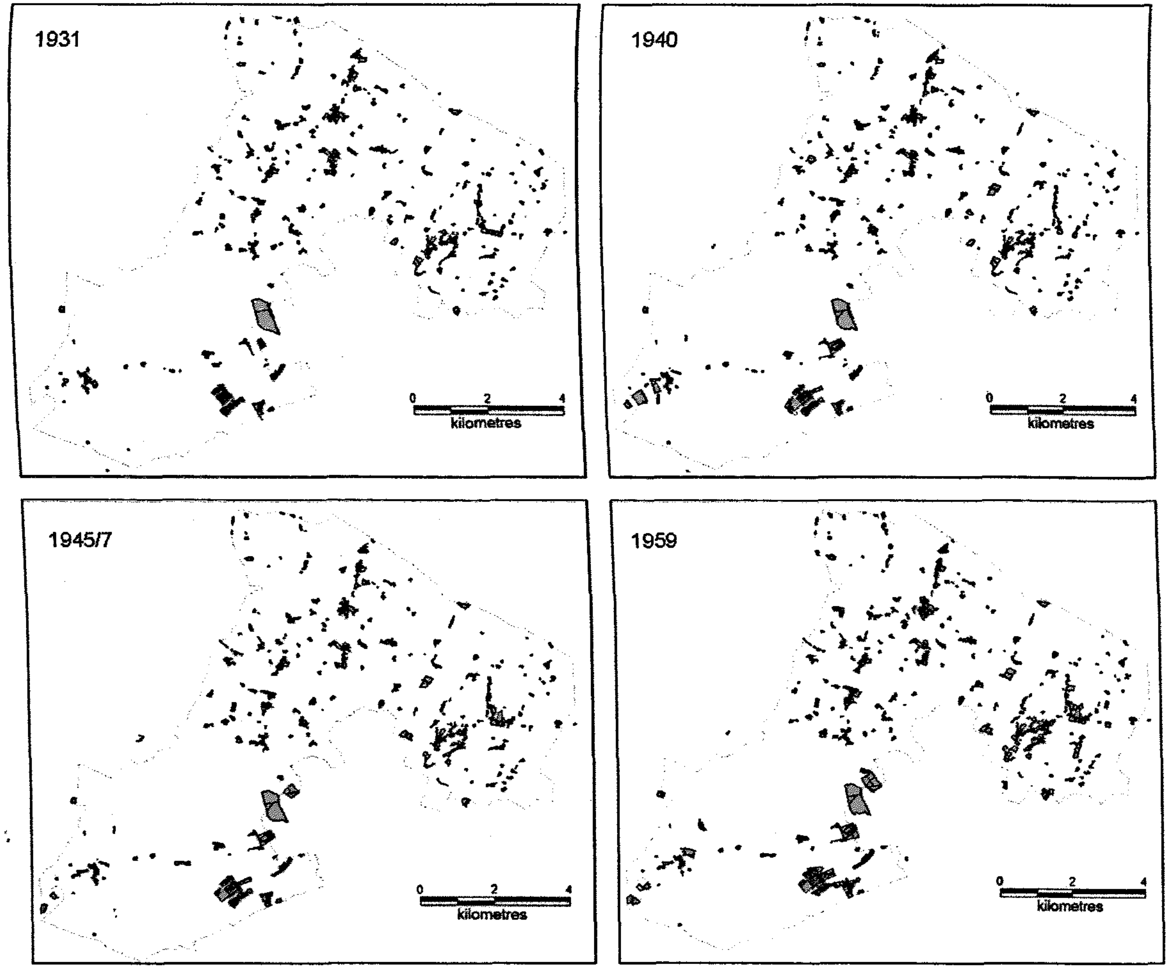


Figure 136: The distribution of Gardens etc. 1931-1959

There are three areas where the expansion in housing is most obvious, as shown circled in red in Figure 137. The Landport estate has appeared on the outskirts of Lewes, and the villages of Kingston near Lewes and Ringmer have both grown noticeably between 1931 and 1959. In 1931 the area around Ringmer was mainly classed as Meadow and Grassland and the parts of Kingston which have become housing were a mixture of Arable and Meadow and Grassland.

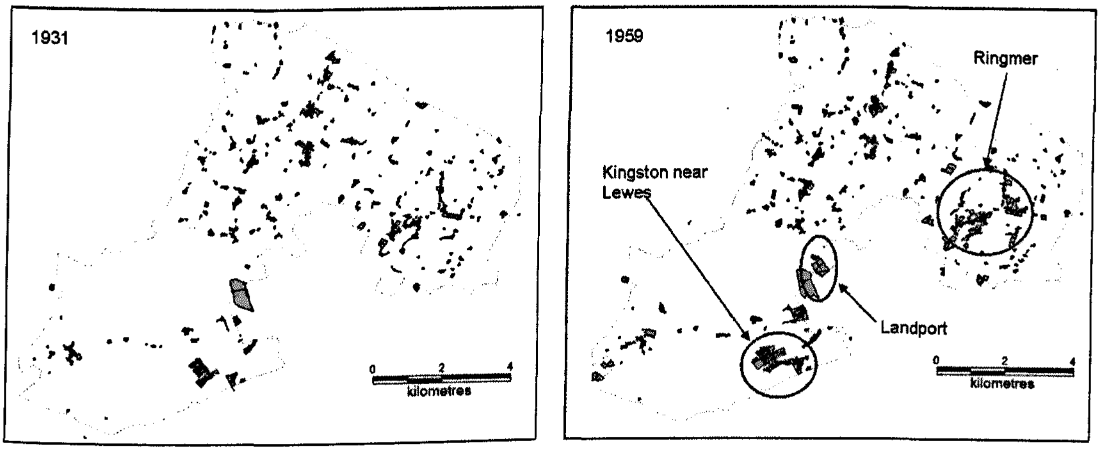
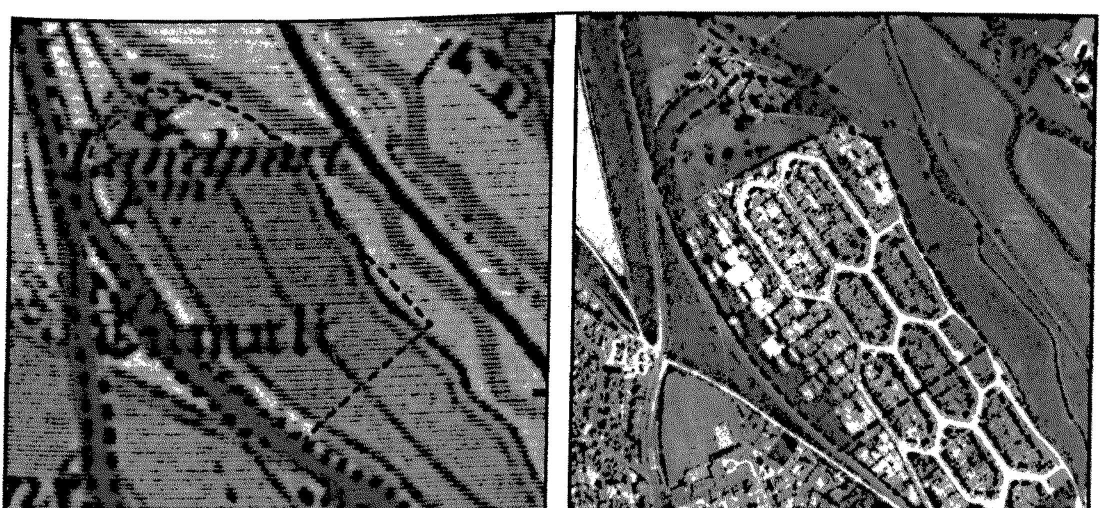


Figure 137: Growth in housing between 1931 and 1959

Landport was classed as Arable in 1931 as can be seen from the area outlined in red on Figure 138.



Landport Farm in 1931

Landport in 1959

Figure 138: The spread of housing across Landport Farm between 1931 and 1959
Source: University of Sussex

The growth of Ringmer has been charted by Ambrose who notes that the number of properties in Ringmer in 1934 was 499 (Ambrose 1974, p50). By 1971 this had more than doubled to 1,263 properties (Ambrose 1974, p69).

Water

This category mainly includes rivers and streams although some ponds were distinguishable from the maps and aerial photographs. Figure 139 shows the acreage of Water from 1931-59 and Figure 140 shows the distribution of Water.

The acreage of Water for 1931 is much lower than for the other years which are reasonably consistent. The number of polygons is also lower at 297 for 1931 compared to 466 for 1940. This may be due to the generalisation of the one inch LUS maps, which would have meant that some of the detail of smaller features was lost. Between 1940 and 1959 there is a slight overall decline of 2.36 acres in the total area of Water which may be attributable to the loss of some agricultural land to housing.

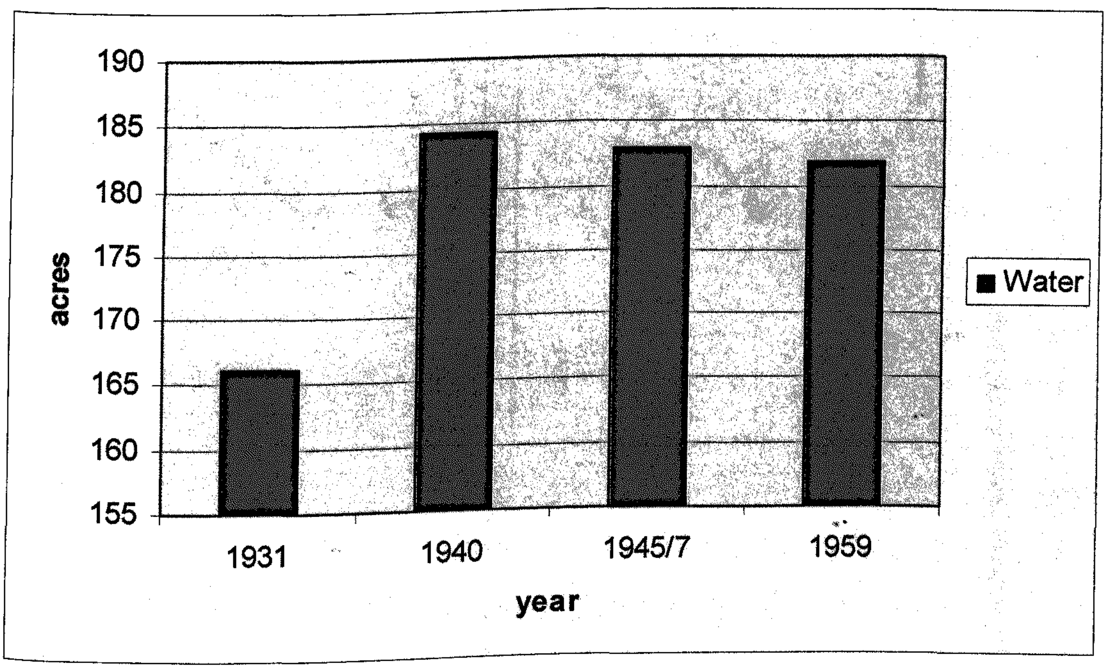


Figure 139: Acreage of Water 1931-1959

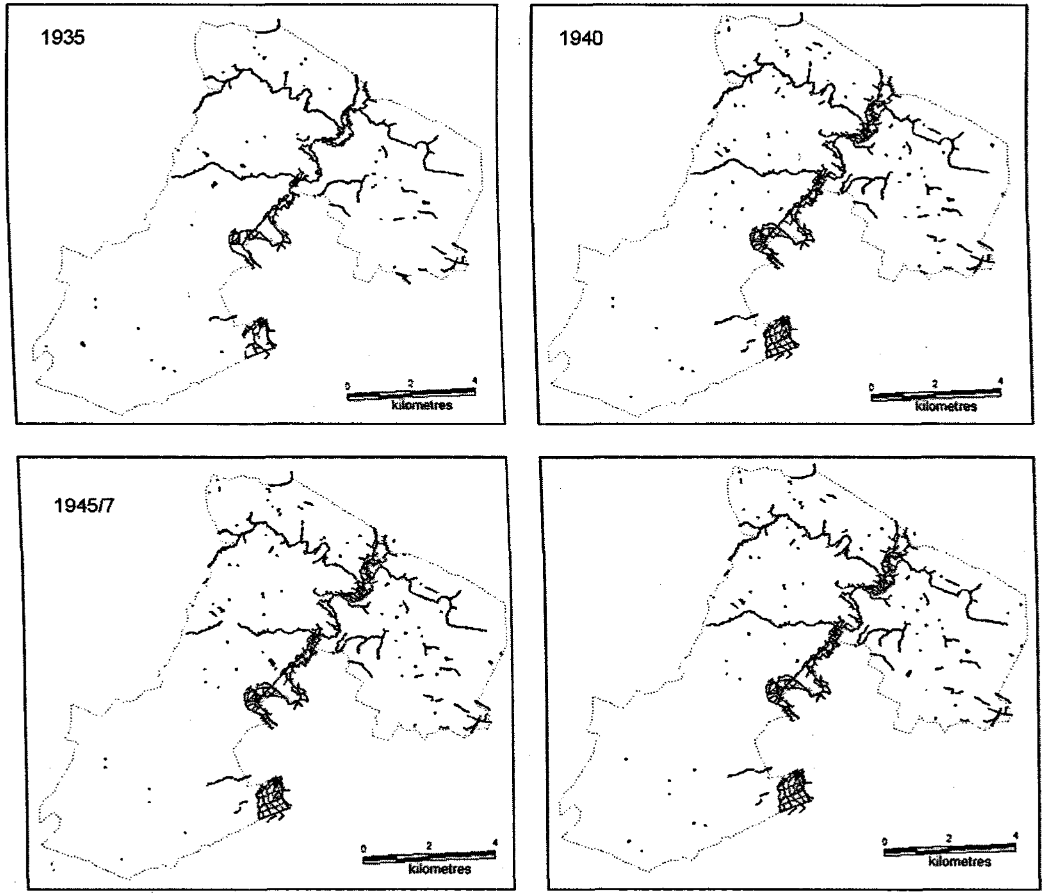


Figure 140: Distribution of Water 1931-1959

Land Agriculturally Unproductive

The final land use category is Land Agriculturally Unproductive. This includes roads and railways as well as industrial areas such as brickworks, and other unproductive land which does not fall into another category, such as churches and cemeteries. Figure 141 shows the acreage of Unproductive land from 1931-1959 and the distribution is shown in Figure 142. Between 1931 and 1959 there was an overall gain in Unproductive land of 8.38 acres.

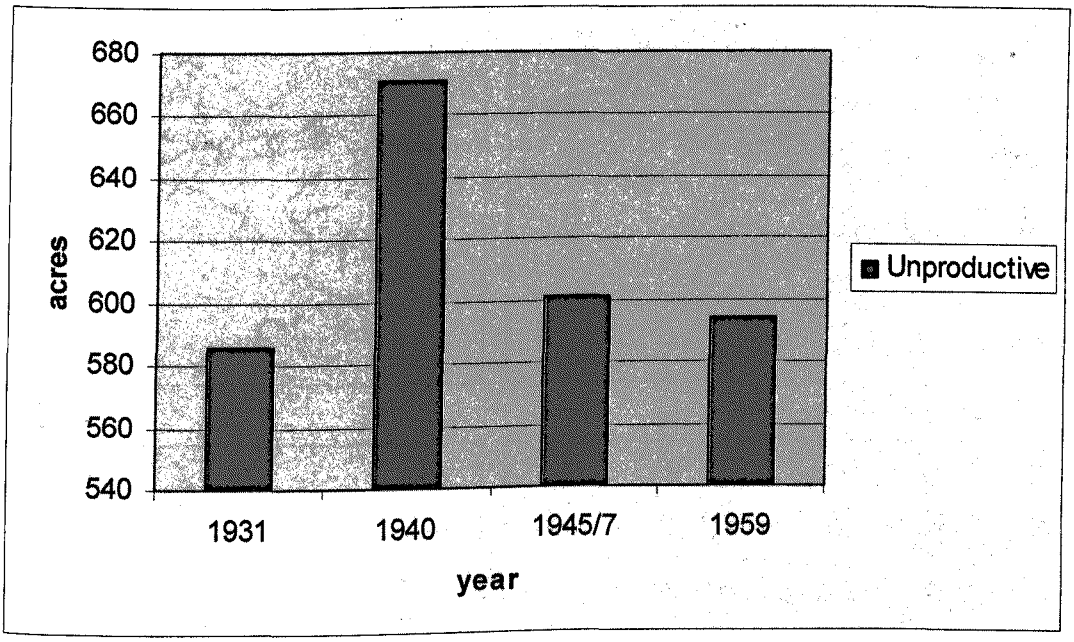


Figure 141: Acreage of Unproductive land 1931-1959

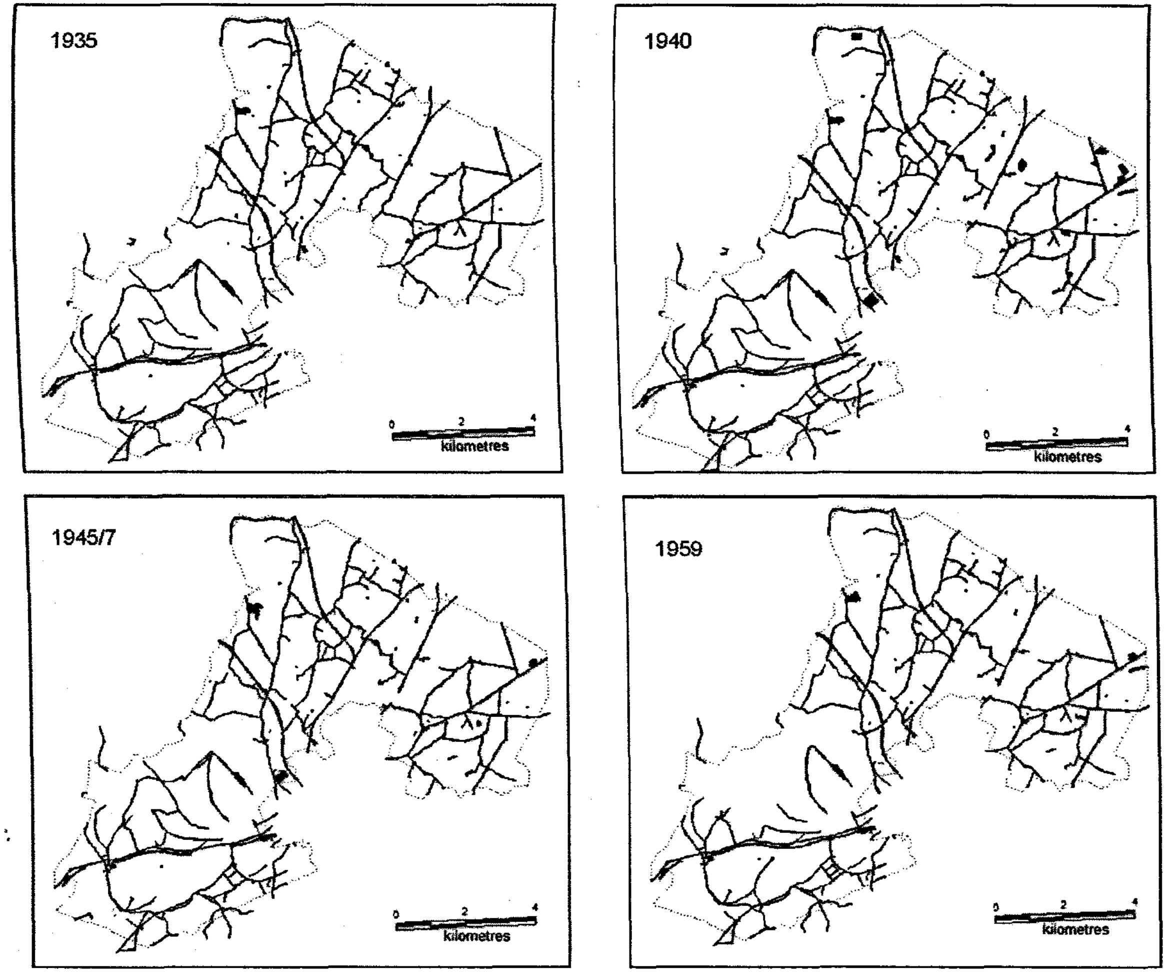


Figure 142: Distribution of Unproductive land 1931-1959

There is a noticeable peak in the acreage of Unproductive land in 1940 as compared to the other years. This may be due in part to 19.52 acres of derelict fields belonging to farms XE 218/89/003 and XE 218/110/017 which were only identified in the 1940 dataset from the NFS records. The Landport estate, which occupies around 49 acres of the study area, was Arable land in 1931, classed as Unproductive whilst it was being built in the 1940s and only changed to Gardens etc. as the houses were completed.

Summary

The pattern of change in land use between 1931 and 1959 was largely as expected, especially when looking at an overview of the whole study area. However, when considering each type of land use in detail some interesting trends were observed. The dip in Forest and Woodland acreage in 1945/7, presumably due to extraction of timber for the war effort, was unexpected. The loss of Meadow and Grassland to Arable was less surprising. However this was not a straightforward transformation from Meadow and Grassland to Arable, as over 1,000 acres of Meadow and Grassland were lost to other land uses in the course of the study period.

The doubling in Arable acreage was expected, but it was interesting to note how the Arable land spread, with new Arable fields tending to be created adjacent to existing Arable land rather than in isolation. The Arable areas thus become more "concentrated" over time and tended to swallow up the Meadow and Grassland in between.

Heath and Rough Grazing had proved to be a problematic category for the surveyors of the LUS, and considerable difficulties were encountered during this project in differentiating this category successfully. Therefore the results are felt to be somewhat unreliable, although using the LUS field sheets for comparison rather than the figures from the one inch map tended to produce more satisfactory results.

One of the reasons that the LUS was undertaken was a growing concern over uncontrolled urban growth and during the study period clear expansion in the areas occupied by housing, as represented by the Gardens etc. category, is evident, particularly around Kingston near Lewes, Ringmer and Landport on the outskirts of Lewes.

The acreage of Water has changed very little between 1940 and 1959, although the 1931 acreage appears to be lower, perhaps due to the effects of map generalisation. The acreage of Unproductive land has also changed by less than seven acres over the study period, despite a peak in 1940.

These results will be discussed more fully in the next chapter and placed in the context of the census data presented above. The final section of this chapter considers the parishes of Barcombe and Kingston near Lewes in more detail.

The Parishes of Barcombe and Kingston

The parish of Barcombe lies in the Weald in the north of the study area and has been used as the pilot area for this project.

Figure 143: View of Barcombe village, January 2009

It was felt that it would be useful to compare and contrast the results obtained for Barcombe with a parish lying to the south of the study area and including some downland. Kingston was chosen for this purpose. The whole parish falls within the study area and the western side of the parish includes part of the South Downs.

Figure 144: View of Kingston and the South Downs from Ashcombe, January 2009

The relative locations of Barcombe and Kingston are shown in Figure 145. As has been explained previously, part of Barcombe lies outside the study area by virtue of falling outside the area covered by the 1940 aerial photograph. The remainder of this section therefore relates only to the portion of Barcombe which falls into the study area.

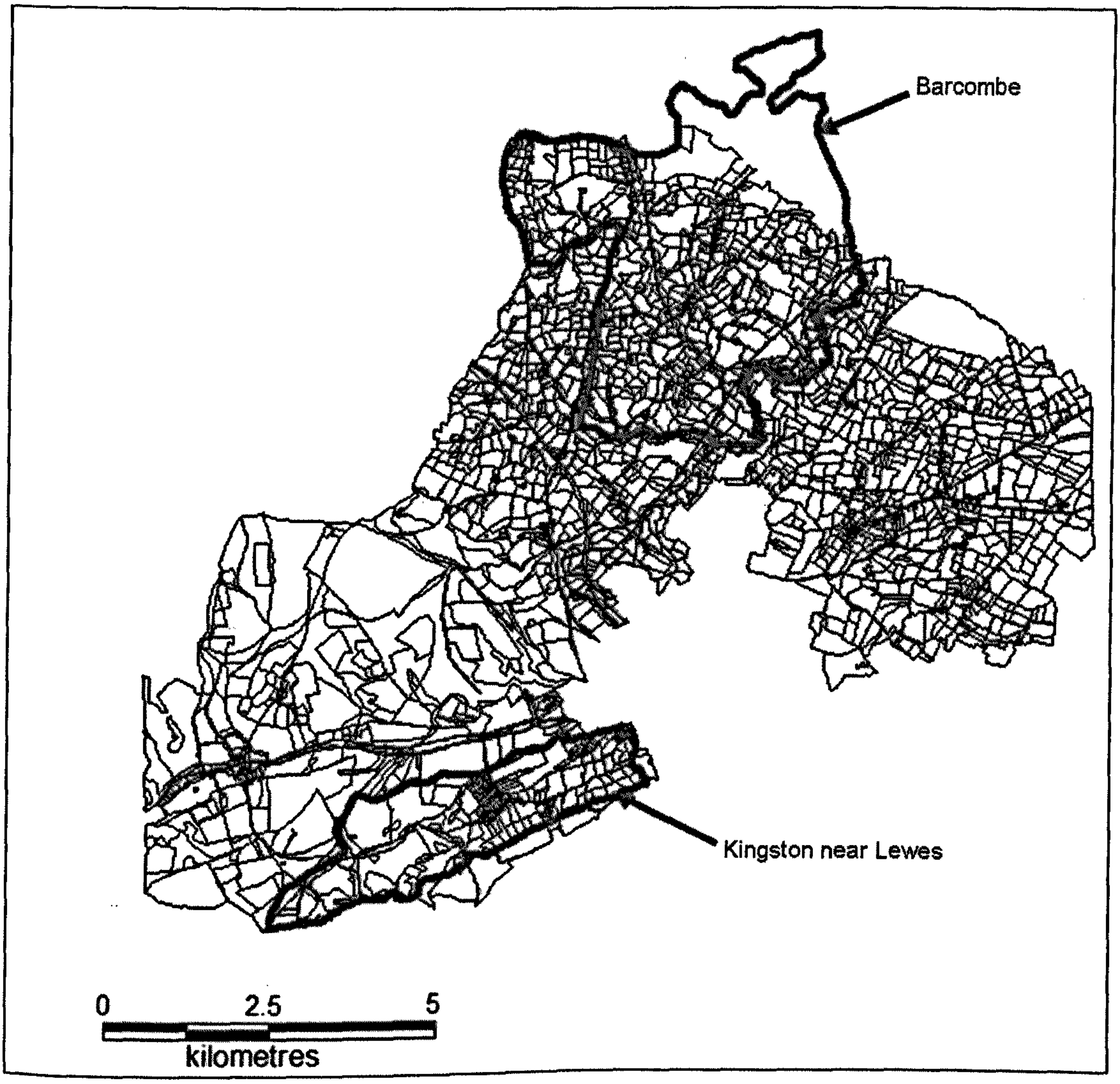


Figure 145: The location of Barcombe and Kingston parishes relative to the study area
Source: Parish boundaries from UK Borders

The different characteristics of the two parishes can be clearly seen by looking at the land use in 1931 (from the one inch maps). The area of Barcombe within the study area is just over 4,000 acres whereas Kingston occupies just over 1,600 acres. Therefore instead of directly comparing the acreage for each land use type, each class has been shown as a percentage of the total acreage for each parish. The results are shown in Figure 146 and Figure 147.

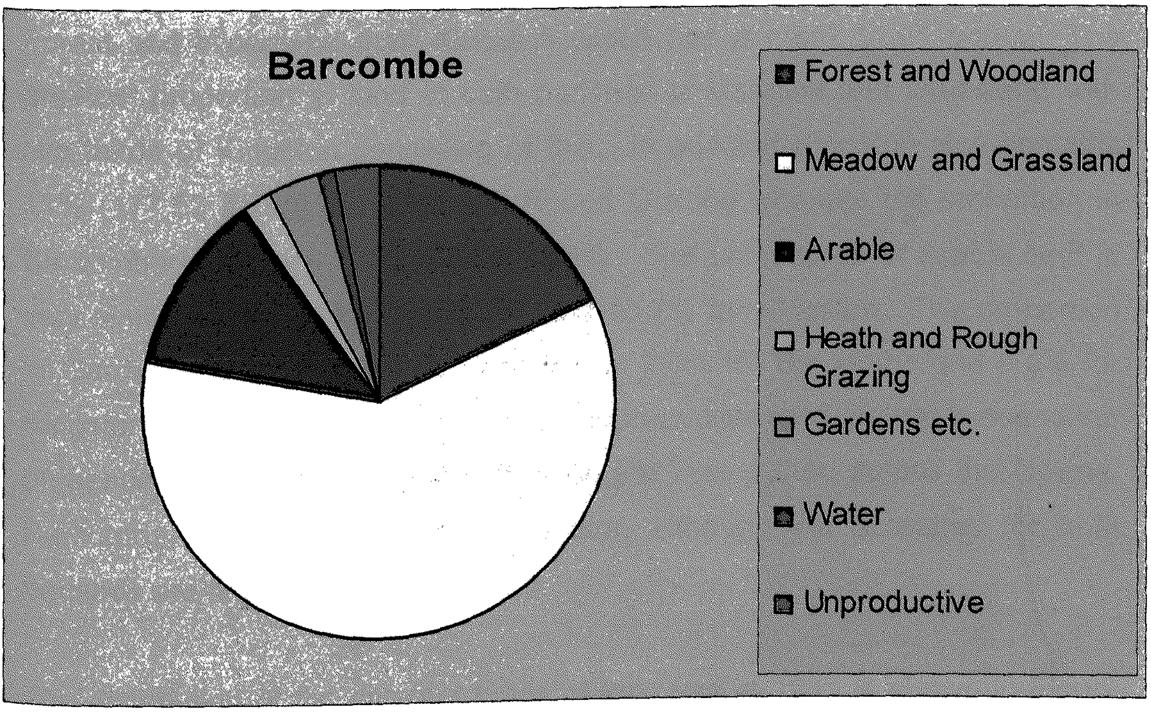


Figure 146: Percentage of each type of land use for Barcombe in 1931

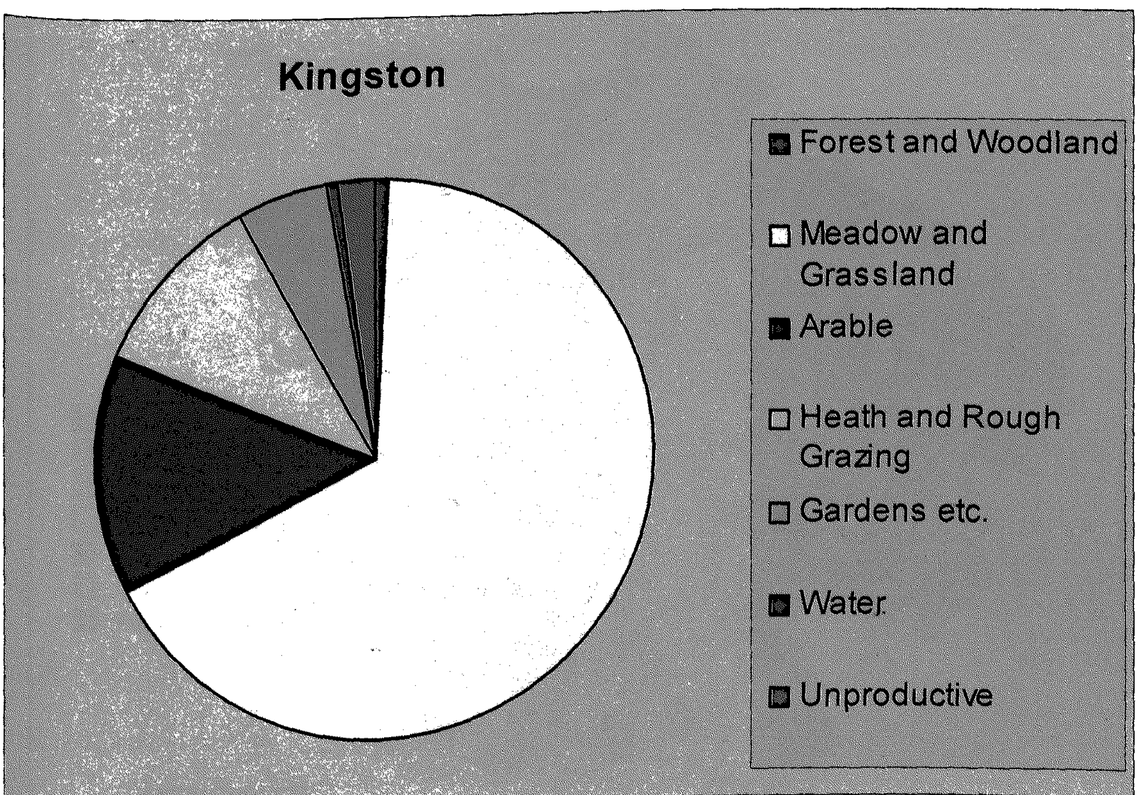


Figure 147: Percentage of each type of land use for Kingston in 1931

One of the most striking features is that Barcombe has considerably more Forest and Woodland than Kingston which has a mere 11.61 acres. The greatest proportion of land in both parishes is Meadow and Grassland with two thirds of Kingston consisting of this. In addition Kingston also contains 11% (177.53 acres) of Heath and Rough Grazing whereas the proportion in Barcombe is a mere 1.9% (76.01 acres). The percentage of Arable land is very similar at 12.7% for Barcombe and 13.7% for Kingston. The proportion of Gardens etc. is also almost identical at 3.5% for Barcombe and 3.4% for Kingston. Barcombe has slightly more Unproductive land, probably due to the presence of more road and rail links on the Weald than across the Downs. Barcombe also has slightly more Water, although the acreages for both parishes are tiny.

The distribution of the different types of land use in 1931 is shown in Figure 148 and Figure 149.

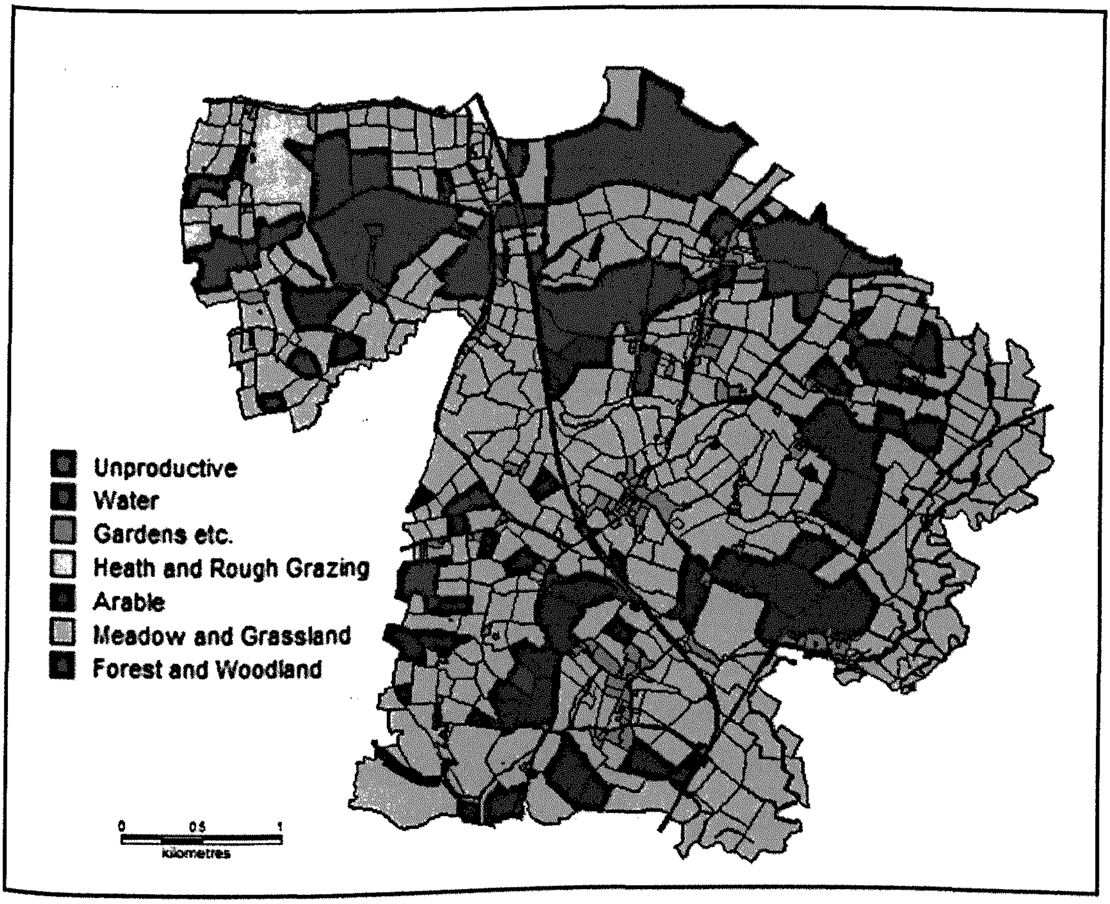


Figure 148: Land use in Barcombe in 1931 from the LUS one inch maps

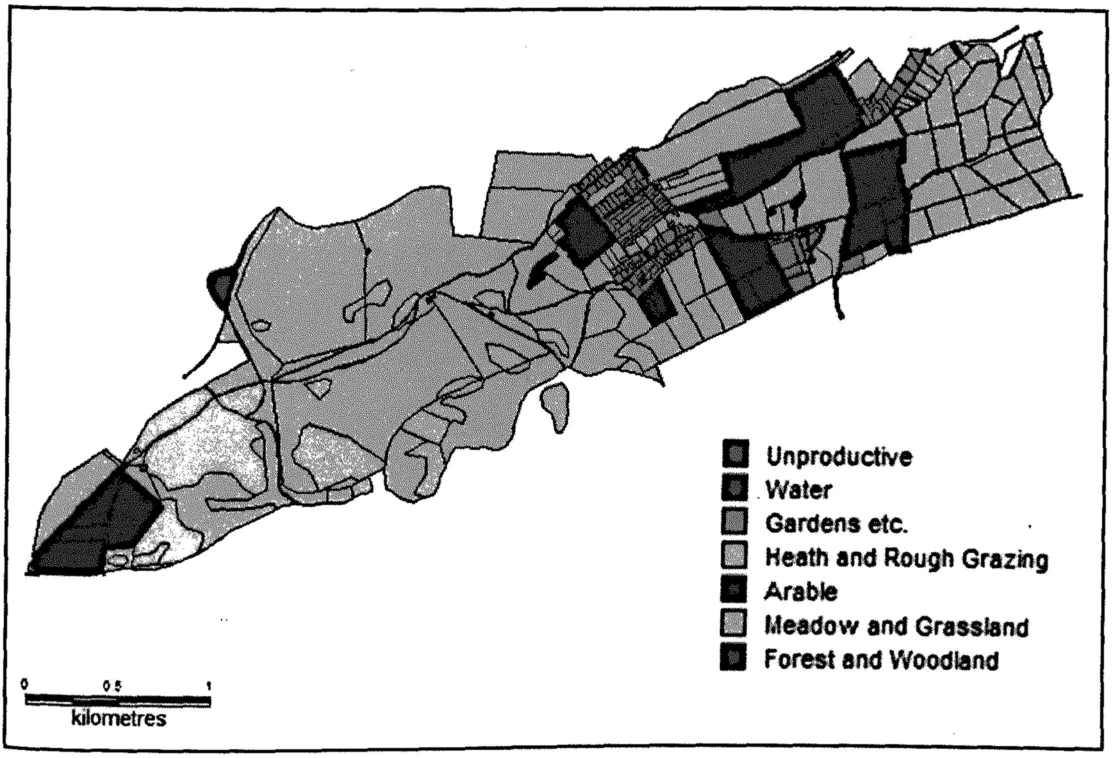


Figure 149: Land use in Kingston in 1931 from the LUS one inch maps

Again some differences between the characteristics of the two parishes are evident. In Barcombe the Forest and Woodland tends to be concentrated in the northern half of the parish whereas the Arable tends to lie in the south and south east. A lot of the housing (Gardens etc.) is situated along the road which runs roughly north-south through the centre of the parish. In Kingston the particular character of the South Downs is very evident with no housing at all in the south west half of the parish which mainly consists of Heath and Rough Grazing and Meadow and Grassland. The north east of the parish has most of the arable land and also three concentrated blocks of housing.

A further difference between the two parishes is the number of polygons and polygon size. Although there are a few large blocks of Forest and Woodland, the polygons in Barcombe generally appear smaller and the mean polygon size is 3.71 acres for a total of 1,092 polygons. In Kingston, particularly the south western half of the parish, polygons are much larger. However the mean polygon size is only 3.82 acres for a total of 423 polygons due to the many small housing polygons making up the village of Kingston near Lewes.

Figure 150 and Figure 151 show the pattern of change over time for the different types of land use in Barcombe and Kingston.

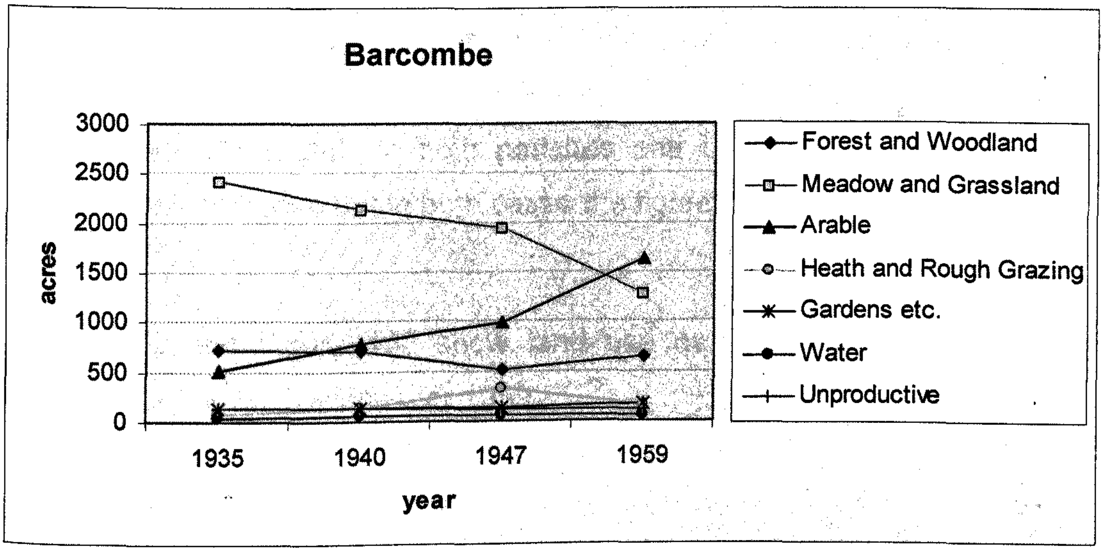


Figure 150: Land use change 1931-1959 for Barcombe parish

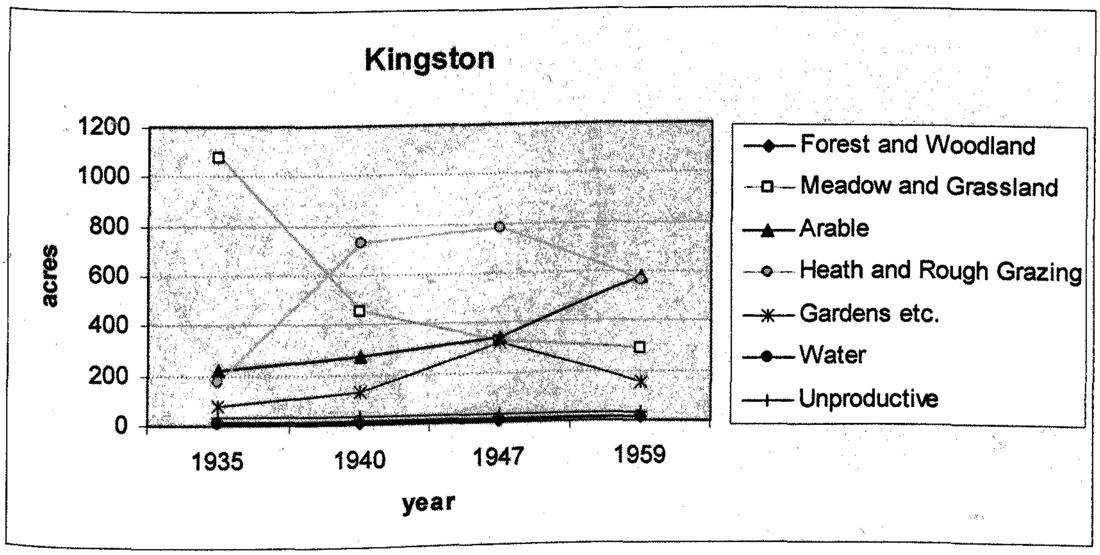


Figure 151: Land use change 1931-1959 for Kingston parish

In Barcombe, Forest and Woodland declines over the study period with a noticeable dip in 1947. In Kingston the acreage of Forest and Woodland remains almost static throughout with a total gain of 1.64 acres between 1931 and 1959. As perhaps would be expected, the Meadow and Grassland acreages decline steadily throughout the study period for both parishes with a particularly steep drop in 1940 for Kingston. A significant amount of land in Kingston was requisitioned by the military and so this may account for the particular decline in 1940. In both parishes the Arable acreage more than doubles in the course of the study period. Interestingly, there is a peak in Heath and Rough Grazing in both parishes in 1947 and a significant overall increase in acreage between 1931 and 1959. Barcombe has a fairly modest increase in Gardens etc. whereas the growth in Kingston is more marked. Water increases slightly in both parishes and Unproductive land shows a slight overall decrease but in both cases the figures are very small.

Figure 152 and Figure 153 show land use as a percentage of the total acreage for the two parishes for 1959.

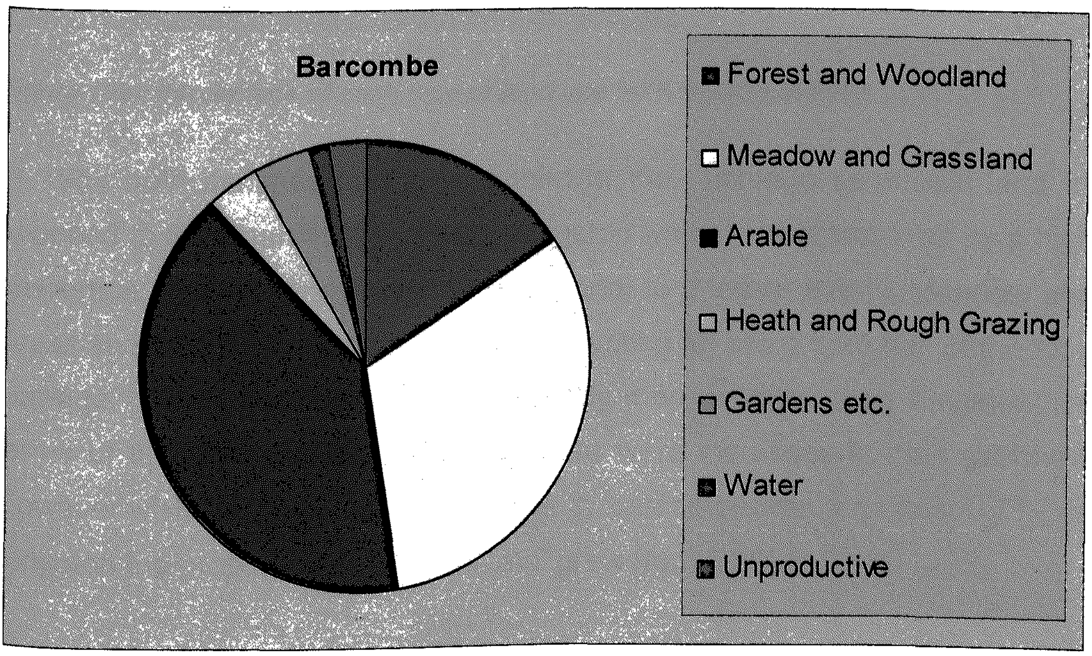


Figure 152: Percentage of each type of land use for Barcombe in 1959

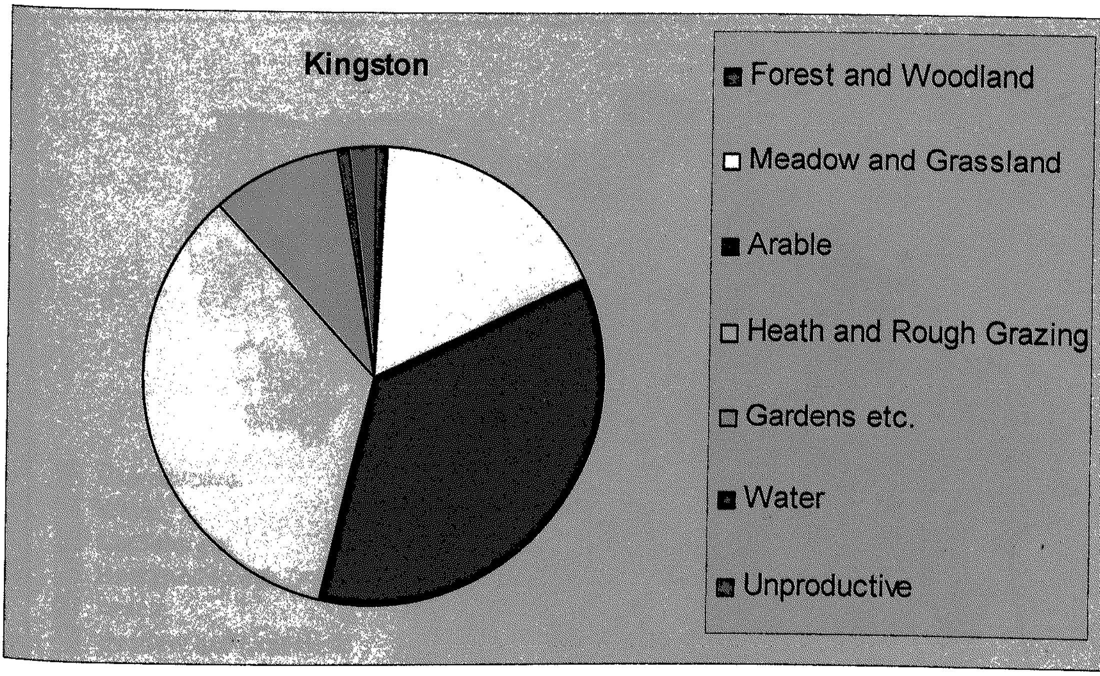


Figure 153: Percentage of each type of land use for Kingston in 1959

In 1959 both parishes had over a third of their acreage as Arable land as opposed to less than 15% in 1931. Kingston was still characterised by a high proportion of Heath and Rough Grazing and, to a lesser extent, Meadow and Grassland with these two categories accounting for more than half of the total acreage. Barcombe remained significantly more wooded than Kingston. In terms of the Gardens etc. category, there were increases in both parishes. However whilst the percentage increase in Barcombe was a modest 0.7%, in Kingston the proportion of Gardens etc. grew from 5.3% to 9.1%.

Turning to the distribution of the different land use types in 1959, Figure 154 and Figure 155 are thematic maps of the two parishes.

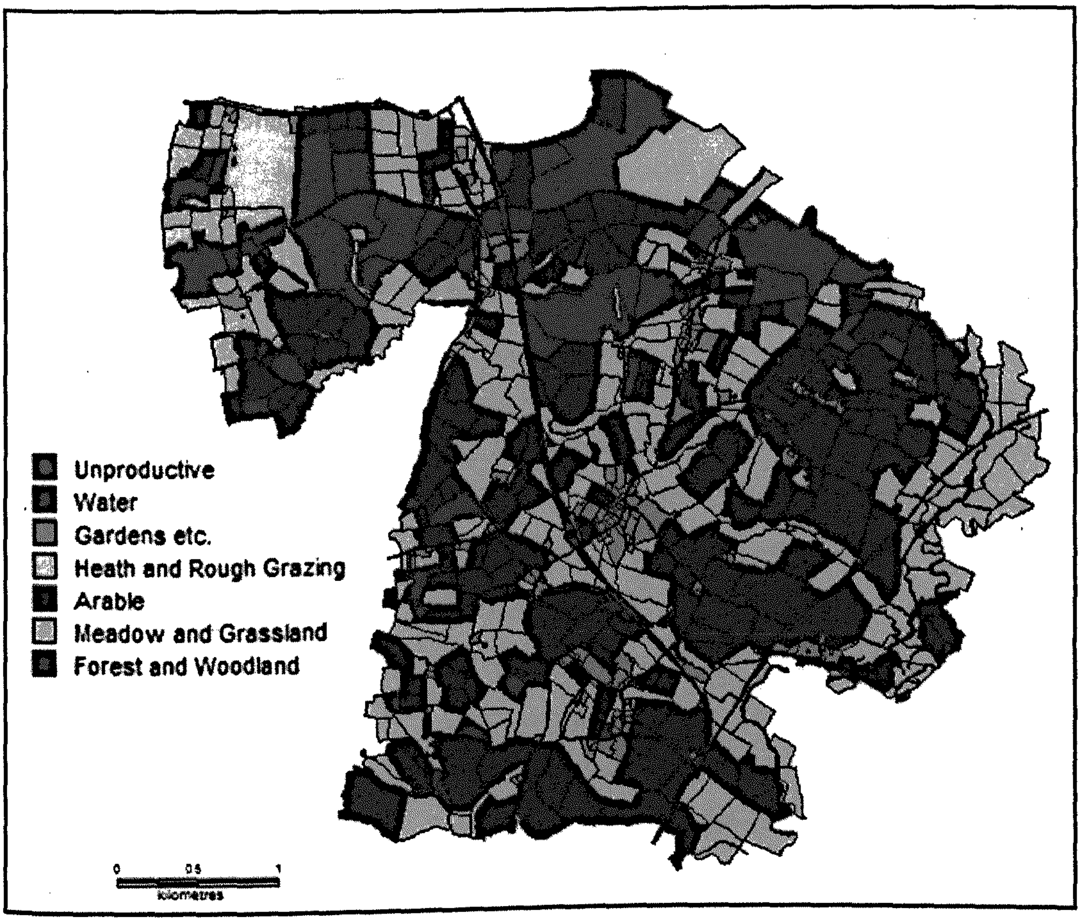


Figure 154: Land use in Barcombe in 1959

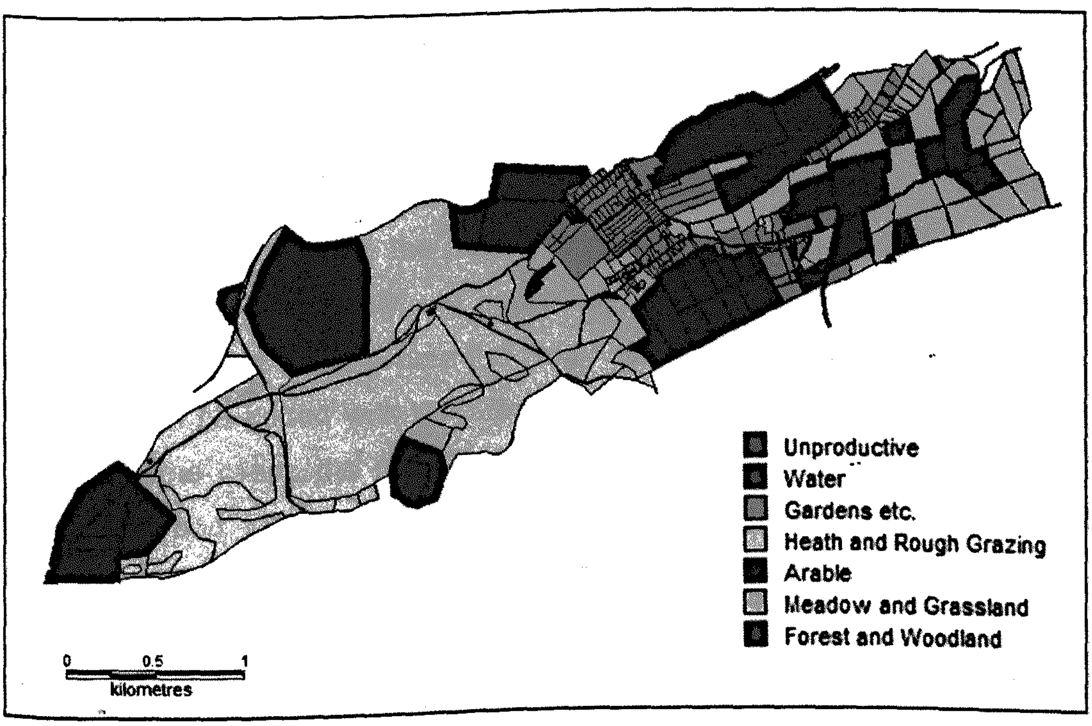


Figure 155: Land use in Kingston in 1959

The spread of Arable across the south eastern half of Barcombe is very evident as is the growth in Heath and Rough Grazing across the Downs in Kingston. There are also three new areas of Arable land in the south western half of Kingston. Mean polygon sizes in both parishes have decreased slightly to 3.60 acres for Barcombe and 3.76 acres for Kingston. The issue of polygon sizes will be addressed in more detail in the next section.

Field Size

One of the objectives of this study is to quantify the changes which occurred in the study area between 1931 and 1959 in order to see whether there is any evidence of a transition into productivism in this part of the UK. One of the indicators of this transition is a growth in field size as a result of increasing mechanisation. Mean polygon sizes have been presented above for Barcombe and Kingston and, surprisingly these seem to have decreased between 1931 and 1959. However it is clear that Kingston consists of some very large polygons on the Downs and also some very small polygons representing houses within the village of Kingston. It may therefore be useful to isolate the Meadow and Grassland and Arable classes for these two parishes to see whether any further conclusions can be drawn regarding field size. It is important to note that not all of the Meadow and Grassland lies within farms. Other areas of grassland such as school playing fields and village greens would also fall into this category.

It is also important to make the point that polygon sizes may not, in all cases, reflect field sizes accurately. In some cases, land use appears to change within a single field. In this case the field has been divided into two polygons so that it can be coded with the attribute data for the different types of land use. In some cases the field boundaries are simply unclear on the aerial photograph and so the polygons created using this as a base may not accurately reflect the arrangement of fields on the ground.

Particular difficulties were also experienced in identifying land parcels on the South Downs. Boundaries were not always clear on the OS maps for either

1931 or 1959 and some areas were very large. Polygons therefore tended to be divided into smaller units for ease of display and manipulation. In general the mean polygon sizes for areas including downland may therefore be smaller than they should be. However in the majority of cases the shape of the polygons does reflect the field boundaries and so mean polygon size is felt to be a useful, if somewhat crude, measure of changes in field size.

Looking first at Barcombe, the mean polygon sizes are as follows:

Meadow and Grassland:	1931 - 4.64 acres	1959 - 4.16 acres
Arable:	1931 – 10.31 acres	1959 - 8.59 acres

In both categories the mean polygon size has decreased over the study period.

The mean polygon sizes for Kingston are:

Meadow and Grassland:	1931 – 8.02 acres	1959 - 4.33 acres
Arable:	1931 – 10.09 acres	1959 - 14.74 acres

In Kingston, Meadow and Grassland polygons have almost halved in size between 1931 and 1959 whereas Arable has shown a significant increase. In 1931 Meadow and Grassland polygons in Kingston were significantly larger than those in Barcombe whereas by 1959 they are of a very similar size. Conversely in 1931, Arable polygons for both Barcombe and Kingston are a similar size whereas by 1959 mean polygon size in Kingston is more than 6 acres greater than in Barcombe.

Mean polygon size has changed significantly in Kingston in both the Meadow and Grassland and Arable categories and this may be relatively easy to explain due to the changing use of the downland. In 1931 much of the Downs was classed as Meadow and Grassland with some patches of Heath and Rough Grazing as shown by the thematic map in Figure 149. The Meadow and Grassland polygons are fairly large and this results in a relatively high mean size. In 1959 much of the downland has been reclassified as Heath and Rough Grazing and Arable and so the remaining polygons are much smaller, hence the drop in mean size for 1959. This also explains the rise in mean polygon size for Arable as larger fields are created on the Downs during the plough up campaign. Brandon, considering the Sussex landscape as a whole, argues that the South Downs have undergone the most radical change in the post-war era and describes "vistas of vast 'prairie' expanses devoid of enclosures except barbed-wire fences" (Brandon 1974, p268).

Figure 156: Court Farm, Falmer on the South Downs, January 2009

The results for Barcombe are more difficult to explain. One factor which may have had some effect is the geography of Barcombe. Brandon comments on the "wooded pattern of the landscape which gives the Weald its special charm" (Brandon 1974, p269). In the north of Barcombe parish there are substantial areas of woodland which, in some cases, extend between the fields, often as shaws or rows of mature trees, as shown in Figure 157. These would, perhaps, be more difficult to remove than a simple fence or hedgerow which may explain why the field size has not increased as it has in Kingston.

Figure 157: Field boundaries near Spithurst in Barcombe parish in 1959
Source: University of Sussex

However it is clear that the process of change has begun by 1959. Figure 158 "zooms in" on the area circled in red in Figure 157. Whilst the quality of the 1940 image is considerably poorer than the 1959 photograph, it does seem that the field boundary has thinned somewhat between 1940 and 1959 and it is quite conceivable that it could have disappeared altogether subsequently. The line of trees or bushes along the footpath running across the bottom of the image has already disappeared. Brandon notes that agricultural innovation in the Weald has often been "later and less extensive than elsewhere in Sussex" (Brandon 1974, p269).

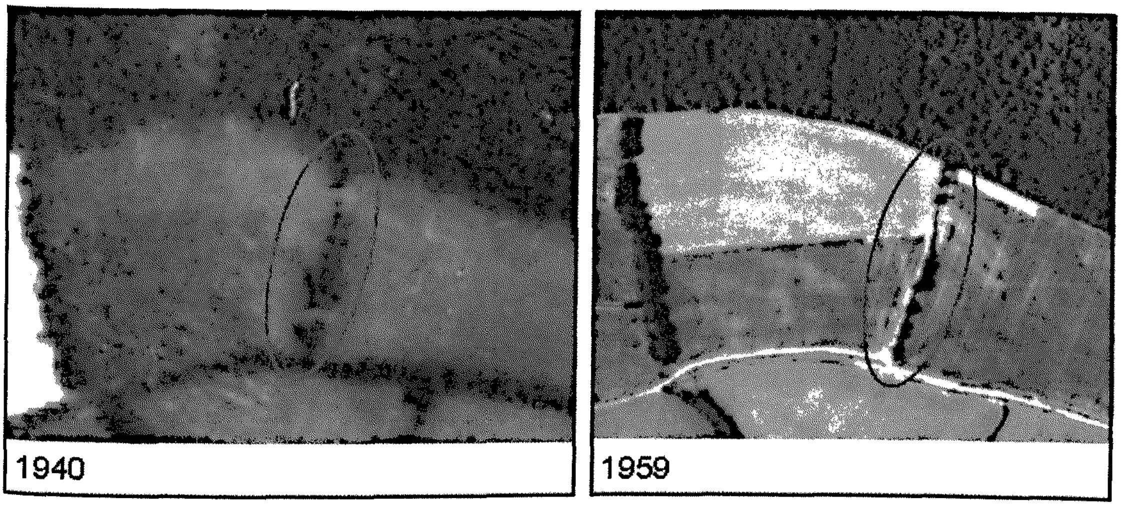


Figure 158: Detail of field boundary near Spithurst in 1940 and 1959
Source: University of Sussex

In addition to wooded field boundaries there is a considerable amount of water, including a number of ditches and drains, as shown in Figure 159 and Figure 160, which could make it difficult to enlarge fields.

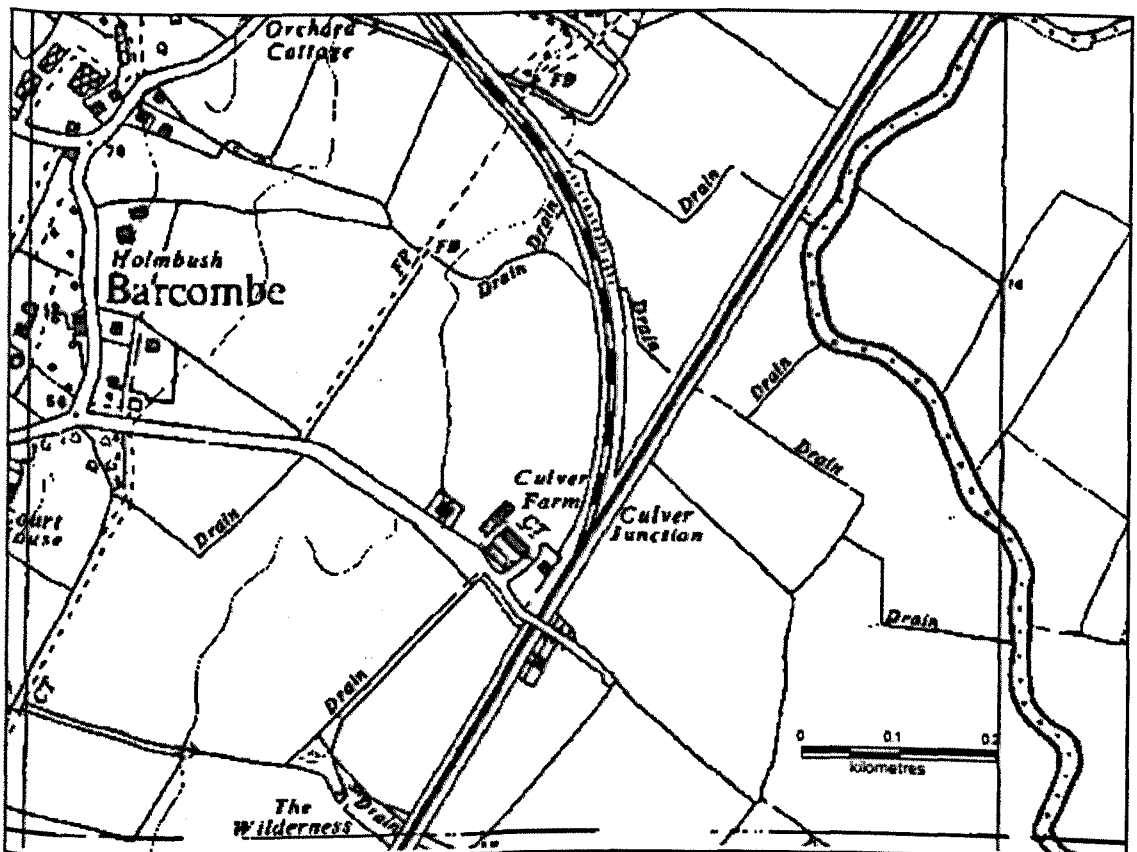


Figure 159: Network of drains around Culver Farm near Barcombe
© Landmark Information Group Ltd and Crown Copyright 2005

Figure 160: Ditch near the Old Mill, Barcombe, January 2009

It is possible that, whilst areas were ploughed up and the Arable acreage increased, the process of mechanisation was slow to get underway and had not fully taken place by 1959. However this seems unlikely given the general growth in mechanisation post-war. Martin notes that:

> "The growth of mechanisation in British agriculture can be quantified by the rapid rise in the numbers of tractors and combines on agricultural holdings. From 102,000 tractors in 1942, they nearly trebled by 1950 to 295,000, rising to 430,000 units in 1958" (Martin 2000, p106).

It would be surprising if this huge rise in the numbers of tractors had bypassed East Sussex entirely.

It was noted at the beginning of this section that mean polygon size serves as a somewhat crude indicator of field size, but may be useful in giving a general idea of trends. The results for Kingston are, perhaps those that would be expected with a reduction in mean polygon size for Meadow and Grassland and a considerable increase in Arable polygon size. The results for

Barcombe are more surprising with a relatively small reduction in mean polygon size for both categories. Reasons for this may include the slower pace of change in the Weald and the geography of Barcombe with its wooded field boundaries and drainage ditches.

Conclusion

This chapter has presented three sets of results. In the first section data from the parish summaries of the 4^{th} June agricultural census were presented in order to give a wider context to the results from this study. The second section looked at the study area as a whole and presented changes over time in each of the land use categories. The final section has considered two contrasting parishes in more detail and has identified some similarities but also some important differences between them. In the next chapter these results will be discussed in more detail in the light of the stated aims and objectives of this project.

CHAPTER 8: DISCUSSION

In Chapters 4, 5 and 6, the process of manipulating and analysing each of the datasets in this study was described. Chapter 7 brought the results of this analysis together and also presented information from the parish summaries of the 4th June census returns. The results for two parishes, Barcombe and Kingston, were examined in some detail to see whether any differences could be detected between the Weald to the north and the Downland to the south of the study area. In this chapter the results presented so far will be considered in the light of the primary aim and related objectives which were stated at the very beginning of the project.

The key aim of the study has been to reconstruct agricultural land use around Lewes in the mid-20th century. The first section of this chapter will consider some of the issues around reconstructing an agricultural landscape and how this has been achieved.

Reconstructing an Agricultural Landscape

The twentieth century landscape of Sussex has arisen as the result of repeated human intervention over many centuries. Brandon comments that "the beautiful bare uplands of the Downs and the wild heathlands of the Weald, are a scenic inheritance which probably owes as much to early man as to nature itself" (Brandon 1974, p44). Brandon and Short argue eloquently that:

> "To a quite unusual degree we can trace the evolution of the landscape and society by slow degrees over the course of centuries, and in particular, we are treated to the spectacle of the *becoming* of places. On account of the richness of historical associations, the region's human development can be clearly discerned in the intimate relations between local natural conditions and local material cultures of a society

rooted in the land and with the bulk of its population either working the land or serving those who did, and the successively accelerating stages over the past 200 years in the dissolution of this traditional, rural, local and regional pattern of life" (Brandon and Short 1990, p2).

Small notes that:

> "Apart from a few small natural areas among mountains and coasts, the landscape of Britain has been modified by farming. Many of the sites now valued for plant and animal communities, such as heathland and chalk downland, are largely the products of agricultural activities" (Small 1994, p29).

It therefore seems entirely appropriate to be considering the *agricultural* landscape of part of East Sussex.

The process of landscape change is ongoing. Westmacott and Worthington comment that "in the past, landscape has changed constantly in response to the changing demands upon it, and it will continue to do so" (Westmacott and Worthington 1974, p1). However the process of change does not happen at a uniform rate over time – there are phases of relative inertia and other periods of rapid change. For example, Martin suggests that the 1930s have been portrayed as a decade of "stagnation and despondency" for farming (Martin 2000, p8), although Brassley sees them as "a mixture of decline and regeneration" (Brassley 2006, p198). Conversely, Short *et al* identify the changes wrought as a result of the Second World War as an "agricultural revolution" (Short *et al* 2006, p15).

The process of change may be accelerated by a number of factors. These include war and the resulting state intervention in agriculture. Short *et al* cite the later stages of the French and Napoleonic Wars (1793-1815) as an example of this:

> "The 'classic' agricultural revolution was boosted by the diminution in food imports which led to a virtual trebling in wheat prices ...Enclosure and changes in land tenure were seen as key methods to increase

productivity at that time and, as a result, an estimated 2.9 million acres of land were enclosed during the French and Napoleonic wars, which contributed to increasing the arable acreage by approximately 20 per cent" (Short *et al* 2006, p2).

Another driver of change is technological advancement leading to a shift in the way that farming is carried out. This, in turn, may have consequences for the agricultural landscape. So, for example, increased mechanisation, allied to government support in the form of grants in the late 1950s, has led to the removal of many hedgerows and the creation of larger fields. Brandon writing in 1974 describes this process:

> "Bulldozing of living hedges...and the grubbing of shaws are giving the countryside a more open appearance. Oak and other beautiful standing trees are not being replaced. Coppice-with-standards, long neglected in the Weald, is now being cleared to make new fields" (Brandon 1974, p269).

This study is concerned with a phase of accelerated change in the agricultural landscape. Martin argues that "the post-1931 period has had more profound consequences for British agriculture than any other period since the agricultural revolution of the eighteenth century" (Martin 2000, p1). However, as already discussed in Chapter 2, it is important to note that this process of change is not always smooth and linear. For example, Wilson comments that "a farmer may adopt (arguably) post-productivist agri-environmental schemes, whilst at the same time continuing to adhere to productivist farming ideologies" (Wilson 2001, p94). As discussed in Chapter 2, different farmers may also adopt innovations at different rates so that there will always be a time lag between the early adopters and the laggards. The section later in this chapter considering the transition into productivism will discuss this issue further.

The stated aim of this study has been to "reconstruct the agricultural environment" and the choice of methodology to approach this task has already been explained in Chapter 1 and Chapter 3. In summary it was felt to be preferable to concentrate on a small but varied area in detail rather than to adopt a sampling approach. Four snapshots in time have been presented using data from 1931 (the LUS), 1940-43 (Luftwaffe aerial photograph and NFS), 1945/7 and 1959 (RAF aerial photographs). To complement this, 4th June census data from the parish summaries for 1931-1959 have been analysed.

This approach has concentrated on quantifying land use and on examining land use patterns. The use of GIS has allowed the relatively easy calculation of acreages of different types of land use, and has allowed the data to be queried in order to identify land use patterns. Furthermore, using GIS has meant that the different types of land use can be mapped so that patterns can be seen, such as the growth of Arable by a process of "filling in the gaps" which was discussed in the last chapter. A simple table of acreages for the different land use classes would not have shown this. The diminution in the acreage of Forest and Woodland during the Second World War is another instance where *mapping* the changes over time has been helpful as two distinct areas (Knowlands Wood and part of Oldpark Wood) can be seen where the land classed as Forest and Woodland has changed to a classification of Heath and Rough Grazing in 1945/7. Looking at the 1959 aerial photographs it is clear that the trees in these two areas are regenerating and they are once again classed as Forest and Woodland.

There are potential pitfalls to this approach, many of which have been discussed in earlier chapters. Whilst mapping the patterns of change has been very useful it must also be acknowledged that:

> "To portray meaningful relationships for a complex three-dimensional world on a flat sheet of paper or a video screen, a map must distort reality...to avoid hiding critical information in a fog of detail, the map must offer a selective, incomplete view of reality" (Monmonier 1996, p1).

The six sources of error and uncertainty when using data in a GIS have already been described in Chapter 3. The internal inconsistencies in the datasets have also been described at length in Chapters 4-6, along with the difficulties encountered in interpreting the aerial photographs. The combination of all these factors means that any reconstruction of the landscape using this, or indeed any, methodology with these datasets will be flawed in some way. Monmonier notes that "a single map is but one of an infinitely large number of maps that might be produced for the same situation or from the same data" (Monmonier 1996, p2).

This last point can be illustrated by considering the land use categories chosen for this study. These were broadly based on the categories used by Stamp in the LUS, as discussed in Chapter 4. The broad class of "Land Agriculturally Unproductive" has rather negative connotations in line with 1930s ideology regarding the need to protect the countryside, and tends to suggest that only agricultural land is of value. So, for example, it might have been possible to identify all the industrial sites from the "Land Agriculturally Unproductive" category and to map these as a separate class. Ambrose notes that in the inter-war years in Ringmer "only about one third of the total [of young men marrying in Ringmer parish church] were directly involved in agriculture while a slightly larger proportion were engaged in a variety of jobs in the manufacturing sector of industry" (Ambrose 1974, p46). Dismissing industry under the grouping of "Land Agriculturally Unproductive" therefore seems rather unfortunate. Thus as Monmonier argues, a completely different map could have been produced from the same data which "says" something different and has rather fewer negative connotations.

It is clear, then, that this study represents just one of many possible approaches to the reconstruction of agricultural land use, and also that it represents a particular interpretation of the data, where other possibilities exist.

This approach has concentrated on quantifying acreages of the different types of land use and comparing these, along with creating thematic maps and looking for patterns of land use. The approach creates a particular model of the landscape but there are certain aspects which are not well represented. The NFS includes the surveyor's general comments in Section E but this is the only direct insight that these data offer into the attitudes of the farmers themselves during the study period. So for example, G. Wibberley who surveyed Malling Cottage Farm (XE 218/104/002) in 1943 noted in Section E that:

> "Occupier is over 75, can do no heavy work and spends almost the whole of his time pottering about on his milk round. Land is understocked, but farmer is reluctant to buy any more cows at the present level of prices."

In consequence of these "personal failings" the farm management was graded as B.

Much more about the people involved in the processes of change could have been gleaned from other sources such as interviews with surviving farmers, historical sources such as the Mass Observation Archive and so on. Historic photographs could have been used to assist with the interpretation of the aerial photographs and to add local colour, and the study could have been approached in a generally more qualitative way. Looking at the patterns of land use tends to give an insight into the *results* of farmers' attitudes and the *response* to state intervention, rather than giving the reasons for the changes themselves.

There are further difficulties with simply identifying patterns of land use from an aerial photograph. With the exception, again, of the NFS data, it was not possible to identify the extent of individual farms from the data available, or to consider changes in ownership or occupation. The parish summaries of the census data provide some insight into the general trend in farm size by giving the total numbers for each size of farm within a parish for each year. However individual farms cannot be picked out of these summaries and so it is not possible to identify changing patterns in ownership, or to see whether farms in a particular locality have grown or diminished in acreage. Walford has examined the process of farm occupancy change on the South Downs in the decades immediately following World War Two using the NFS data in combination with the Electoral Register and notes that "the time-consuming and protracted process of searching through successive electoral registers suggests that such a procedure can only feasibly be undertaken on a case study basis" (Walford 2006, p229). Given that 135 farms fall, at least partly, into the study area, tracing farmers' occupation and ownership would not have been possible within the time available.

One of the objectives of this project was to demonstrate the power of GIS as a tool for historical reconstruction, and this will be discussed more fully later in this chapter. In summary, the use of GIS allowed a number of disparate datasets to be integrated and manipulated in a way that would not have been possible using other methodologies. It would have been quite problematic to handle the more qualitative data using a GIS, although this could have been achieved. Therefore the choice of quantitative analysis of the data fitted with the objective of using GIS and also worked well with the data available.

The next four sections of this chapter consider each of the stated objectives in turn, commencing with the use of 1931 as a baseline against which the subsequent changes are measured.

1931 as a Baseline

The first of the datasets used in the study is the LUS. The background to the LUS in East Sussex has already been described in Chapter 4. The field work for East Sussex was undertaken in summer 1931 and so this is taken as the baseline date. The study dates have been dictated, to some extent, by data availability as detailed land use information at field level only became available with the LUS. However 1931 is also an important moment for British agriculture and so it is a happy coincidence that this is the same year as the LUS was undertaken.

Agriculture in Britain had been in a phase of slow decline since the 1870s, and was mired in deep depression by the 1930s, although some individuals were able to embrace new techniques such as bail milking and farm successfully during this period. The Scott Report comments that "Whilst, when seen from afar, it retained the beauty of the old broad pattern, the landscape of 1938 had, in many districts, assumed a neglected and unkempt appearance" (Scott Report 1942, p15). However, as discussed in Chapter 1, 1931 marked a "watershed" in government policy towards British farming (Martin 2000, p6) with the establishment of Marketing Boards under the 1931 Agriculture Act designed to control output and stabilise the market, followed by the imposition of import duties in 1932. As noted earlier, Self and Storing argue that "from this point can be dated the modern period of state intervention, assistance and control" (Self and Storing 1962, p18) and Martin contends that these measures "paved the way for the Ministry of Agriculture to instigate wider controls over agricultural production in the Second World War" (Martin 2000, p26). It seems appropriate, therefore, to choose 1931 as the start date for a study which considers the effect of the Second World War on British farming.

Having established that 1931 is a suitable baseline date it is also important to evaluate the sources used for these baseline data. The LUS is sometimes criticised as it was carried out by school children and so felt to be somewhat unreliable. Stamp notes that "in the early stages the Government was accused of 'a policy of employing school children on Government work'!" (Stamp 1950, p5). This was, at least to some degree, through necessity rather than choice. Pilfold notes that:

> "Stamp's initial thought had been to base the survey on parish units and so he approached parish councils and clergy first. He was always referred to the village schoolmaster and so concluded the survey would best be done through the educational organisation" (Pilfold 2005, p102).

It is certainly true that there were some issues with the conduct of the survey. In Devon, for example, in the early days of the survey, the maps were completed by teachers or from pupils' local knowledge without ever visiting the locations in the field (Pilfold 2005, p101). However, in the case of East Sussex, as has already been noted in Chapter 4, the county was actually surveyed twice, with the second survey being carried out by Henderson, Briault and Smith in the early 1930s. This afforded a double check and also strengthens the validity of the data.

There were, however, unexpected issues with the LUS data in the form of the significant differences between the field sheets and published one inch maps. It had originally been decided to work from the field sheets as these were mainly based on the second County series maps and so were the same as the mapping used to create the base polygon layer in many cases. They also showed the field by field information very clearly. However, as described in Chapter 4, it became apparent that substantial changes had been made to the maps before publication. Within the study area two categories in particular had differences of more than 1,000 acres, with Heath and Rough Grazing declining by 1,317.56 acres between the field sheets and one inch maps, and Meadow and Grassland gaining 1,522.27 acres on the one inch maps.

It is argued in Chapter 4 that one of the reasons for particular differences in these two categories could be the difficulty of actually distinguishing between Heath and Rough Grazing and Meadow and Grassland in the field. Stamp's comments on this matter would seem to support this argument and bear repeating here:

> "Some of the commonest errors arose from local interpretations. For example, in a well-farmed East Anglian county there was a tendency for the surveyor to record a neglected grass field with a growth of thistles as 'rough grazing', whereas it was probably better than the best field of permanent grass on a hill farm of the west" (Stamp 1950, p25).

Clark also makes a similar point in relation to farmers' completion of the agricultural census returns:

> "The definition of 'permanent pasture' varies within Great Britain according to how long it must survive unploughed or under grass to become 'permanent' rather than 'temporary'. The dividing line between permanent pasture and rough grazing is similarly not self-evident to all upland and lowland farmers. What would seem to be rough grazing to the lowland arable farmer may be fair permanent pasture in the eyes of the hill farmer. Sometimes permanent pasture has been used, particularly in England, not as an actual land use but as a balancing item, that is, as the area of the farm not under crops or temporary grass, whatever the land's actual use" (Clark 1982, p11).

It is interesting to compare the data from the parish summaries of the 1931 census with the figures obtained by this study for the field sheets and published maps. A direct comparison is not possible as the parish summaries cover the whole of each parish whereas the figures from this study for the field sheets and one inch maps include only parts of most parishes. Furthermore the census data include only land belonging to a holding and so reported on by a farmer, whereas the LUS data include all land within the study area, whether belonging to a farm or not. Finally, until 1948 the farmer's place of residence was used to determine to which parish his/her farmland was allocated (Clark 1982, p18). This meant that a farm could be recorded in one parish although the bulk of its land was in another parish. This is helpfully illustrated by Clark (after Coppock, 1965, p104) with reference to Wendover District in 1941 as shown in Figure 161. This shows the areas of holdings or parts of holdings lying in one parish but returned under another parish for the census.

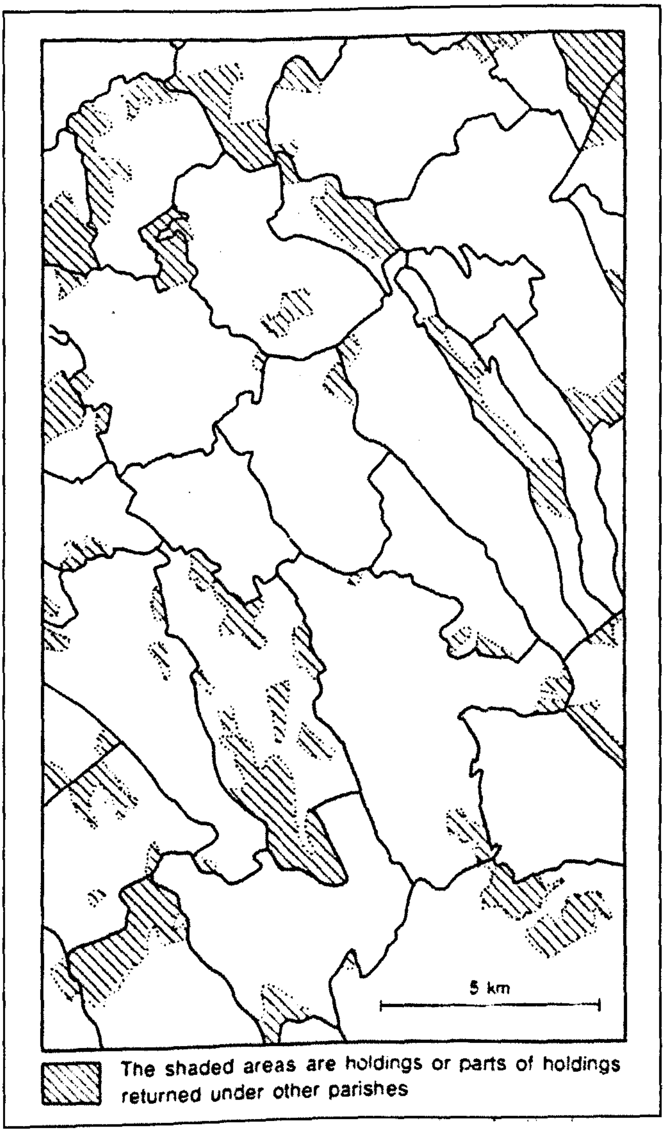


Figure 161: Boundaries of holdings and civil parishes in Wendover district, 1941 (Clark 1982, p20)

After 1948, the location of the bulk of a farm's land was used in order to allocate each farm to a parish (Clark 1982, p18). There may still be farmland from outside the parish included in the census return, however. If the total crops and grass for Kingston in 1958 is calculated as a percentage of the area of the parish, the figure obtained is 113%. This tends to suggest that there is a reasonable amount of land lying outside the parish which is being recorded in the census returns for Kingston.

Bearing all these caveats in mind, Table 56 shows the acreage for three land use classes in 1931: Meadow and Grassland, Arable and Heath and Rough Grazing. Chapter 7 explains which section(s) of the census each of the three classes relates to.

	Census summary (7 complete parishes)	**LUS field sheets (study area only)**	**LUS one inch maps (study area only)**
Meadow and Grassland	10,419.25	10,487.88	12,017.59
Arable	4,353.75	4,264.97	4,267.66
Heath and Rough Grazing	4,638.75	3,888.24	2,570.7

Table 56: 1931 Census data and LUS data compared for three land use classes

It is interesting to note that the Arable acreages from the LUS and the census are reasonably similar. The census acreage for both Meadow and Grassland and Heath and Rough Grazing is closer to the figures obtained from the field sheets than to the one inch maps. In Chapter 7, the section discussing changes in Heath and Rough Grazing pointed out that the considerable gain in acreage in this category between 1931 (as taken from the one inch map) and 1940 was unexpected. It was suggested that using the acreage from the 1931 field sheets and looking at change over time gave a more plausible result with a less dramatic increase in Heath and Rough Grazing between 1931 and 1940. Whilst by no means proving conclusive due to the issues listed above, the high census acreage for Heath and Rough Grazing may nevertheless add a little weight to the argument that the baseline for Heath and Rough Grazing as taken from the 1931 one inch maps is actually too low.

The use of GIS will be discussed later, but it must be acknowledged that using the published LUS maps to extract information at the field scale may have been taking the maps beyond the use for which they were originally intended. It is reasonably simple to import historic data into a GIS and then to "zoom in" in order to examine the maps far more closely than they were originally intended for. The published LUS maps were subject to a process of generalisation so that, for example, many of the areas of water shown on the field sheets were simply not shown on the smaller scale published map.

In summary, then, 1931 is a suitable date to use as a baseline due to particularly significant changes in Government policy towards farmers during that year which, in turn had implications for the later changes resulting from the Second World War. 1931 was also the date in which the LUS was completed in East Sussex and so this year proved to be a suitable starting point on both counts.

The LUS is a rich and detailed data source, and Sussex has the added advantage of having been surveyed twice and thus double checked. The data could thus be assumed to be reasonably accurate. The magnitude of the differences between the field sheets and published maps was therefore somewhat surprising and it is interesting to note that the acreages from the parish summaries of the census figures for 1931 appear to accord more closely with the LUS field sheets than with the "checked" one inch maps. Therefore whilst the LUS one inch maps have generally been used for the purposes of comparison, in some cases the LUS field sheets may provide a more convincing baseline.

Pre-Productivism

The second of the stated objectives of this project has been to contribute to the theoretical debate surrounding productivism. In Chapter 1 the question was asked "What are the characteristics of the agricultural landscape of East Sussex in the early 1930s, and can these be said to be distinctively pre-productivist?" The figures obtained from the LUS combined with the 1931 census data can together give some idea of the characteristics of the agricultural landscape. Whilst the NFS was undertaken in the early 1940s it may still be seen to reflect, to some extent, the state of farms pre-war. Interventions such as taking over the farm in extreme cases came about as a result of the initial NFS survey and so the move towards productivism becomes more evident from later data. Some NFS data are therefore included here in order to gain more insight into the state of agriculture in the study area in the 1930s.

Figure 162 shows the percentage of each type of land use in the study area in 1931 from the LUS one inch maps.

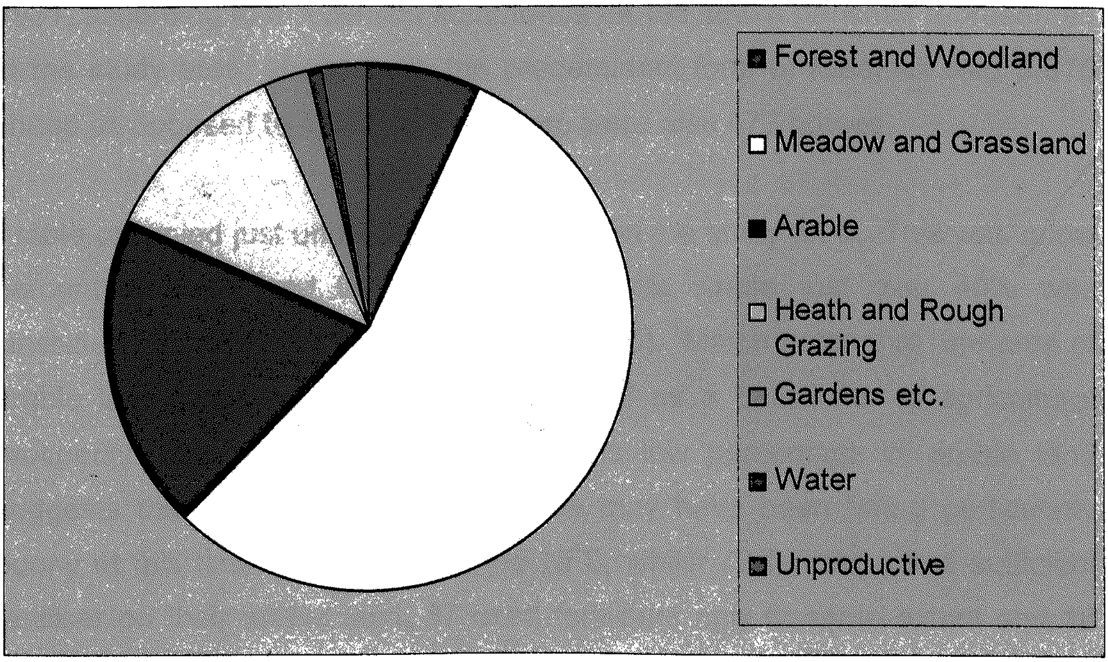


Figure 162: Percentage of each type of land use for 1931 from the LUS one inch maps

Just over half of the study area consists of Meadow and Grassland with a further 11.8% being represented by Heath and Rough Grazing. It is likely that much of the Meadow and Grassland within the study area was of relatively poor quality in the 1930s. Martin notes that:

> "The abandonment of arable cultivation and the ploughing up phase of rotations had allowed many fields to 'tumble down', or revert to inferior grassland...The Grassland Survey of 1936 showed that more than 90 per cent of pasture fields throughout England and Wales were classed as fourth rate" (Martin 2000, p11).

According to the NFS data for the study area, 59 of the 134 farms with data available had some degree of weed infestation. In addition, seven farms had derelict fields. This suggests a process of decline that had been underway for some time, and so it is quite possible that this land was already degraded at the time of the LUS.

In the 1930s much of the Meadow and Grassland, along with the Rough Grazing which is included with Heath, would have been used for livestock production which was "the most important sector of British agriculture in terms of the area of land it occupied and levels of output" (Martin 2000, p12). In 1931, according to the census summaries for the seven parishes represented in the study area, sheep were the predominant form of livestock with 5,876 sheep as opposed to 4,041 cattle. There were also 473 horses.

Arable occupied just under 20% of the land in the study area. This was a low percentage compared to Britain as a whole where just over 40% was classified as Arable in 1931 (Martin 2000, p10). Martin notes that "the area of arable land has traditionally been regarded as a barometer of agricultural prosperity" (Martin 2000, p10) and so the low percentage of arable land suggests that farmers in the study area may have been faring particularly poorly at this time. According to the NFS, whilst 79 farmers used sufficient fertiliser on their arable land, 37 used fertilisers only to some extent and 18 used none. Of the 76 B and C graded farms which overlap the study area, poor management was cited as a reason for failure in 15 cases.

It is interesting to note that in 14 cases lack of ambition was given as a reason for B or C grading, with a further 19 farmers charged with either lack of knowledge or lack of initiative. Martin notes that the conventional wisdom was that "farmers were lacking in entrepreneurial flair, being sluggish in responding to new economic challenges in terms of the way they farmed and their adoption of more productive methods" (Martin 2006, p23). The government's approach to agriculture before the Second World War has been described as "laissez-faire" but this descriptor could perhaps also be applied to the farmers themselves. Many of the farmers graded as failing seem to have been content to continue as they had always done, with little regard for innovation or increasing production. The surveyor of Middle Broyle Farm (XE 218/110/028) which was graded C, makes the damning observation that the farmer "Fails to put into effect the limited amount of knowledge he possesses."

The Gardens etc category, which includes housing, orchards and market gardens, occupies just 3% of the study area. 501 individuals were employed in agriculture in the seven parishes according to the census summaries for 1931. This included full, part-time and casual workers. In terms of labour, Short *et al* note that in Britain as a whole farm labour fell "from 825,000 in 1930-34 to 738,000 in 1935-39" (Short *et al* 2006, p9) and Martin comments that "the number of men in regular agricultural work declined from 631,000 in 1931 to 546,000 in 1939, a 13.7 per cent fall in only eight years" (Martin 2000, p21). This fall in numbers is, perhaps surprising, coming as it does before the widespread adoption of mechanisation during and after the Second World War. However, as discussed earlier, it resulted, at least in part, from the depression with farmers economising as much as possible in order to survive. This is evidenced by some of the comments on the NFS Primary Return. The surveyor of Spooners and Whitehouse Farm (XE 218/97/003) which was graded as B, remarks on the "failure to employ sufficient labour to cope with the work on a farm of this size which includes dairy and some market garden work."

In addition, agriculture was an unattractive occupation in comparison with the urban workforce, with lower wages and therefore a relatively poor standard of living. Martin argues that "low wages were a prime factor in causing a rural exodus" (Martin 2000, p20). Ambrose notes that "since, under the 'tied cottage' system, dismissal meant the loss of a home as well as a job, it is easy to see how cautious an employee had to be and how little a farmer who was acting oppressively had to fear" (Ambrose 1974, p49). As has already been noted, in the village of Ringmer between 1926 and 1935 only one third of the men marrying in the Parish Church were directly engaged in agriculture, with just over a third more being engaged in "a variety of jobs in the manufacturing sector of industry" (Ambrose 1974, p46).

Some agricultural labourers were able to move to other occupations, although this was an era of mass unemployment and so opportunities were limited. However, farmers in general tended to be characterised by "occupational immobility" (Newby 1985, p81). Studies undertaken in the 1930s showed that "about 75 per cent of farmers in England and Wales were farmers' sons, the vast majority of whom had inherited the family farm" (Martin 2000, p19). When times were hard, hired employees were dispensed with and only family members retained so that by 1939 almost 40 per cent of agricultural holdings in England and Wales no longer employed regular workers (Martin 2000, p21).

In terms of farm size in 1931, the largest number of farms in the seven parishes in the study area fell into the 5-20 acres bracket according to the census figures, and well over half of the farms occupied less than 50 acres.

The NFS data give a little more insight into farming in the study area before the changes resulting from the Second World War really took hold. Of the 135 farms overlapping the study area, 102 were tenanted, 15 were owned outright, and the remainder were part-owned and part-tenanted. There were six landowners who each owned part or all of ten or more holdings. Captain Christie owned 18 farms; East Sussex County Council (ESCC) 14; Executors of W.W. Grantham 13; Executors of Sir H. Shiffner 11; Trustees of late Lord Monkbretton 10; Chichester Estates 10. Almost three quarters of the tenanted farms in the study area were therefore owned by just six landowners. Figure 163 shows the farms which were owned or part-owned by these six landowners. It is important to note that this is for illustrative purposes only and does not accurately reflect the acreage held by each landowner – in some cases only part of a farm was owned, but the whole holding has been shaded as is it not possible to determine which specific sections of a farm are owned by whom from the NFS records.

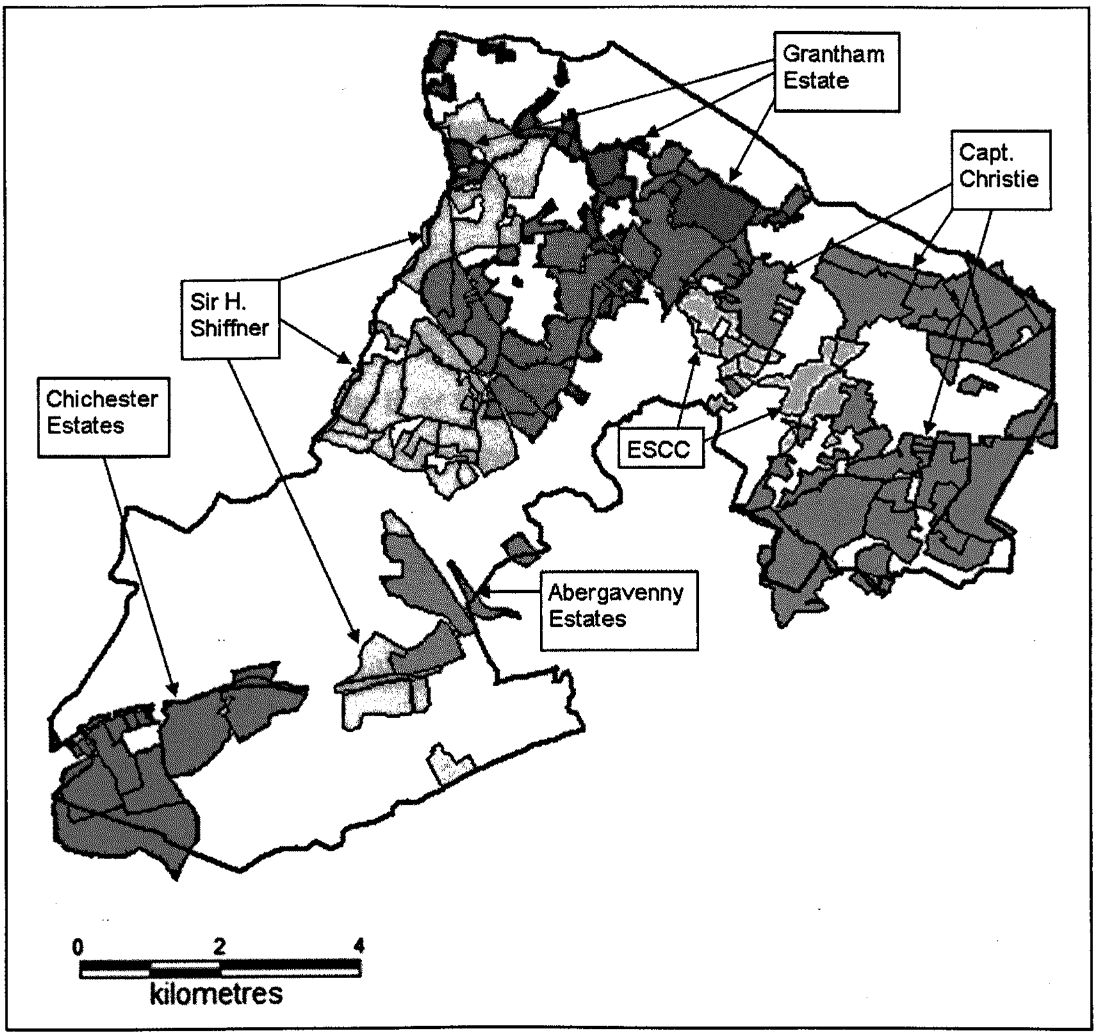


Figure 163: Farms owned or partly owned by the six main landowners in the study area
Source: TNA MAF 32

In addition the executors of Miss Shenstone held six farms, Glynde Estates and Abergavenny Estates each had three holdings which overlapped the study area and by the time of the NFS, the CWAEC owned, or part-owned two farms.

Martin argues that one of the results of the First World War was the transfer of significant areas of estate land from tenancy to the ownership of farmers as a result of the imposition on estates of death duties and controls on land rents. War would also have played a part in this transfer of land. The move away from tenancy to ownership allowed farmers greater freedom in the way that they farmed their land and contributed to the further demise of the landed aristocracy. However it seems that in the study area large landowners still held considerable sway until at least the early 1940s, and so the freedom of farmers would have been more limited. Davidson and Wibberley comment that "over the first half of the twentieth century there was a surprising rigidity in the land tenure situation" (Davidson and Wibberley 1977, p14).

In terms of farm management from the NFS, 57 of the farms overlapping the study area were graded A with 68 classed as B and 8 graded as C. The most common reason given for B or C grading was lack of capital, closely followed by poor management, lack of ambition and lack of attention. Over half of the A graded farms were small (under 100 acres) as were three quarters of the B graded farms. The majority of the C graded farms were located in the Weald.

Astor and Rowntree calculated that in 1938 there were some 80,000 part-time and spare-time farmers in Great Britain as compared to 300,000 full-time farmers (Martin 2000, p18). According to the NFS, of the 135 farms overlapping the study area, 26 were farmed part-time (no data were available for four farms). Of these, perhaps unsurprisingly, 20 farms were less than 50 acres according to the NFS Primary Return. Ten of the farms were graded A whereas the remaining 16 achieved only a B grade as could be expected where the farmer's interests were divided. The surveyor of Eleven Oaks Farm, Chailey (XE 218/94/005) noted that "Other occupation occupies most of tenant's time so that this holding does not receive the necessary attention." The farmer, H. Bristow, was also a "contractor for ploughing, cultivations etc." Farming part-time could also be indicative of a shortage of capital. Newby comments that:

> "Unless the small farmer is to be removed by force his ambitious neighbour must wait for him to become bankrupt, run out of heirs or take advantage of the many inducements offered by the government to leave – and even part-time employment elsewhere may be preferable to making a complete break with the land" (Newby 1985, p81).

The results for Barcombe and Kingston parishes were presented in some detail in Chapter 7 in order to contrast a wealden parish with one containing downland. It may therefore be useful to briefly consider whether the characteristics of the two parishes were different in the early 1930s.

It was noted in Chapter 7 that the predominant land use type in both parishes was Meadow and Grassland, with very similar percentages of Arable land and Gardens etc. in both Kingston and Barcombe. Mean polygon size (used as a rough indicator of mean field size) was also similar for both parishes for Arable fields.

The differences between the two parishes are, perhaps, unsurprising given the characteristics of the landscape. In Kingston in 1931, there were 49 sheep per 100 acres of crops and grass plus rough grazing, as opposed to just 32 in Barcombe. In contrast there were 44 cattle per 100 acres of crops and grass in Barcombe, as opposed to 33 in Kingston. Barcombe had 3 horses per 100 acres of crops and grass whereas Kingston had only 2. Martin notes that:

> "Prior to the Second World War, horses were the main source of motive power for British agriculture. In 1939 they accounted for more than half the total draught power and were doing approximately two thirds of work undertaken on farms" (Martin 2000, p15).

According to the NFS, in the early 1940s less than one third of farms in the study area had a tractor, and fewer than half had access to an electric motor, oil or petrol engine.

Mean polygon size for Meadow and Grassland was noticeably different between the two parishes with the mean for Barcombe at 4.64 acres whereas Kingston stood at 8.02 acres, again due to the more open nature of the downland in contrast to the smaller fields of Barcombe bounded by wooded shaws.

Farm size for both parishes was generally small according to the 4th June census summaries but, perhaps surprisingly, Kingston had many more very small farms than Barcombe in 1931, with almost half falling into the 1-5 acres category. There were a number of smallholdings around the village of Kingston near Lewes which are likely to account for this. 20 of the 27 farms in Kingston occupied less than 50 acres. In Barcombe 29 of the 53 farms were less than 50 acres but there were also a further 10 farms occupying 50 to 100 acres and so the farm size generally was slightly larger than in Kingston.

Looking at the issue of farm ownership from the NFS data (which only includes farms over 5 acres) the two parishes are strikingly different. In Barcombe just two out of 31 farms overlapping the study area were owned by the farmer. In Kingston, four out of eight farms were owned and not tenanted. One of the remaining farms belonged to East Sussex County Council, another to A. Selby-Bigge and the last two to Mr. Blackman. In contrast most of the farms in Barcombe were in the hands of just three landowners, Executors of Miss Shenstone (6), Executors of the late Lord Mountbretton (5) and Executors of W.W. Grantham (13). Just five of the tenanted farms in Barcombe belonged to other individuals.

If all of these data are taken together it is possible to draw out some of the main characteristics of the study area at this time, as shown in Table 57.

High percentage of Meadow and Grassland Low percentage of Arable land Farms graded B or C in NFS due to lack of capital Part-time farmers Declining numbers of agricultural labourers	Suggests low economic prosperity
High levels of weed infestation Poor quality grassland Poor farm management	Suggests low levels of productivity
High number of horses, especially in the Weald Small farm sizes Arable field sizes similar in both Weald and downland areas	Suggests low levels of mechanisation
Predominance of sheep in downland areas	Suggests low intensity
Landownership still concentrated in the hands of a few, especially in the Weald Most farmers tenants not owners	Suggests that farmers' power was somewhat limited
Many farms graded B or C due to lack of ambition or lack of attention	Suggests a sense of farmer apathy and *laissez-faire*

Table 57: Summary of the characteristics of farms and farmers in the study area in the 1930s

The key features at this time, then, appear to be low economic prosperity, low productivity, and low mechanisation. Most farmers are tenants and so enjoy limited power. However there is also a sense of pervasive apathy with many of the B and C graded farmers being castigated for their lack of ambition and initiative.

At the beginning of this section the question was asked as to how far the study area in the early 1930s could be seen as distinctively pre-productivist. Wilson argues that "if we agree with the conceptual notions of 'productivism' and 'post productivism', then we also need to leave room for the possibility of *pre-productivist* agricultural regimes" (Wilson 2001, p91). Chapter 2 included a review of the literature around productivism and noted that pre-productivism remained poorly defined, although the transition into productivism is generally agreed to have begun around the time of the Second World War (Wilson 2001, p89). Wilson argues that the pre-productivist phase was characterised by "high environmental sustainability, low intensity and productivity, weak integration into capitalist markets and horizontally integrated rural communities" (Wilson 2001, p91).

The themes of low intensity and low productivity have emerged in Table 57 and so these would seem to be characteristic of the study area pre-war. Farmer apathy allied with financial difficulty could lead to weak integration into capitalist markets. The concept of high environmental sustainability is perhaps more arguable. The "dominance of permanent pasture and its inherent biodiversity" (Martin 2000, p170) was not felt to be particularly desirable at the time and, indeed, symptomatic of low standards of farming. Intensification and mechanisation were the goal towards which farmers were encouraged, or driven in some cases, and the environmental impact of this only became apparent in later years. Between 1947 and 1980, Britain lost 95 per cent of its lowland herb-rich grasslands, 80 per cent of chalk and limestone grasslands, 60 per cent of lowland heaths, 45 per cent of limestone pavements, 50 per cent of natural woodlands, 50 per cent of lowland marshes and fens, over 60 per cent of lowland raised bog and a third of all upland grasslands, heaths and mires (Martin 2000, p173). Short comments that "the modern consensus remains that the post-war environmental modifications were 'deleterious if not disastrous', because of intensification and chemical inputs" (Short 2007a, p38). Whilst Martin and Short both argue that significant environmental damage was caused by the productivist regime, does this necessarily imply that pre-productivism was sustainable?

There is no universally agreed definition of agricultural sustainability. Although the term is much-used it appears to mean different things to different people. Robinson and Harris (after Doering 1992) identify a number of key aspects of sustainable agriculture:

1. Limited inputs
2. Specific practices (eg organic farming) and management perspectives based on ecological and social considerations
3. Less specialised farming, especially mixed crop and livestock farming
4. Off-farm inputs should not be subsidised and products contributing to adverse environmental impacts should not receive government price-support
5. Farm-level decision-making should consider disadvantageous off-farm impacts of farm-based production eg contamination of groundwater
6. May require different types of management structure eg family farms as opposed to factory farms (Robinson and Harris 2004, p141)

Many of the comments on farm management made by the NFS surveyors refer to the low level of biochemical inputs (which was felt, at the time, to be undesirable). Even East Sussex County Council, which is listed as the farmer for Pouchlands Farm, Chailey (XE 218/94/072) is castigated for "inadequate use of fertilizers" and the farm management is graded "B" for "personal failings". Pre-war agriculture therefore fits the first criterion quite well. Mixed crop and livestock farming appears to be more prevalent pre-war, fitting with criterion 3, and off-farm inputs were not subsidised, fulfilling criterion 4. It is also clear from the farmer names given on the NFS forms, and from the NFS comments, that many holdings were family farms, often run by father and son(s). The NFS Primary Return for Overs Farm, Barcombe (XE 218/89/007) for example carries the comment "Father infirm. Son intelligent but lacks initiative."

The two aspects of agricultural sustainability which are rather more problematic in terms of pre-war agriculture are no. 2 and no. 5. The environmental movement of the 1960s was instrumental in bringing issues of sustainability to the public consciousness. In the 1930s there would therefore have been much lower awareness of environmental issues. Short, commenting on the wartime plough-up campaign quotes Orwin (1945, p88) who

> "cites the question posed by a land-girl to an expert tractor driver: 'What do you think about when you are sitting on your tractor all day?' He replied, 'I looks at the bloody earth and I says, blast it.' So, there is seemingly no overriding aesthetic sense, no rural idyll, and thus probably few senses of loss at the wartime reclamation" (Short 2007a, p38).

This would seem to bear out the sense that farm practices and farm management techniques were not consciously sustainable. Davidson and Wibberley argue that:

> "If the decision-maker is concerned with *managing* rather than otherwise manipulating resources, then his allocation decisions will be based upon defined objectives derived from various sources such as national laws and directives; boardroom or council chamber decisions; or a more direct encounter with public opinion" (Davidson and Wibberley 1977, p68).

It is this decision-making based on 'defined objectives' including ecological considerations and the avoidance of disadvantageous impacts of farming which appears to be missing in the pre-productivist era.

DEFRA also lists a number of indicators of sustainable farming as shown in Table 58.

Strategic Outcomes	**Indicators**
Economic sustainability:	
A farming sector focused on the market, successfully producing food and non food crops in a more efficient way, to help enhance the incomes of competitive farm businesses	Greater value added per head
Greater efficiency of the total food chain	Higher productivity of food and drink processing
Reduced burden on taxpayers and the rest of the economy	Lower production-related CAP subsidies from consumers and taxpayers
Environmental sustainability:	
Reduced environmental cost of food chain	Reduced greenhouse gas emissions from food and farming Improved river water quality
Better use of natural resources	Improved soil nutrient status
Improved landscape and biodiversity	Favourable condition of designated wildlife sites Reverse decline in farmland birds
Social sustainability:	
Better public health, in particular through improved nutrition and workplace health and safety	Consumption of fresh fruit and vegetables
Higher animal welfare	Improved time taken to clear up cases of farmland and transportation animal welfare cases
More cohesive and productive rural communities	Reduced gap in productivity between the less well performing quartile of rural areas and the English median by 2006, and improved accessibility of services for rural people

Table 58: Strategic outcomes and indicators of sustainable farming according to DEFRA (Department for Environment, Food and Rural Affairs 2002)

Considering economic sustainability first of all, it is difficult to characterise agriculture before the Second World War as "successfully producing food and non food crops in a more efficient way" (DEFRA 2002). Figure 8 showed the decline in arable land in England and Wales after 1871, and Martin describes Britain's increasing dependence on overseas supplies:

> "Omitting sugar, tea and coffee, in monetary terms, the United Kingdom produced more than half of its total food requirements in 1914, whereas the corresponding figure for 1939 was only 42 per cent. In volume terms, 60 per cent of Britain's total food requirements overall were derived from abroad. By the late 1930s, 88 per cent of wheat grain and flour were imported" (Martin 2000, p10).

In terms of environmental sustainability, the loss of biodiversity after the Second World War has already been acknowledged. However as far as the DEFRA concept of "improved landscape" goes, it is difficult to imagine the bramble-choked wilderness which was beginning to spring up as an improvement. Martin quotes Sir Emrys Jones' description of the countryside in the 1930s:

> "I can only describe it as a wilderness in modern terms. The hedges were overgrown, the whole place ridden with millions of rabbits. It looked hardly possible to grow any sort of corn crop; if the rabbits didn't have it, the mildew caught it" (Martin 2000, p9).

There is a sense here of the countryside no longer being adequately managed and of encroaching decay which seems incompatible with the DEFRA criteria of "better use of natural resources" and "improved landscape and biodiversity" quoted in Figure 56 above.

If we take the term pre-productivist to refer to the phase which preceded productivism, and if we accept that the transition into productivism began around the time of the Second World War, then the landscape in the study area in the 1930s is pre-productivist. Whilst elements of Wilson's definition hold true for this part of East Sussex, the concept of high environmental sustainability is somewhat questionable in the light of the two sets of indicators of sustainable agriculture presented above.

In addition to low intensity and productivity, certain other factors would appear to characterise pre-productivism in the study area. These include poor management by farmers allied to low morale and a lack of power due to the high levels of tenancy rather than ownership. Financial hardship is a clear theme, leading to low levels of investment. Martin notes that:

> "Irrespective of whether they were tenant farmers or owner-occupiers, the prevailing belief was that money was more easily made than saved. Economic survival rather than increasing or even maintaining existing levels of agricultural production was their prime concern" (Martin 2000, p10).

Employment in agriculture was declining with many labourers moving to better paid jobs elsewhere, although the farmers themselves often remained, choosing to farm part time and supplement their income with other work if necessary. The result of all these factors was a deteriorating and decaying landscape gradually subsiding into wilderness.

Before moving on to look at the transition into productivism it is important to emphasize two further points. Firstly, pre-productivism itself is just a phase. It does not cover the entire time period before productivism. An argument can be made for other productivist periods of agriculture before this particular pre-productivist phase, and indeed Wilson (2007) has attempted to identify phases in Western European agriculture since 1500 AD as was shown in Figure 12. Secondly, whilst an attempt has been made to characterise pre-productivism more fully, it cannot be possible to generalise about the whole country from the characteristics of this small area alone.

Land Use Change Over Time

The third stated objective of this project has been to quantify the changes which have occurred in the course of the study period and to consider whether these represent a clear transition into productivism. Wilson's (2001) summary of current conceptualisations of productivism was presented in Chapter 2 and these data will be examined in the light of three of Wilson's headings: agricultural production, farming techniques and environmental impacts as it is these indicators that can be quantified to some extent in relation to the landscape around Lewes.

The aim is not to dispute the existence of productivism and the changes which were accelerated as a result of the Second World War. Rather it is to see how those changes looked in this particular geographical area. It has already been acknowledged that examining patterns of land use change can only tell part of the story. Additional sources of information such as farmers' diaries, farm accounts, and contemporary newspapers could provide further assistance here.

Productivist agricultural production may be characterised by intensification, the ideal of securing self-sufficiency, specialisation and concentration and an increase in corporate involvement. Some indicators of this could include increases in farm size and field size, higher levels of mechanisation and increased productivity. The results presented so far will now be examined for evidence of these indicators.

Considering, first of all, the total area under cultivation (total crops and grass from the census data) for the seven parishes included in the study area, this generally fell during the war years as land in five of the seven parishes was requisitioned by the military (Figure 101 and Table 46). Falmer parish lost more than 1,000 acres between 1939 and 1945. However, comparing the 1931 crops and grass figures with 1959, shows that parishes including some downland have particularly increased their acreage of crops and grass with Falmer gaining 896.75 acres, and Kingston gaining 743.5 despite losing some land to Lewes Borough due to parish boundary changes. It is clear from the distribution maps in Chapter 7 that large areas of the South Downs were ploughed up for Arable cultivation in the course of the study period. Some of these areas would previously have been included in the census total crops and grass figures as rough grazing and so would simply have changed use, but others must have been included as agricultural land for the first time in order for the total acreages to have increased. An example of this may be "Land at Race Hill" which was farmed by the CWAEC during the Second World War but did not have a farm number associated with it, suggesting that had not been used as agricultural land pre-war. The total gain in crops and grass for the seven parishes between 1931 and 1959 was 1,377.25 acres which represents just over 9% growth.

In St Anne the effects of the expansion of Lewes are clear as the total area of crops and grass almost halves between 1931 and 1959 from 755 to 360 acres. Much of this is lost to housing with the construction of the Landport estate. In the Weald, Barcombe loses a total of 169.5 acres of crops and grass over the same period and, looking at the distribution map for Gardens etc. (Figure 136) there is evidence of increasing ribbon development along the main roads in the parish.

In addition to some increase in the total area of crops and grass, there are clear indications of a general increase in productivity. The wartime policy was to maximise the arable acreage, and land previously devoted to producing foodstuffs for animals was now used to produce crops for human consumption. Short *et al* note that "it was calculated that one acre of arable under wheat would produce 2 million calories, or under potatoes 4.1 million calories, whereas under pasture 1 acre would produce 120,000 calories from meat or 450,000 calories from dairying" (Short *et al* 2000, p32). According to the census data for the seven parishes, the acreage of arable land more than doubled between 1939 and 1945 from 3,470 acres to 7,546 acres.

The increase in Arable land is not just confined to the war years but continues afterwards. In the study area, the largest increase in Arable land occurs between 1945/7 and 1959 with a jump of over 2,000 acres. Overall between 1931 and 1959 according to the census, the arable area increases by 6,792 acres or 296%. Brandon and Short note that "the emergency war-time plough-up was...maintained in the protected economic climate after the war, and the downland in particular was transformed into a grain-producing area of international importance" (Brandon and Short 1990, p371).

If the area represented by total crops and grass has increased by only 1,377.25 acres but the total Arable acreage has grown by 6,792 between 1931 and 1959 it is clear that much of this Arable growth must have been at the expense of another type of land use. As might be expected the acreage of Meadow and Grassland declines considerably in the course of the study period. According to the census data for the seven parishes, the acreage of permanent grass halves between 1939 and 1945 from 10,843.5 to 5,235.25 acres. It must be acknowledged, however, that some of this may be land requisitioned by the military which would have been returned after the end of the war. Looking at the whole period from 1931 to 1959, over 6,000 acres of Meadow and Grassland are lost to other uses in the study area.

With such a dramatic decline in the area of Meadow and Grassland, the numbers of livestock could, perhaps, be expected to fall. However between 1931 and 1959 the total number of cattle in the seven parishes rises from 4,041 to 6,205 according to the census. The number of cattle per 100 acres of crops and grass also rises in all seven parishes between 1931 and 1959. This strongly suggests a process of intensification as more cattle are being raised on less land. This is borne out by Martin, who notes that:

> "The intensification of animal production which began in Britain after the Second World War was accompanied by increasing numbers of livestock on fewer holdings. Productivity increased due to scientific advances in animal breeding, nutrition and systems of environmental control" (Martin 2000, p111).

The numbers of sheep decline from 5,876 to 4,996 over the study period. Sheep are traditionally associated with the Downs where much of the grassland was ploughed up to make way for Arable, and numbers of sheep per 100 acres of grass and rough grazing fell in Falmer from 78 in 1931 to just

38 in 1959. In addition it may have been more problematic to intensify sheep production. Newby notes that:

> "The animal which has proved highly resistant to factory farming techniques is the sheep. They pine if they become too enclosed and they also become more susceptible to parasitic infection and other diseases....Modern breeding methods have yet to perfect a sheep which does not thrive on space" (Newby 1985, p92).

However in Hamsey, numbers of sheep per 100 acres of grass and rough grazing increased from just 6 in 1931 to 50 in 1959, and numbers in Barcombe increased from 32 in 1931 to 48 in 1959.

Further evidence of intensification and mechanisation may be found in the increase in farm size over the study period. According to the census data the number of farms of less than 50 acres in the seven parishes declined from 117 in 1931 to 82 in 1958 (no figures are available for 1959). Over the same period, the number of holdings over 300 acres increased from 9 to 14. Newby comments that:

> "In general the impact of new agricultural technology has required larger holdings to take full advantage of the new means of production, so that the size of holding which can be considered economically marginal has slowly increased" (Newby 1985, p81).

With regard to mechanisation, according to Dewey "in slightly less than six years the numbers of farm tractors tripled" (Dewey 2006, p99). If the tractor numbers shown on the NFS for the study area had tripled by the end of the war, then almost every farm would have had a tractor by 1945. A further consequence of mechanisation is a decline in the numbers of farm labourers. Despite increased levels of Arable land and cattle production in the seven parishes, the census shows that the number of labourers fell by 70 between 1931 and 1959. The number of labourers per 100 acres of crops and grass remained static or declined in six of the seven parishes overlapping the study area. Newby comments that the nature of the remaining labourers would have been very different after the war:

> "On arable farms, traditionally the most labour-intensive section of the industry and now the most capital-intensive, the changes wrought by technological innovation have not only resulted in a reduction in the number of workers, but a dramatic decrease in the division of labour among those that remain. Whereas a horseman might manage to plough an acre a day, a tractor driver might now manage up to forty. A farm employing twenty workers before the war in a complex hierarchy of bailiffs, foremen, charge-hands, horsemen and day-labourers may today make do with less than five. These five workers have been forced to become adept at tackling the complete range of jobs which may arise on the farm over a year. Thus, whereas a horseman's work formerly revolved almost entirely around his horses, his modern counterpart must not only be a tractor driver but a 'general farm worker' – a mechanic, a labourer and perhaps even a part-time stockman too" (Newby 1985, p127).

A further indicator of increased mechanisation in the seven parishes is the declining number of horses which fell from 473 in 1931 to just 123 in 1958 (no data are available for 1959). The number of horses per 100 acres of crops and grass declined in six of the seven parishes overlapping the study area between 1931 and 1958.

Field sizes would be expected to increase with the removal of shaws and hedgerows in order to facilitate ploughing and increase crop yields. Newby notes that "it has been estimated that the presence of hedgerows reduces the output of cereals farms by up to 15 per cent (Newby 1985, p213). However in Barcombe parish lying on the Weald to the north of the study area, mean polygon size, which has been used as a rough indicator of field size, decreased in both the Meadow and Grassland and Arable categories between 1931 and 1959. In the parish of Kingston, mean Arable polygons increased in size by almost 50 per cent, but Meadow and Grassland polygons halved in size. This is somewhat problematic as it flies in the face of the other indicators of intensification and mechanisation described above. Possible explanations for this could be the geography of the area as discussed in Chapter 7, and also the fact that grants for the removal of hedgerows did not become available until 1957 (Martin 2000, p172) and so the effects were not yet widespread by 1959.

In terms of environmental impacts in the study area, it is clear from surveyors' comments in the NFS that increasing use of biochemical inputs was being strongly encouraged, with "insufficient use of fertilizer" being cited as the reason for a poor grading in a number of cases. Cox *et al* note that "the county committees were mainly composed of the larger and more 'progressive' farmers, and the powers invested in them were intended to help overcome the conservatism and traditionalism that prevailed among their fellows" (Cox *et al* 1986, p483). These were perhaps the innovators and early adopters of the period. However this 'encouragement' towards more progressive and productive farming was sometimes met with resistance. The surveyor of Shelley's Farm in Chailey (XE 218/94/007) comments on the farmer's "reluctance to take advice and assistance offered by WAEC." In England and Wales between 1943/45 and 1957, the overall rate of fertilizers applied to individual crops in England and Wales increased significantly for all crops except winter wheat (Martin 2000, p104).

In terms of land use change over time, then, there was a clear increase in Arable acreage and a corresponding decline in Meadow and Grassland. Cattle numbers increased by a third and they appear to have been farmed more intensively, given the reduction in acreage of Meadow and Grassland. Surprisingly, polygon size did not increase as expected, except for Arable polygons in Kingston, but it is likely that the effects of increased mechanisation and hedgerow removal became more apparent in the 1960s.

Methodology and the use of GIS

Having considered the results of the data analysis in the light of the theoretical debate surrounding productivism it is now appropriate to evaluate the methodology used. Did the use of GIS enhance the project and did it cause any particular difficulties?

The two advantages of using GIS, as explained in Chapter 3, were the ability to integrate data from a number of different sources and also the facility to generate maps quickly and easily in order to show distributions of different types of land use and changes over time. Both of these facets of GIS proved to be a very important part of the project.

The study dealt with an enormous volume of data from different sources and at different scales. Without the capability to register these to the British National Grid and overlay them, it would have been very difficult and time consuming to work with all the data at the same time. Table 59 shows the main source and derived datasets used in the project.

Source	**Derived**
OS base maps (second and third County Series)	Base polygon layer digitised from base maps
1931	
LUS field sheets	Barcombe 1931 layer
LUS one inch maps (scanned from paper copy)	Whole area 1931 layer
LUS one inch maps (from *Vision of Britain* website)	
1940-1943	
1940 aerial photograph (geocorrected)	Barcombe 1940 layer
NFS maps	Whole area 1940 layer
	Farm outlines layer
	Military areas layer
1945/7	
1945/7 aerial photographs	Barcombe 1945/7 layer
	Whole area 1945/7 layer
1959	
1959 aerial photographs	Barcombe 1959 layer
	Whole area 1959 layer

Table 59: The main source and derived datasets used in this project

There were eight main sources of data, as both the paper maps and later the *Vision of Britain* website were used for the LUS one inch map data. In addition to this there were eleven main derived data layers created within the GIS. The NFS data from the forms were not held within the GIS but in a separate Access database due to the complexity of the data. However this was easily related to the GIS data via the farm reference number.

The base polygon layer was created and then subsequently copied and modified for each new layer. Beyond this there were numerous further layers created by querying the secondary layers in order to show specific aspects of the data, for example the plough up (Figure 85) and polygons which changed classification between the LUS field sheets and one inch map (Figure 43).

The number of layers brings home the magnitude of the task if it had been attempted outside the GIS. The layers for the whole study area each contained over 4,000 polygons whilst the Barcombe only layers each contained over 1,000. To manually identify each polygon and annotate it on a separate map with a land use code would have been difficult enough, but to then analyse the results and map them manually would have been onerous in the extreme. The calculation of acreages within the GIS was another very helpful factor, as this could be done relatively easily at any level from parish to polygon. Thus it can be argued that the use of GIS was a huge advantage and enabled this project to map and analyse some of the data in ways that had not been attempted before, for example quantifying the differences between the LUS field sheets and one inch maps. Gregory argues that:

> "The full potential of GIS lies in its ability to integrate data from a variety of layers...This approach goes beyond basic mapping, as querying the underlying attribute database allows a detailed understanding of a multi-faceted study area to be developed. In this way an understanding of the problem can be derived from many (possibly highly disparate) sources" (Gregory 2005, p50).

However it would be erroneous to imply that the use of GIS made the data processing a quick and simple experience. Numerous difficulties were encountered just in the course of getting the primary data into MapInfo. For example, issues with the edge matching of the County series maps which were used as the base datasets were described in Chapter 4 (Figure 16). The use of GIS did, however, serve to highlight these difficulties with the data and allowed them to be made explicit.

The 1940 aerial photograph, which covered quite a large area and had been taken from 20,000 feet, had variations in scale right across the image and required a considerable amount of “rubber sheeting” before it was able to be used in conjunction with the other datasets. The other aerial photographs also had minor variations in scale but these were not corrected as they did not cause major problems and the other datasets could be overlaid sufficiently closely.

All of the aerial photographs were scanned and then imported into MapInfo. The 1945/7 images were too large to be scanned as a whole in a standard A4 scanner and so each photomosaic was scanned in four or six sections, which meant that there were a large number of scans to import and register.

Once the primary data had been imported into the GIS, the process of creating secondary data layers began. As already discussed in Chapter 3, the potential for introducing errors at this stage was huge. Digitising errors could mean that the shape of a polygon was wrong, or that it had overlaps with neighbouring polygons. Perhaps more significantly, attribution errors could be made which would, obviously have implications for the final analysis.

In terms of this study there are two main reasons why attributes would be uncertain. The first is the difficulty with the internal consistency of some of the data. There were significant differences between the LUS field sheets and one inch maps for example so that, in the end, they were treated as two separate datasets and analysed separately. The assumption has generally been made that the published maps, which are the checked versions of the field sheets, are the correct versions for the purposes of analysis. The NFS data were surprisingly inconsistent in some cases, with less than one third of the farm acreages agreeing exactly between the census and Primary Return and over 12% of farms diverging by more than 20%.

Secondly, attributes may be uncertain due to difficulties of interpretation. These may arise from operator error or from poor quality data (or a combination of both). These difficulties have been described already but will be summarised here. The paper copies of the LUS maps were sometimes hard to read, especially where colour had leaked, and there were also folds which obscured some of the data. These areas were re-examined later when the LUS maps became available online at the *Vision of Britain* website. The LUS maps were designed to give a general overview of the land use county by county and predated GIS technology by a long way. They were not designed for large scale scrutiny and so in some areas it was very difficult to pick out the detail. In terms of the NFS data, farm extents were difficult to identify in some cases due to erratic outlining. Given the inconsistencies in farm acreage between forms it was often difficult to double check that the farm extent had been captured correctly by looking at the acreage.

Gregory summarises the difficulties encountered when using historic maps very helpfully:

> "Much historical data will be taken from historical maps, which may not be accurate, and the representation of features from these maps in the GIS at best will only be as accurate as the original source. In reality they are likely to be worse, as new errors are added when the data are captured (or transcribed, to use the historical term). Many of the clues about the accuracy of the original source will be lost when the data are captured. An obvious example is that if a feature is represented on a map by a crude, hand-drawn, thick line we may question its accuracy. In the GIS this will simply appear as a digital line like any other. Less obvious, but at least as important, is the scale of the source map: a map is only ever accurate within the limitations of its scale. In a GIS, however, we are able to zoom in hard or to integrate data taken from maps with very different scales. This demands more from the data

> than the original map or maps were designed to accommodate and may lead to inaccuracy, error and misunderstanding" (Gregory 2005, p13).

The process of reconstructing individual farms as described in Chapter 5 proved to be somewhat problematic. The levels of agreement between the MapInfo, census and Primary Return were assessed for the 98 complete farms, whose extent lay entirely within the study area. When the Meadow and Grassland, Arable and Heath and Rough Grazing totals classified in MapInfo from the 1940 Luftwaffe photograph were compared to the original NFS data, good agreement (68% of farms with acreage within 20%) was obtained in the Meadow and Grassland category with Arable and Heath and Rough Grazing closely agreeing in only about one third of cases. In 1945/7 the Arable agreement had improved slightly to 45% but Meadow and Grassland acreage within 20% of the NFS total had fallen to 57%.

One of the reasons for this discrepancy could be difficulties in interpreting the 1940 aerial photograph. This is always a subjective process, although in many cases the colour, pattern and texture are enough to give a fairly good idea of land use. However, Fuller notes that:

> "The temporary nature of crops and cropping practices may...lead to problems in interpretation. A crop changes appearance markedly within the growing season. For example, barley passes from being a low-growing green grass, to a crop with a green, vertical, flowering spike or ear, which in turn yellows with ripening and bows over. It is then, of course, harvested. The crop's appearance has changed four times in a matter of weeks" (Fuller 1985, p221).

In order to make this uncertainty explicit, a "best guess" code was used. This did not mean that the interpretation was necessarily wrong for the polygons in this class, but simply pointed out that they had been double checked in some way. Almost all buildings tended to be coded as best guess as it was not always possible from the aerial photograph alone to distinguish between a house (classed as Gardens etc.), a church or chapel (classed as

Unproductive) and an industrial site such as a brickworks (also classed as Unproductive). In 1931 only 0.4% of the Meadow and Grassland and Arable polygons were coded as best guess and double checked. In 1940 and 1945/7 around a quarter of the Meadow and Grassland polygons were rechecked in some way. Arable was checked in 22.5% of cases in 1940 and 38% of cases in 1945/7. In 1959, the 1945/7 classification was also rechecked due to the poor quality of the aerial photograph and so many more polygons were examined twice. Riley and Watkins encountered similar problems when examining three case study farms using the NFS and contemporary aerial photographs and concluded that:

> "The aerial photograph does help in interpretation of the land use of Castle Farm, Amberley, but not conclusively, and further farm or estate records, fieldwork or oral histories, are needed to be certain of its wartime land use. The difficulties of interpretation at this farm are also compounded by the relatively poor quality of the aerial photograph" (Riley and Watkins 2006, p214).

In terms of farm acreage, the MapInfo and Primary Return acreage differed by more than 20% for just over 10% of farms, and the census and MapInfo acreage differed by more than 20% for 17% of farms. However, as already noted, the census and Primary Return acreages also differed by more than 20% for 12% of farms. Riley and Watkins also encountered similar difficulties with regard to Castle Farm, Amberley:

> There is a significant inconsistency between the farm area given in the census return of 4 June 1941 (100 acres) and that given in the Primary Return of 10 February 1942 (121 acres). The difficulty is made worse when we add up the acreage of the farm from the NFS map (date not given) which is no less than 205 acres! This is a major problem, because from this evidence alone we are not sure whether the farm has doubled in size between 1941 and the date the farm was mapped, or whether different criteria were used to define the farm at different times. The different areas moreover, make it very difficult to use the

data to reconstruct land use field-by-field" (Riley and Watkins 2006, p214).

In general, better levels of agreement were obtained for larger farms, which is, perhaps unsurprising as a small difference in acreage constitutes a high percentage difference in relation to a small farm. Figure 164 compares the levels of agreement for the ten smallest and ten largest complete farms (ranked according to their acreage in MapInfo).

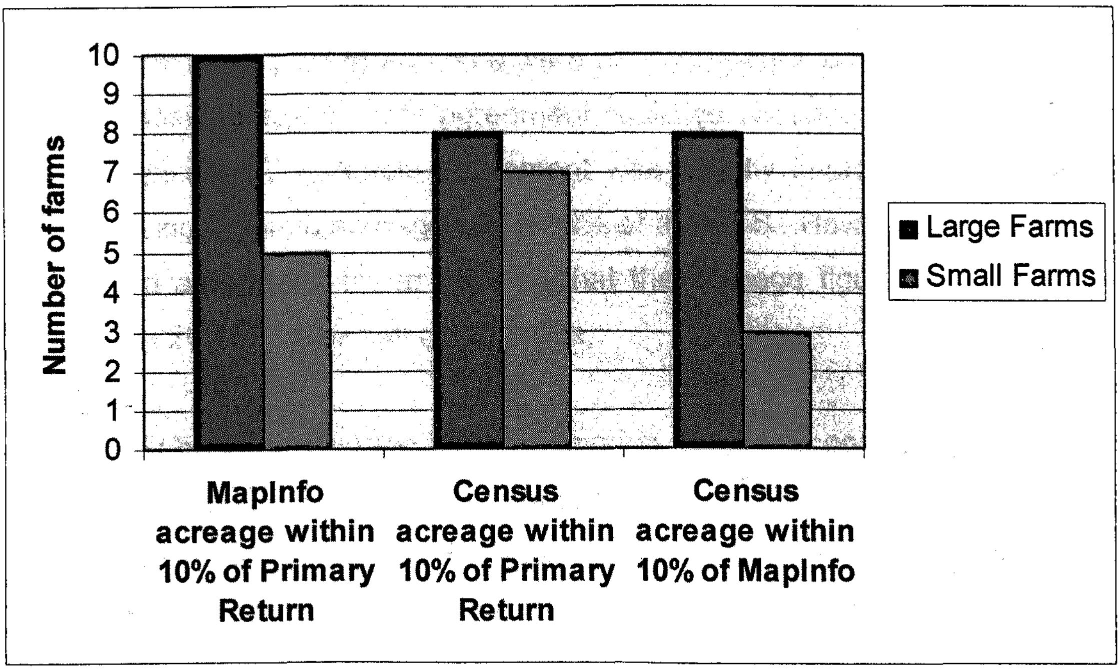


Figure 164: Levels of agreement for the 10 largest and 10 smallest farms

The MapInfo and Primary Return acreages are within 10% for all ten of the largest farms, but for only five of the smallest farms. There were poorer levels of agreement with the census data for the large farms with eight farms where the census and Primary Return acreages were within 10%, and also eight farms where the MapInfo and census data were within 10%. However this was still better than the smaller farms where the Primary Return and census acreages were within 10% of each other for only seven farms, and the MapInfo and census acreages were within 10% for only three farms.

The Luftwaffe aerial photograph was taken on 12th August 1940 before the plough up campaign had started in earnest and so the time gap between this and the NFS data was problematic. Attempts were made to take this into account by adjusting the 1940 land use figures for the plough up. However, much of the plough up affected "parts" of fields, with no indication as to which part. It was therefore difficult to pin down the actual plough up acreages for each farm with any real accuracy. Even after adjustment, the arable figures from MapInfo differed from the NFS by more than 20% in almost two thirds of farms.

The 1945/7 aerial photograph data were also compared to the NFS on a farm by farm basis to see if better agreement could be obtained, as this was after the plough up. The Arable agreement was slightly improved with 45% of farms having MapInfo acreage within 20% of the NFS. However Meadow and Grassland agreement fell to 45% so that the acreage figures disagreed by more than 20% for over half of the farms.

This study has demonstrated that attempting to fully reconstruct the farms is problematic, and this difficulty may be due to a number of factors combining to produce a large difference overall. Inconsistencies within the NFS forms certainly account for some of the problems. Erratic farm outlining on the maps may mean that some farm extents have been captured incorrectly in MapInfo meaning that the acreage will be wrong. Equally, the interpretation of the aerial photographs may be at fault in some cases. Finally the time differences between the aerial photographs and the NFS may have some bearing.

One of the other difficulties with using a GIS is handling time, as explained in Chapter 3. This project has adopted a very simple "snapshot" approach to the issue. However this has some implications. It is difficult to be sure what happened in between the snapshots – the assumption is that the process of change was smooth and linear. However, particularly in the 12 year gap between the last two datasets it would be possible for quite major changes to pass by unnoticed.

It was convenient in terms of this analysis to hold all the data for a similar time period in a single layer. However the RAF aerial photographs for 1945/7 span a period of two years and even the NFS data span more than a year. The snapshot created by interpreting the aerial photographs or NFS purports to show a particular moment in time, but actually it represents a period of time and changes may have occurred in the study area even within that period.

This chapter has attempted to bring together the results of the data analysis and to consider these in the light of the aim and objectives stated at the very beginning of the project. The final chapter will draw some conclusions as to how far these objectives have been met and will reflect on some of the lessons learned during the research process.

CHAPTER 9: CONCLUSION

The aim and objectives for this study were set out at the beginning of the first chapter and it is appropriate to revisit them at the conclusion of this study to assess how effectively they have been achieved.

The study set out to reconstruct the agricultural environment around Lewes using a range of datasets dating from 1931 to 1959. This reconstruction was undertaken in order to contribute to the broader debate around theories of productivism and also to demonstrate the power of GIS as a tool for this type of project.

Just as the process of creating a map involves a degree of generalisation, so the process of reconstructing the agricultural landscape has involved a similar degree of simplification. Monmonier notes that "reality is three-dimensional, rich in detail, and far too factual to allow a complete yet uncluttered two-dimensional graphic scale model" (Monmonier 1996, p25). This study has used seven simple land use classes based on the LUS to try to gain an understanding of patterns of land use in the study area. The use of a vector GIS system to capture and represent these seven land use classes means that each polygon is neatly categorised to a single land use class and has a clear edge to it.

The reality, as discussed in Chapter 4, is that features have fuzzy boundaries. At the edge of an area of dense woodland the trees may gradually thin out and merge into grassland. In a simple classification system, the question then arises of where to set the boundary between the two land use classes. In this project this has largely been a matter of subjective judgment guided by the boundaries shown on the OS base maps.

Equally, adopting a classification system that worked for all of the datasets meant that the classes were necessarily very simple and much of the detail was lost. It would have been interesting to have been able to pick out crop types and even species of tree, but the quality of the aerial photographs made this an impossible task.

Thus the reconstruction of the agricultural landscape which has been presented in this study is premised on a very simple model which highlights selected broad elements of interest but necessarily leaves out much of the detail.

The reality of reconstructing historic land use is that it is not possible to check the data in the field. There are clearly some sources that could be used to assist with the reconstruction of the landscape such as historic photographs, farm records and so on, but it is unlikely that coverage exists for the entire study area to allow the complete classification to be checked from these additional sources. This means that, insofar as possible, data have to be checked intertextually against historical sources. It was helpful to be able to use the 4th June census returns as an additional source of data against which to measure the changes in the study area. It was reassuring that the decrease in Meadow and Grassland and the corresponding rise in Arable acreage between 1931 and 1959 which was calculated from the datasets used in this study was also reflected in the census summaries for the seven parishes which overlapped the study area.

However, as has already been discussed at length, there were many difficulties with the internal consistency of the datasets. Therefore checking the datasets against each other could, at worst, simply constitute comparing one inconsistent dataset with another without any means of knowing which, if any, was actually correct.

In terms of the aerial photographs these were literally images of what was on the ground and so could be seen as more reliable data sources than the survey data. However, in this case the images underwent a process of interpretation which was inevitably subjective, and many polygons had to be classified on a "best guess" basis.

This study does not therefore claim to be a definitive reconstruction of the agricultural landscape of part of East Sussex between 1931 and 1959. It may not be possible from the remaining data sources to ever reconstruct the landscape as it would have been. However some clear trends and patterns have consistently emerged from the data and it is the weight of this evidence which leads to the conclusions below.

The first objective of the study was to provide a baseline against which subsequent changes could be measured. As has already been noted, it is generally agreed that the transition into productivism began around the time of the Second World War (Wilson 2001) and so 1931 could be expected to be characteristic of the phase before productivism.

The choice of a baseline date was, to a large extent, governed by data availability, with the LUS providing maps with a level of detail that had previously been unavailable, allowing a relatively small region to be examined in depth for the first time. Martin has argued that 1931 was a particularly significant date for the development of modern agriculture with the abandonment of free trade, and increasing government intervention in agriculture throughout the 1930s and beyond (Martin 2000, p23) and so it was fortuitous that the LUS was completed in East Sussex at this date.

The differences between the LUS field sheets and one inch maps have been discussed at length, particularly with regard to the Heath and Rough Grazing and Meadow and Grassland categories. This has cast some doubt as to which of the two versions of the LUS is most appropriate to use as a baseline. However, whichever set of figures is used for Meadow and Grassland, the general trend over time is still the same. Heath and Rough Grazing proved problematic to identify from the aerial photographs and so the results for this category overall should be treated with some caution. The differences between the two sets of LUS data were therefore interesting to explore and it is believed that this study is among the first to undertake such an analysis of these two sources. However, the differences identified have not proved crucial in terms of identifying the general trends of land use change in the study area.

The second objective was to consider whether the study area in 1931 could be characterised as distinctively pre-productivist. It has been noted that pre-productivism has, thus far, been poorly defined in the literature, with most of the debate concentrating on productivism and the phases beyond. However Wilson proposes that pre-productivism is characterised by "high environmental sustainability, low intensity and productivity, weak integration into capitalist markets and horizontally integrated rural communities" (Wilson 2001, p91), and this was used as the starting point for a consideration of the study area in 1931, although the concept of "high environmental sustainability" was challenged.

Indicators of low productivity and low environmental sustainability were found with clear evidence of weed infestation, poor quality grassland, and poor management emerging from the data. Farm sizes were generally lower in 1931 than in 1959 suggesting low intensity. Certain additional indicators also emerged, with lack of capital appearing to play a major role, as would be expected in the midst of a depression. However lack of ambition and inattention amongst farmers also figures heavily in the NFS comments of the early 1940s, and there is a clear sense of apathy and "doing things as they have always been done." This may perhaps be summed up by the comments recorded on the Primary Return with regard to Broyle Place Farm (XE 218/110/019), "The farmer ...is very inactive and likes things done his way which seems usually rather out of date".

In the study area, particularly in the Weald, there also appeared to be issues around landownership with the majority of farmers still tenants and the ownership of land remaining concentrated in the hands of relatively few individuals. Writing of Captain Christie from Glyndebourne, the largest landowner in the study area, Ambrose notes that "clearly decisions taken by this one landowner concerning terms and conditions of service could have had decisive effects on the standard of living of a large proportion of those employed in agriculture and related occupations" (Ambrose 1974, p50). The status of individual farmers could only be gleaned from the NFS data for the early 1940s and so it was not possible from these data to say whether patterns of landownership had changed by the 1950s.

The characterisation of pre-productivism in the study area could therefore be widened beyond low intensity and low productivity to include low economic prosperity, poor management of the land, general apathy of farmers and also some degree of powerlessness. With the national depression in the 1930s it is likely that some of these characteristics, such as low economic prosperity, could be applicable more widely than to this area alone.

The third objective was to look for evidence of a clear transition to productivism occurring in the study area. The plough up campaign during the Second World War concentrated on increasing Arable acreage and this was reflected in the study area with the acreage more than doubling between 1931 and 1959. From the census totals for Arable, it was only in 1940 that acreages began to rise and the largest increase in a single year for the seven parishes overlapping the study area was between 1940 and 1941 when the area under Arable cultivation increased by 1,480.75 acres. This suggests that it was the war and the associated intervention in agriculture which really was responsible for accelerating the rate of change. Arable acreages do not drop back down to pre-war levels in the late 1940s and 1950s but continue to increase steadily, suggesting that the process of change was ongoing after the war.

In the permanent grass category of the census for the same seven parishes, the largest drop is also in 1940/41 when 1,253 acres are lost, although the requisitioning of land by the military may well have affected this figure. After the war, permanent grass never recovers to pre-war levels and the general trend in acreage is downwards, although this does fluctuate from year to year.

The figures obtained from analysing the aerial photographs and NFS bear this out, although the actual moment when change begins to accelerate is not so obvious. The first snapshot in time after the LUS is the Luftwaffe image from August 1940 when the changes were already underway according to the census data.

There is some strong evidence for a process of intensification during the study period. In 1958 (no data for 1959) there are 43 fewer farms than in 1931 according to the census. However there are over 1,300 more acres of crops and grass and, as has already been noted, the area under Arable has more than doubled. In addition there are 1,500 more cattle in 1958 than in 1931 and stocking densities for cattle have generally increased.

Levels of mechanisation increased nationally over the war years with the number of tractors tripling (Dewey 2006, p99). This would have been expected to result in larger field sizes as hedgerows were removed to assist with mechanised ploughing and to increase crop yields. This was the case on the downland with mean Arable field size almost doubling over the study period. In the Weald, however, the mean Arable field size actually decreased slightly. This suggests that the pace of change may have varied across the study area. The downland would have been relatively easy to plough up for Arable cultivation with its wide open spaces. However in a wealden parish such as Barcombe, where the field boundaries tended to be wooded shaws or else ditches, it could be considerably more difficult to create larger fields without substantial effort. Thus whilst there has clearly been a shift towards Arable farming in Barcombe, the field size has remained largely the same throughout the study period.

It was noted at the beginning of this chapter that the approach taken has necessarily been very simplified in terms of looking at broad general land use categories. Farm extents have been identified from the NFS maps of the early 1940s but are not available from the LUS data or the census. It is therefore not possible to look at the process of change from the point of view of individual farms from these datasets. The danger of considering broad general categories and identifying substantial changes is the ecological fallacy, implying that all of the farms changed at a uniform rate. It has already been noted that there appear to be significant differences between the Weald and the downland in terms of growth in Arable field sizes. In reality the process of change is likely to have been patchy, and it may be that just a few of the more progressive farms actually contributed most to the increase in Arable acreage and the growth in cattle numbers. It was noted above that 43 farms were lost during the study period and it would be interesting to discover whether these were the C graded farms which were, perhaps, the most marginal to begin with. Walford (2008) looking at the whole of the South Downs found that farm size had more influence on the "survivability of farmers in the post-war decades" than the farm grading from the NFS.

The categories of Meadow and Grassland and Arable have been emphasized in the discussion as they are the most obviously "agricultural" land use classes and the shift towards more intensive Arable cultivation over the study period is very clear. However, some of the other land use categories are also worthy of comment. The dip in acreage of Forest and Woodland in 1945/7 was unexpected and the thinning of two areas of woodland in Barcombe parish could clearly be seen on the aerial photographs for 1945/7. It was speculated that the cause for this dip was likely to have been timber extraction for the war effort, but no further evidence has yet been uncovered to support this and it would be an interesting avenue to pursue in order to further extend understanding of the area.

Urban growth can also be seen over time, particularly around Kingston near Lewes and with the construction of the Landport Estate on the outskirts of Lewes, as was illustrated in Figure 137 and Figure 138. The parish of St

Anne Without which contains the Landport Estate lost almost half of its agricultural land (total crops and grass) between 1931 and 1959.

The fourth objective of this study was to demonstrate the power of GIS as a tool for historical reconstruction. It proved enormously helpful in terms of integrating and manipulating the many layers of data which were utilised in this project and the facility to query the data and create thematic maps was also most useful. However the use of GIS did also serve to highlight some of the inconsistencies in the data and there was a danger that the data (especially the published LUS maps) were sometimes used to provide a level of detail for which they were never originally intended. As has already been noted,

> "Much historical data will be taken from historical maps, which may not be accurate, and the representation of features from these maps in the GIS at best will only be as accurate as the original source. In reality they are likely to be worse" (Gregory 2005, p13).

In summary, then, a very simplified model was used to represent the agricultural landscape around Lewes from 1931-1959. This meant that much detail was lost but did allow some general themes and patterns in land use to emerge. There is strong evidence for a transition from a pre-productivist state characterised by low productivity and intensity to a much more productive phase characterised by increased mechanisation and more intensive land use. The shift from predominantly Meadow and Grassland to high levels of Arable is also very clear.

Many difficulties were encountered with the data themselves and with the methodology chosen. The study area originally selected was reduced in size fairly early on in the project as it became clear that the first area was too large to analyse effectively within the time available. As the study location was constrained by the area covered by the Luftwaffe aerial photograph this meant that the data analysis became very complicated as the area covered did not correspond neatly to any particular administrative units. Thus the final study area contained just three complete parishes together with large sections of four more parishes. It would have been much simpler to study the whole of each of the seven parishes if the data had been available. Of course, if the whole of the seven parishes had been included in the study area then this would have made the data directly comparable with the 4th June census data. However some farmers held land outside the parish in which they made their census returns, and so without knowing the extent of each individual holding it would still have been problematic to compare the data directly.

A further contingent difficulty was the requisitioning of so much land across the South Downs by the military. This affected five of the seven parishes overlapping the study area and made a huge difference to agricultural land use during the war. In Falmer parish, which lost over half of its total area to the military, the acreage of rough grazing as shown by the census, plummeted from 1,580.5 in 1941 to just 32 in 1943. During the plough up campaign of 1941-43, almost 1,800 acres of land were lost according to the census total of crops and grass for the seven parishes. Again this must have been due to the effect of the military area and the requisitioning of land. Thus the patterns of land use, particularly between 1940 and 1945/7 were rather unexpected. With hindsight, and with unlimited data availability, it would have been preferable to choose an area that was not so extensively affected by the military in order to see the patterns in agricultural land use better. However, any search for a 'purely' agricultural area, untouched by any extrinsic factors, would have been time consuming and possibly ultimately fruitless.

It has been repeatedly emphasized that pre-productivism is a phase of agriculture and does not represent everything that came before productivism. It was speculated that there had been other productivist phases before the "second agricultural" revolution around the Second World War. Having attempted to augment the existing definition of pre-productivism it would also be interesting to look back to the beginning of this pre-productivist phase and to consider its historic origins in more depth. Is the whole of agricultural history prior to 1939 to be characterized by 'pre-productivism, or do we require a quite different conceptual model such as that proposed by Wilson (2007)?

The NFS contains a wealth of data which were transcribed into a database but not used in the final analysis. There are many further ways in which these data could be analysed in order to extend the study. For example, the proportion of land naturally good, fair, or poor is shown for each farm. It would be helpful to explore this further and to discover whether farmers with naturally good land were generally more successful and more highly graded. It would also be fascinating to create a thematic map showing the B and C graded farms coloured according to the reasons for their poor grading. Are there any patterns evident? So, for instance, are the farms which are suffering from lack of capital clustered together in the Weald or spread across the whole of the study area?

In terms of the differences between the two sets of LUS maps, the identification of Heath and Rough Grazing presented a problem. This difficulty persisted when attempting to differentiate Heath and Rough Grazing from Meadow and Grassland on the aerial photographs. It would therefore have been helpful to have been able to verify the location of the areas of Heath and Rough Grazing in some way, and this is an avenue that could be pursued in future in order to strengthen the validity of the results of this study.

This study has concentrated on general patterns of land use. Much can be deduced about the attitudes of the farmers and the management of their farms early on in the study period from the NFS data. However the later datasets used in this study are devoid of personal detail. It would be interesting to "populate" these data using archive material and farmer interviews where individuals still survive in order to get a sense of farmers' values and attitudes in 1959 at the end of the study period.

Another potential avenue to explore would be to extend the study forward in time to the 1960s using the data from the second Land Utilisation Survey.

Some of the changes which were expected but did not occur, such as a significant growth in field size, might have become more evident by the 1960s.

The use of GIS has generally concentrated on creating two-dimensional, mainly thematic maps to illustrate the changes in land use over time. Some attempt has been made to explore the differences between the downland and the Weald. However it would be helpful to be able to visualise the variety of landscape more effectively. To this end, the use of a Digital Elevation Model (DEM) with the aerial photographs draped over it could be very helpful in giving a sense of the topography of the region and this is another avenue which could be explored in order to extend this work.

This study has aimed to chart part of the course of the "agricultural revolution" identified by Short *et al* (2006). This has been attempted using a very broad brush and has assessed general trends over time such as the increase in Arable land. However from this study it remains unclear whether the changes occurred as the results of the actions of a few innovative farmers or whether it was, in fact, a shift in practice by the majority of individuals. As has been noted, it is not possible to determine the *attitudes* behind the actions from most of the data examined in this study.

Despite these reservations, it is true to say that some of the characteristics of pre-productivism have been characterised more fully and clear trends in land use have been identified, and so to that extent the study may be deemed to have fulfilled its objectives. However this is just one small piece of a much bigger picture, both spatially and temporally, and there are many more ways in which this picture could be painted to provide more colour and more detail.

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APPENDIX 1

Acreages from the agricultural census for 1931-1959 for various land use and livestock categories.

	Barcombe	Falmer	Hamsey	Kingston	Ringmer	St Anne	St John
1931	2541.25	735.5	1433.5	702.25	4030	435.25	541.5
1932	2560	794.25	1422.75	688.75	4036.25	436	556
1933	2572.25	826	1422	718.75	4111.25	418	512
1934	2534	760	1443.25	722.75	4063.75	398.5	432
1935	2474.25	771.5	1434.75	737.5	4042	341.5	401.5
1936	2604.75	735	1499.25	597.5	4013	283.5	306.5
1937	2609.5	864.5	1579.25	590.5	3931.75	407.75	304.5
1938	2630.5	984	1591.75	599.75	4019.75	447	318.5
1939	2613.75	1086	1623.5	428.75	4130.5	629	332
1940	2382.5	813.25	1463.5	325.25	3944.75	973	276.25
1941	2170.5	537	1198.75	334.5	3610.75	852	221.5
1942	2056.75	129.25	1109.5	290.25	3316	182	178
1943	1773.5	109.5	942.5	287.5	2713.75	140	147
1944	1649.25	90	783.25	234.25	2193.75	121	121.75
1945	1593.75	94.5	795.5	219.75	2287.75	111	133
1946	1529.25	103	885.75	335.5	2360.75	61.25	130
1947	1454.5	95.25	900.75	337	2419.25	96	146.25
1948	1429	162.75	856.5	332.25	2515.5	105	138
1949	1605	137.75	917.25	348.5	2582.75	100	217.5
1950	1648	165.25	1017.75	392.75	2638.25	108.5	93.75
1951	1609.25	298	1077	392.5	2862.5	69	224
1952	1503.25	302.75	1007.25	386	2718.5	29.5	164.5
1953	1469	307.5	902	417	2832.75	92.25	177.5
1954	1382.5	213.25	912.25	395.25	2761.75	66.5	180.5
1955	1437.75	566.25	971.5	407.25	2996.25	51	119.5
1956	1513.5	587.5	989.25	376	2687.75	66	0
1957	1428	826.5	1018.25	428.5	2749.75	65	96
1958	1468.5	759	961.75	657	2690.5	57	96
1959	1261.75	237.5	967.25	571.75	2792	52	92

Table 60: Acreage of permanent grass 1931-1959 for the seven parishes in the study area
Source: TNA MAF 68

	Barcombe	Falmer	Hamsey	Kingston	Ringmer	St Anne	St John
1931	782.25	916.75	435.75	323	1305.5	275	315.5
1932	768	907.25	445.5	329.75	1296.75	286.25	301
1933	751	875.5	454	310.75	1226.5	228.5	280
1934	756.75	930.75	471.5	301.5	1194	266.5	167.5
1935	796.75	924.75	452	301.75	1286	414	141
1936	774.25	841.25	586.25	269.5	1085.25	413	64
1937	769.75	715.75	484.5	262.75	1166.75	272.25	66
1938	753.25	661.75	443.25	277	1121.5	262.5	72
1939	770.5	545.5	401.5	293.5	1164.5	230.5	64
1940	1016.5	652.5	571.5	383.75	1378	185	124.75
1941	1196.25	902.5	805.25	436	1800.25	472.75	179.75
1942	1301.25	506.5	950	462	1951.5	309.75	182.25
1943	1619.5	549.75	1119	437.75	2520.25	340.5	208.25
1944	1736.25	568.5	1275	491.25	3006.5	362.25	238
1945	1787.5	567.5	1274.75	503	2923.25	262.5	227.5
1946	1841	563.5	1216.25	587	2854.5	297.75	230
1947	1864.75	596	1220.25	573.25	2791	261	224
1948	1905.5	658.75	1267.75	599.5	2707.5	258.75	228.25
1949	1811.25	687	1191.85	663.25	2543.75	275.5	198.25
1950	1765.75	686.75	1172.75	738.5	2546.5	279.25	190
1951	1810.5	1548.75	1135.25	707.5	2329.5	317.5	187.25
1952	1922	1762.25	1224.25	759.5	2461	379	247
1953	1961	1832.25	1363.5	840.75	2462.25	313.75	233.25
1954	2047.75	2115.25	1361.25	1059.75	2530.25	323.75	230.5
1955	1979.75	1787.25	1500	1084.5	2275.25	335.5	54
1956	1910.75	1932.5	1497	1114.5	2536.25	314	60
1957	2019	1696.75	1638.5	1087.75	2505.5	330	12
1958	1943.75	1751.5	1717	1090.5	2576	323	60.5
1959	1907.75	2308	2047	1199.25	2472	328	0

Table 61: Acreage of arable for the seven parishes in the study area from 1931-1959
Source: TNA MAF 68

	Barcombe	Falmer	Hamsey	Kingston	Ringmer	St Anne	St John
1931	84.75	1432	44	871.75	521	641	1045.25
1932	73	1591	44	877.25	530	641	1045.25
1933	72	1591	44	871.25	519.75	651	1045.25
1934	81.25	1601.25	44	870.75	519.75	645	1074
1935	47.25	1598	44	864	513.75	627	1074
1936	79.75	1505	178	866	466.5	627	940
1937	77.25	1507	179	879	466.5	627	940
1938	79.25	1360.25	179	841.5	472.5	707	940
1939	84.75	1360	197	858.5	489.5	707	918.25
1940	52.5	1574.5	183.25	897.5	502.5	1121.25	11.5
1941	80.75	1580.5	183.5	881.25	531	924	0
1942	87.75	101	92.75	266.25	519	135	30
1943	38.25	32	92.75	266.5	504.5	60	30
1944	42.25	32	92.75	313	514.5	48	30
1945	36.25	32	77.75	290.5	511.5	48	30
1946	57.5	32	22	290	512.5	48	30
1947	70.25	288.25	720	870	508.5	64	171
1948	39.75	193.5	778	1227	513.5	62	50
1949	52.25	193.5	736.5	1142	523.25	28.5	10.25
1950	56.5	776.75	679.5	1121.75	782	28.5	10.25
1951	50.25	1354.5	685.5	1150	782.5	25.5	15
1952	42.25	1137.5	685.5	1105.5	782.5	28.5	0
1953	43.5	1065.5	642.5	991.75	489.5	28.5	110
1954	42.5	823	637	766.25	502	23.5	0
1955	46.25	780	637	709.75	524	27.5	9
1956	30	624	637	654.5	544	34	0
1957	30	624	573.5	654.5	513	34	0
1958	17.75	624	584.5	408	503.5	51	0
1959	24.25	589	564.5	381	494	51	0

Table 62: Acreage of rough grazing for the seven parishes in the study area from 1931-1959
Source: TNA MAF 68

	Barcombe	Falmer	Hamsey	Kingston	Ringmer	St Anne	St John
1931	24.75	2.5	2.25	35.75	14.5	0	0
1932	24.25	2.25	1.75	38.25	13.75	2.25	0
1933	20	2.25	2	33.25	13	2	0
1934	26.75	4.25	1.75	37.25	9.5	0	0
1935	23.5	2.25	1.25	22	11	0	0
1936	23	2.25	3	23.25	8.25	0	0
1937	18.75	2.25	1.25	22.5	11	0	0
1938	17	1.5	3.25	35.5	11	0	0
1939	18.5	2	2.75	33	9.5	0	0
1940	17.75	1.25	3.25	33	7	0	0
1941	19	1	3	38	9	0	0
1942	19.5	0.5	4.25	32.75	12	0	0
1943	0	0.75	1.25	33.75	15.5	0	0
1944	16	0.5	1.5	31	8.5	0	0
1945	8.25	0.5	2.5	33.75	9.5	0	0
1946	14.25	0.5	1.75	26.5	9.5	0	0
1947	15.25	0	2.75	30	15	0	1.5
1948	20.25	4.5	2.25	36	14.5	0	1.25
1949	13.5	4.5	3.25	42.5	18	0	0.5
1950	13	9.5	1	36	16.25	0	0
1951	13.25	8.5	5	45.75	7	0	0.25
1952	13.25	11	0.5	40.25	13.75	0	0
1953	12.5	9.5	1.75	45.75	12	0	0
1954	11.5	9.25	0.5	27.5	15.5	0	0
1955	11.5	7.75	0	40	15.25	0	0
1956	10.75	6.25	0.5	41.25	12.75	0	0
1957	8.75	6.75	0.25	13.75	14.75	0	0
1958	10.5	6.5	4.25	26.5	14.25	0	0
1959	8.75	5.5	1	34.25	3.25	0	0

Table 63: Acreage of orchards for the seven parishes in the study area from 1931-1959
Source: TNA MAF 68

	Barcombe	Falmer	Hamsey	Kingston	Ringmer	St Anne	St John
1931	125	54	59	46	177	21	19
1932	132	56	56	46	179	21	18
1933	137	53	64	58	164	25	18
1934	125	55	59	59	159	27	10
1935	121	42	56	52	156	24	15
1936	133	43	60	46	144	18	7
1937	142	51	60	43	137	17	12
1938	134	57	57	44	132	13	14
1939	133	55	55	67	156	17	9
1940	141	54	64	66	168	23	9
1941	139	61	61	56	177	24	7
1942	152	41	74	62	184	21	16
1943	175	43	72	56	206	24	17
1944	144	49	81	65	210	18	16
1945	173	60	84	64	221	27	18
1946	178	57	84	79	224	16	21
1947	186	52	87	83	228	14	20
1948	151	54	88	79	197	17	19
1949	160	56	100	75	203	18	12
1950	173	55	87	80	194	13	20
1951	147	57	82	73	192	12	14
1952	158	91	74	65	180	14	16
1953	136	95	75	66	174	14	17
1954	129	92	66	60	170	16	21
1955	142	88	65	51	160	16	9
1956	127	74	68	47	154	13	9
1957	116	65	65	36	147	13	8
1958	106	80	68	41	139	13	6
1959	105	69	66	38	135	10	8

Table 64: Numbers of labourers for the seven parishes in the study area 1931-1959
Source: TNA MAF 68

	Barcombe	Falmer	Hamsey	Kingston	Ringmer	St Anne	St John
1931	1156	256	557	250	1628	43	151
1932	1165	327	573	355	1792	53	160
1933	1302	288	663	434	1820	61	201
1934	1271	322	651	419	1852	48	119
1935	1241	305	680	398	1747	47	106
1936	1313	230	664	285	1597	36	73
1937	1341	267	656	251	1626	70	79
1938	1384	341	620	330	1714	48	87
1939	1398	305	663	278	1807	146	97
1940	1479	402	752	270	1843	295	93
1941	1400	232	709	276	1783	232	76
1942	1427	66	623	177	1813	31	86
1943	1426	65	727	235	1863	70	102
1944	1354	83	744	259	1874	44	122
1945	1312	129	754	297	1896	43	104
1946	1262	172	714	359	1922	25	108
1947	1299	203	702	428	1890	27	97
1948	1467	180	730	592	1978	29	121
1949	1563	200	737	574	2076	75	103
1950	1516	486	826	633	2208	66	133
1951	1408	564	852	617	2242	107	77
1952	1430	556	827	554	2140	109	59
1953	1541	434	738	442	1985	88	80
1954	1399	426	816	421	2028	112	117
1955	1457	581	819	483	1910	121	28
1956	1560	684	925	530	1900	106	46
1957	1376	678	887	543	1893	106	38
1958	1386	694	864	620	1819	105	48
1959	1376	792	1146	670	2021	128	72

Table 65: Total numbers of cattle in the seven parishes in the study area 1931-1959
Source : TNA MAF 68

	Barcombe	Falmer	Hamsey	Kingston	Ringmer	St Anne	St John
1931	564	146	223	109	816	22	52
1932	628	128	211	119	800	19	60
1933	651	129	246	137	850	21	61
1934	677	133	255	142	914	22	53
1935	646	132	268	137	916	28	53
1936	719	124	252	87	826	23	36
1937	700	128	295	91	827	24	37
1938	692	139	257	97	853	36	22
1939	724	183	278	90	826	27	27
1940	722	186	252	78	820	62	27
1941	702	118	265	91	807	71	30
1942	640	11	236	8	798	20	30
1943	704	28	288	80	852	27	42
1944	644	33	253	80	838	32	47
1945	590	32	254	80	820	28	42
1946	567	26	268	75	815	18	40
1947	547	50	262	81	802	19	46
1948	540	68	269	94	855	21	67
1949	543	55	258	124	817	31	43
1950	548	37	278	131	858	35	35
1951	529	94	273	136	937	35	30
1952	518	132	253	111	699	32	24
1953	490	128	171	63	780	35	31
1954	489	53	241	78	782	43	31
1955	466	132	191	81	666	46	0
1956	383	80	242	80	722	44	16
1957	434	207	245	79	713	43	20
1958	480	200	259	88	727	39	25
1959	432	214	356	100	767	38	27

Table 66: Numbers of cows and heifers in milk in the seven parishes in the study area 1931-1959
Source: TNA MAF 68

	Barcombe	Falmer	Hamsey	Kingston	Ringmer	St Anne	St John
1931	862	1825	92	806	730	795	766
1932	987	2137	164	853	232	611	797
1933	791	2288	341	915	934	1072	656
1934	747	2047	0	751	659	455	0
1935	1139	1334	0	569	650	870	0
1936	1055	1006	115	517	1022	865	0
1937	767	732	426	745	958	828	0
1938	821	483	483	582	681	981	0
1939	924	985	489	662	643	523	0
1940	200	442	344	376	999	449	0
1941	470	362	26	754	940	211	0
1942	896	0	21	944	924	542	0
1943	977	0	108	830	854	119	0
1944	834	0	16	732	811	25	0
1945	660	0	0	840	830	16	0
1946	75	0	0	876	725	0	0
1947	109	0	0	457	813	0	0
1948	75	0	23	543	510	0	0
1949	10	0	15	514	497	0	0
1950	43	104	5	582	535	0	0
1951	105	4	0	623	532	0	0
1952	102	0	0	644	594	0	0
1953	38	0	2	670	817	0	0
1954	40	207	12	965	856	0	0
1955	80	291	438	1041	1143	0	0
1956	450	383	766	524	1182	0	0
1957	792	334	815	832	899	0	0
1958	958	601	694	943	1005	0	0
1959	877	721	1176	918	1304	0	0

Table 67: Numbers of sheep in the seven parishes in the study area 1931-1959
Source: TNA MAF 68

	Barcombe	Falmer	Hamsey	Kingston	Ringmer	St Anne	St John
1931	106	45	50	20	172	63	17
1932	92	44	47	20	141	37	28
1933	97	50	53	25	143	22	31
1934	86	45	51	22	140	35	13
1935	85	42	68	21	121	43	35
1936	85	37	77	19	143	14	4
1937	90	39	74	23	133	12	29
1938	82	31	70	16	127	10	31
1939	83	33	51	11	135	24	35
1941	82	51	51	17	136	34	51
1942	79	25	44	14	113	19	38
1943	76	21	38	14	104	18	32
1944	73	18	35	11	105	16	40
1945	64	22	49	11	99	23	35
1946	60	18	55	9	98	6	25
1947	67	26	58	8	91	6	35
1948	10	25	66	12	85	5	30
1949	40	24	62	9	72	4	30
1950	39	14	47	11	60	2	31
1951	32	22	41	10	56	2	8
1952	27	20	57	9	59	2	32
1953	27	15	34	13	53	2	31
1954	22	14	31	9	51	1	31
1955	21	11	29	13	38	1	30
1956	15	10	25	10	34	1	60
1957	10	11	14	6	31	1	35
1958	8	14	23	13	32	0	33

Table 68: Numbers of horses in the seven parishes in the study area 1931-1959
Source: TNA MAF 68