PART I

Understanding Green Revolutions: an overview
The agricultural revolution in Western Europe

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Much of the literature that has described the agriculture of the less developed countries has emphasised the backwardness of their farming methods. But it is worth noting that both their food and total agricultural output has increased rapidly since 1950; indeed it has not only increased as rapidly as output in the developed countries in this period, but more rapidly than in Europe at any time before 1950. In Europe agricultural output has also grown at a high rate since 1950, and many have described this as an agricultural revolution. The achievements of Afro-Asia and Latin America, in contrast, have been damned with faint praise. The first reason for this is that population has grown nearly as rapidly as food output in this period so that there have not been dramatic improvements in per caput food supplies, although a smaller proportion of the population have inadequate diets than in 1950 (Grigg, 1981, 1982a). A second reason is that the Green Revolution, which many regard as the principal cause of increased output, is alleged to have also caused landlessness and increasing income inequality in rural Asia. A third reason for confusion is the lack of any agreed methodology for measuring the nature and pace of agricultural change in these regions. This problem is not new. The agricultural revolution in Western Europe has also been the subject of much controversy. The aim of this chapter is to show why the past has been so variously interpreted.

Use of the term agricultural revolution

The term agricultural revolution has been used to describe events in many parts of the world and at different times (Ross & Tontz, 1942). It has, for example, been applied to changes in English agriculture in the period since 1945 (Slater, 1961; Duckham, 1959). But its use goes further back. L.T. White believed the years between the sixth and the ninth centuries saw an agricultural revolution in Western Europe (White, 1962). Georges Duby (1954) put a similar change between the late eighth and the twelfth centuries, and believed there were no further improvements in farming methods before the mid-eightheenth century. Lord Ernle thought the agricultural revolution in England began in 1760 (Ernle, 1968) and was completed by 1820; his views influenced three generations of historians. In the 1960s an alternative view
was put forward by Eric Kerridge (1967) who argued that new methods were adopted in the late sixteenth century that transformed English agriculture; this revolution was complete by 1767 and there was no comparable progress thereafter. Although it is now widely agreed that new farming methods were introduced in England in the mid-seventeenth century, there are few who believe that there was little progress after 1767 (E.L. Jones, 1967). F.M.L. Thompson (1968) has argued that the English agricultural revolution had four stages. Beginning in the sixteenth century there was a shift from subsistence to commercial farming; then the agricultural revolution proper involved the extinction of the open fields and the introduction of new rotations and livestock improvements and was largely complete by 1815.

The period between 1820 and 1880, the third stage, was characterised by the purchase by farmers of cattle-feeds and artificial fertilisers, and investment in new buildings and underdrainage. The last stage, after 1914, saw the introduction of the tractor and of labour-saving machinery. Thus the English agricultural revolution, once thought to be a short, sharp break in the history of English farming, largely achieved between 1760 and 1820, has now been stretched to cover some three hundred years. French historians, in contrast, have brought the agricultural revolution even nearer the present. Early writers believed the French agricultural revolution began, like the English, in the mid-eighteenth century (Bloch, 1966; Faucher, 1956). But recent work has cast doubt upon this, and has suggested that the 1820s or 1840s were a more likely time for its commencement (Morineau, 1968; Newell, 1973).

One of the problems in discussing the agricultural revolution in Europe is that it is rarely defined; one rare such instance is by J.D. Chambers and G.E. Mingay, who define it as the transition from traditional husbandry practices to modern scientific agriculture and high farming (Chambers & Mingay, 1966). But this could be said to cover a period of several centuries; yet the term revolution implies a short period of radical change after a period of little change. But how long is an agricultural revolution, how radical must the changes be, and what exactly is changing?

Approaches to the study of the agricultural revolution

Enclosure

Few historians have specified what they mean by an agricultural revolution; nonetheless three contrasting approaches have been adopted. First are those who have seen changes in landownership, farm size and labour supply as critical. Such work derives from Marx’s interpretation of English agricultural history and it is noteworthy that he referred to ‘an agrarian revolution’ (Marx, 1977). His approach has been followed widely by later writers, not by any means all of them neo-Marxists. Marx thought England in the fifteenth cen-
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tury was a nation of small peasant farmers, who held approximately equal areas of land, farmed the land with their own labour and owned their livestock and farm implements. Over the next four hundred years this was radically changed. First, the ownership of land was concentrated in relatively few hands; these rentier landlords did not farm the land themselves but rented it to tenants with capital. Second, farms became much larger than in the fifteenth century and were worked by landless labourers who owned no livestock or implements, and were paid wages. Marx believed that the peasant was deprived of his land by force and later legally by enclosure. It is not clear when this happened although he and later writers have emphasised two periods, the sixteenth century and the period after 1750. In the latter era Parliamentary enclosure not only led to the final expropriation of the peasant, and the creation of large farms, but drove the expropriated to the towns where they formed the labour supply for the new factories of the industrial revolution (Saville, 1969; Dobb, 1963; Hammond & Hammond, 1911). Such a view has been subject to much criticism, but the absence of any comprehensive records of land ownership until 1873–74, of farm size until 1885, and of the labour supply until 1851, has made confirmation or refutation of this thesis difficult. The lack of reliable records of enclosure before the era of Parliamentary acts and awards, and the difficulty of interpreting the acreages listed in the latter all add to the problem (Turner, 1980).

Technology

A second approach has been to emphasise the importance of changing farm technology; historians have used farm records, estate archives, contemporary descriptions of farming, and works on agronomy to trace the adoption of improved farming methods, and hence by implication, increased output and productivity. The most common method of measuring improved productivity has been to trace changes in crop yields. But there are few national records of these before 1840; the first French agricultural census was published in that year. Before then crop yields covering more than a few farms for a few years are rare. The only accurate long-run series are for manors in the south of England in the thirteenth and fourteenth centuries (Titow, 1972). There are of course data for individual farms for single years at different times in profusion, but they are rarely part of a series. Thus the main means of tracing changes in land productivity has been by using written descriptions of methods and implements and assuming that the adoption of new methods implies increased productivity. There are several difficulties in such an approach.

First, it is too often assumed that the first recorded instance of a new method was followed by widespread and rapid adoption of the innovation, and hence a sharp increase in productivity. Yet modern studies of innovation
adoption amongst farmers shows that there is invariably a considerable lag between the first adoption by the more enterprising farmers and majority adoption (G.E. Jones, 1967). This lag could be considerable. Thus in a sample of farms in Norfolk and Suffolk the turnip was first recorded in the 1640s, and may have been introduced some decades earlier; by the 1730s less than half the farms in the sample were growing the crop (Overton, 1979). The first practical milking machine was exhibited in Scotland in 1895. On the eve of the Second World War only 8% of the dairy farmers in Britain were using a machine, and it was not until the 1960s that it had become generally adopted. We can reasonably suppose that before the seventeenth century the rate of adoption was even slower.

Second, innovations introduced in one region were slow to spread to other areas; farmers learned mainly from observing their neighbours, and so innovations spread slowly outwards from farmer to farmer, taking time to reach the remotest areas. Thomas Coke, the celebrated improving landlord of Holkham in Norfolk, believed his improvements spread at about a mile a year in the eighteenth century, about the same speed at which, one archaeologist has estimated, the domestication of wheat and barley spread into Europe from the Near East some five or six thousand years ago (Clark, 1965; Ernle, 1968, p. 220). Neither estimate can be taken too seriously, but it can be assumed that new ideas were slow to travel from one region to another. It follows from this that even if one region in a country can be shown to have adopted an innovation at a given date, it does not follow that all other regions progressed at the same rate. This point has been well made for the north and south of France in the nineteenth century (Newell, 1973).

Third, without adequate figures on crop yields it is difficult to estimate just how important the adoption of a new method would be. What increase in crop yields did the use of a new rotation give, or an improved plough or harrow? Did the selection of seed from better crops give yield increases? How far did underdrainage increase yields? The same questions could be asked of improvements in livestock breeding, and are equally difficult to answer. Crop yields are a function of a great variety of factors, and the importance of one technical change is hard to disentangle from others (Fig. 1.1). Even in modern times it is difficult to assess the quantitative role of new factor inputs. However, in experimental plots in the north-eastern United States the same fertiliser and other inputs have been applied to wheat varieties grown in the 1920s as to later improved varieties. From this it can be argued that the introduction of the new variety accounted for nearly half the increase in wheat yield between 1935 and 1975 (Jensen, 1978). No such calculation can be made for the past. However, attempts to trace the flow of the nitrogen cycle suggest the great importance of the adoption of fodder legumes in Western Europe after 1770; they accounted for one third of the increase in crop yields between 1770 and 1880 (Chorley, 1981).
Fig. 1.1. The interrelationships of changes in cultivation practices and the effect upon crop yields.
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Fourth, not all farming methods were necessarily suitable for all regions. Lord Ernle and later historians emphasised the importance of the turnip. If sown with the drill upon the fallow it allowed weeding during growth, which was not possible with cereals. Fed to livestock it helped them put on weight and increased milk and meat output per animal. Their dung, mixed with the straw from cereal crops, was thought to have increased cereal yields, although it may be that clover was more important in maintaining soil nutrient status. But the turnip was not grown in all parts of England – there were difficulties in growing and lifting it in heavy clay soils (Grigg, 1966) – and was not widely grown in continental Europe, where sugar-beet and potatoes served a similar function. In the south maize was the major new crop, but it could not be grown successfully in Northern Europe (Hohenburg, 1977). Indeed much of the discussion of the agricultural revolution has emphasised improvements in arable farming; yet even as early as 1750 a considerable proportion of the value of West European farm output came from livestock products.

Economics

A third approach to the study of the agricultural revolution not widely applied as yet, is to follow the procedures adopted by economists in analysing changes in modern agriculture. Provided data are available for production and prices, it is possible to measure changes in the rate at which agricultural and food output is increasing. Many developed nations publish such estimates, whilst the Food and Agricultural Organisation of the United Nations has published indices of output for most individual countries since the early 1960s, and for major regions of the world since the 1950s. If data are also available for inputs then it is possible to measure productivity changes. Four such indices have been used. First, changes in output can be related to total factor input, measuring the efficiency with which all inputs are processed into outputs. Although such indices have been published for a few western countries since the 1950s, the lack of data makes it difficult to construct them before the mid-nineteenth century. Thus partial productivity indices have been more commonly used. The most widely used index is labour productivity growth, which relates changes in total output to changes in total labour input: this requires consistent figures on the labour input, not easy to obtain in an industry which uses a great deal of family, seasonal and casual labour: consequently the adult male labour force is often used as a measure. A second partial productivity index is land productivity growth, or changes in total output per hectare of agricultural land (Hayami & Ruttan, 1971); land productivity changes are more commonly measured by using yields of the major food crop. A final index widely used in the post-war era is to relate total food output to total population. The reason for this of course is the concern
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over food supplies in the developing countries since 1950. However, it is equally applicable to Western Europe in the past. Paul Bairoch has argued that prior to the agricultural revolution, variability in crop yields meant that harvest failure was frequent and food supplies periodically inadequate; further the surplus above the needs of the agricultural population was insufficient to maintain a manufacturing population (Bairoch, 1973). Thus an agricultural revolution was a necessary prerequisite for an industrial revolution; others would argue that it was the improved nutrition made possible by the agricultural revolution that led to population increase after 1750 (McKeown, 1976).

Thus there are clearly a variety of possible meanings of the term ‘agricultural revolution’. It could be, first, a radical change in the tenurial and structural character of agriculture. Second, it could be the accelerated adoption of new farming methods. Third, it could be an accelerated rate of growth of total output or food output. Fourth, it could be an increase in the rate of productivity growth in agriculture, measured either by total factor productivity growth, the growth of total output per hectare, or total food output per head of the total population. It is these measures which are considered here.

The measurement of input and output during the agricultural revolution

It should be said straight away that the measurement of agricultural output and productivity changes even today is hampered by methodological differences about the construction of such indices and also by lack of reliable data. Prior to the commencement of agricultural censuses – few of which exist before the 1840s – the estimates of output, arable acreages, changes in labour supply or crop yields are based upon contemporary estimates which are at the best of doubtful provenance, at worst, wishful thinking. Further there are few if any estimates for any country before 1700, yet the period between 1600 and 1700 in the Low Countries and England is regarded as critical by many historians (Kerridge, 1967; Slicher van Bath, 1960).

Output

There are few estimates of the growth of agricultural output for the eighteenth century: in England and France output is thought to have grown little faster than total population (Slicher van Bath, 1977; Ladurie, 1975). In both countries output accelerated in the first half of the nineteenth century, but the rate of increase declined in the later nineteenth century, rising later to much higher rates after the 1930s (Fig. 1.2). In other West European countries the rate of increase in output in the later nineteenth century was higher than in England and France (Eddie, 1968; Dovring, 1969; Bairoch, 1965), but, as in England and France, reached the highest rates after the
1930s. The record is thus one of steady growth in the rate of increase, without any sudden spurs, except possibly in the early nineteenth century. It is sadly impossible to compare this with changes before 1700.

**Land**

Most historians have emphasised the importance of the adoption of new farming methods in the eighteenth and nineteenth centuries, and thus implied that increased crop yields were the major reason for increased output. But there is no doubt that between 1700 and the 1880s there was a substantial increase in the arable area of Western Europe (Fig. 1.3). Even where estimates of the area in cultivation are not available, contemporary descriptions support this view. In addition the proportion of the arable area in bare fallow declined quite dramatically; in France for example, from one third in 1701–10 to 13% in 1892 (Toutain, 1961), and in Sweden from about 50% in 1750 to only 7% in 1900 (Osvald, 1952; Thomas, 1941). This was used not only to increase the area in cereals but also to grow fodder legumes and roots, sugar-beet and potatoes. Hence a considerable part of the increased output of West European agriculture in this period came from increases in area rather than yields. In England the increase in output due to the rise in the sown area between 1700 and 1850 has been put at nearly two thirds (Mingay, 1977; Grigg, 1982b). However, in England and France the arable area had reached its peak by the 1870s, elsewhere by the 1920s. Since then there have been fluctuations in the area in crops, but no further increase. Indeed the general trend has been downwards, particularly since the 1950s. Hence crop yield increases have become of increasing importance in raising total output (Dovring, 1965b).

**Labour**

It is notoriously difficult to measure the labour input in agriculture, and there are few accurate occupational statistics in national censuses before the mid-nineteenth century. These may neglect family labour and seasonal labour. Yet there is little doubt that the numbers employed in agriculture increased in the eighteenth century and continued its increase in the first half of the nineteenth century (Fig. 1.4). In the 1850s there began a long decline in the labour force in Britain and Ireland; somewhat later a decline began in Belgium and Switzerland, although very slowly, and at the turn of the century France and Germany followed suit and later Scandinavia and the Netherlands (Grigg, 1974). Thus the agricultural revolution before 1850 did not see a decline in the labour force. Indeed many of the new techniques and crops required greater labour inputs (Timmer, 1969). The slow reduction of the fallow increased labour needs; the widespread cultivation of the potato in
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Fig. 1.2. The rate of increase in agricultural output 1750–1976 (per cent per annum). Source: Toutain (1961); Deane & Cole (1962); Hayami & Ruttan (1971); F.A.O. (1963, 1980).

Fig. 1.3. Changes in the arable area, 1750–1980. Source: Toutain (1961); Grigg (1980); Thomas (1941); F.A.O. (1958, 1980); Jensen (1937).