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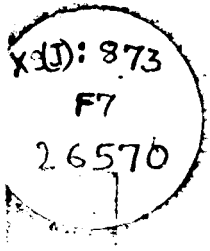
AS AN AID TO MORE PRODUCTIVE FARMING

BY

J. S. KING



Price 10/6 Net.

OXFORD UNIVERSITY PRESS
LONDON: HUMPHREY MILFORD

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OXFORD UNIVERSITY
PRESS
LONDON EDINBURGH GLASGOW
COPENHAGEN NEW YORK TORONTO
MELBOURNE CAPETOWN BOMBAY
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PUBLISHER TO THE
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OXFORD UNIVERSITY PRESS
LONDON: HUMPHREY MILFORD
1927

Printed in Great Britain

PREFACE

THE initiative, in this country, in promoting the use of cost accounting as an instrument of value to the farmer and the Agricultural Economist, has come, in the main, from Mr. C. S. Orwin at the Agricultural Economics Research Institute, Oxford. To that initiative was due, in large measure, the form of the work of the post-war Agricultural Costings Committee, and it has given direction, in later days, to much of the work of the Advisory Agricultural Economists, now established by the Ministry of Agriculture at various centres throughout the country. This small volume has arisen out of an attempt to apply, to the solution of some of the economic problems of farmers, the methods of farm accounting, involving the determination of costs, which are at present advocated.

Scientific method in accounting, as in every other branch of human activity, is only perfected by a process of trial and error. No scientific weapon was ever forged that proved entirely suitable under trial and that could not be sharpened on the wheel of critical discussion. If in these pages some modifications of present methods are suggested, it is hoped that the reasons adduced for change may not prove to be inadequate. It is hoped, too, that the interest of farmers in the efforts now being made to obtain for agriculture the benefits accounting can offer, will be increased by a frank discussion of the difficulties arising from the character of the industry, and of the limits within which accounts may be of practical value.

Critical discussion, however, to be effective for good, must be constructive. To that end, where weaknesses may have been established in existing methods, new lines of approach to the same problems have been suggested. For the use of the farmer simpler means have been devised. For the investigator, in search of comparative data, accuracy of principle rather than simplification of method has been the objective :

at the same time it is proposed to eliminate some of the wearisome labour of apportionment without, it is hoped, any loss of vital information. The excuse for putting these alternative methods into print is that they have been tried, and, if the farmers who have allowed themselves to be the subject of experiment are not merely charitable, they have been found to work.

Acknowledgement is gratefully made to the Ministry of Agriculture and Fisheries and to the Research Board of the University of Reading for making the work and its publication possible; to Mr. C. S. Orwin, who read the work in draft, and, whilst giving helpful criticism, generously advised publication and offered to put the methods advocated to practical test under his supervision at Oxford; to Professor S. Pennington of Reading and Professor J. A. S. Watson of Oxford, whose careful scanning of the proofs has resulted in the removal of some flaws; to the workers on the advisory staffs at the Midland Agricultural and Dairy College and the University of Reading, for their patience and loyalty in carrying out the constant changes in the detailed work of farm accounting suggested by growing experience; and finally, and in greatest measure, to the farmers in the Midlands and the South of England, too numerous to mention by name, who have, during the past four years, personally recorded in detail the operations on their farms, and placed full information upon the practical and financial aspects of their business at the writer's disposal. Such blemishes as appear in the book are due entirely to the writer's failure to profit by the help so freely given.

J. S. K.

University of Reading,
September 1927.

INTRODUCTION

ACCOUNTING as an end in itself has no attractions for the practical farmer. It must be a direct means to the attainment of some definitely useful purpose if it is to make any appeal to the man whose interests are very largely centred in crops and stock, which are often not only the source of his profit, but the basis of his reputation as a farmer as well. Cost accounting, even in factory industry, is used in only a small proportion of businesses in which it could be an effective instrument for promoting efficiency. An essential condition for its more widespread use by the farming community is that its practical utility, for throwing light upon specific problems in management, must be clearly demonstrated with reference to particular cases. It is, at best, an irksome and rather monotonous business to keep records from day to day and analyse them periodically. The work only becomes attractive if it can proceed upon fairly definite lines to results which can be readily understood and used as a basis of action.

Any system of cost accounting must take account of the conditions under which the industry is carried on. It is necessary, therefore, to make some preliminary inquiries into the characteristics of farming which may determine the nature of the problems to be solved. It has been proposed to apply to agriculture conceptions of the uses of cost accounts which arise in factory industry. Accounts have been framed to arrive at the cost of the individual products of the farm by a detailed apportionment of expenses, and to arrive at a Profit and Loss Account in which the net return on each saleable crop or live-stock product is stated separately. These methods will be examined in the light of the circumstances of the industry, in Chapter I from the standpoint of the farmer, and in Chapter II from the comparative standpoint.

The individual farmer would no doubt be interested in cost accounting if, with a reasonable expenditure of time and effort, his records would provide him with some means of measuring the efficiency of his methods, and indicate where he has succeeded or failed in achieving the objects at which he had aimed. His outlook and his interests are, however, limited by the circumstances in which he finds himself. The possibilities of change, or of develop-

ment, may be conditioned by the physical and economic environment of his farm; by its soil, climate, situation relative to markets; by its size, the amount of capital at his disposal, and by labour conditions in the locality. Comparative costs and returns on other farms, similarly situated, but on a larger or smaller scale, or differently organized, may help him to solve his own particular problems. He is, however, chiefly interested in comparisons between alternatives which he can apply under the circumstances prevailing in his district, and in figures by which he can test the efficiency of the use of his labour and capital.

An investigator into the economics of farming will wish to take a wider and more comprehensive view of the methods and costs of production in different localities, and of the relative economy of working on a large or a small scale. The statesman, who may be called upon to legislate for the promotion of agriculture in the national interest, must, of necessity, take wide and long views, and visualize adjustments in methods and in organization which, in the light of economic investigation, seem to suggest possibilities of greater efficiency in the agricultural activities of the country as a whole. Comparative data may be of very great significance when considering farmers as an industrial class, or for determining the effects of policy upon the fortunes of different sections of the agricultural community.

The major difficulty in farm cost accounting seems to arise from the organic nature of the farming business, its processes being the exploitation of living organisms, which require the maintenance of suitable conditions for development, and a consequent dependence upon natural forces. In the present state of knowledge these forces can only be brought under control at a cost which is altogether beyond the possibilities of economical production at the present level of food values. Farming thus exhibits a state of affairs in which limiting factors of an uncontrollable kind are constantly in operation, and in which a balance of activities must be maintained; conditions which are to a great extent eliminated in factory industry when inert material is being dealt with in a controlled environment. The farmer's problem is thus the grouping of activities within a circumscribed field. The farm cost accountant is, in consequence, faced with the measurement of factors which are not independent of one another, and he must fall back upon the expedient of expressing their joint

effect in such a way that the possibilities of economical change are shown as clearly as possible. That has been the objective in these pages, and the constructive suggestions in Chapter III are offered as a contribution to the discussion of principles and to the technique of what may prove to be an essential part of the machinery for the study of Agricultural Economics.

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The abbreviated titles used in the text are given in brackets.

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CHAPTER I

COST ACCOUNTING FROM THE STANDPOINT OF THE INDIVIDUAL FARMER

The Functions of Cost Accounting.—The special uses of 'cost accounting' in the agricultural industry, as distinguished from the keeping of ordinary financial books of account, have been variously defined. The main emphasis, particularly in this country and in the United States of America, has been laid upon the determination of the individual product cost, and the separation of the profits and losses on the several branches of the farm activities.

The post-war Agricultural Costings Committee (1919–21), charged with the collection of information as to the costs and returns of farming, took that view of its functions.

'That particular form of accounts which we term "Cost Accounts" are designed to show, not only the profit and loss resulting on the whole farm from the year's operations, but also the separate results, in the way of cost and also of profit and loss, of each department of the farm. . . . It is not always sufficiently realized, when farm accounts are discussed, that except in comparatively few cases, the farm is composed of several distinct departments, in that a number of different products are produced for sale. If the accounts that are kept on the farm follow this natural division and are divided into separate accounts for each department, this form of accounts will undoubtedly give the maximum amount of information useful to the farmer. He can then ascertain each year, not only the over-all profit or loss arising from the working of the farm, which may cover profits earned on some branches and losses sustained by others, but he can ascertain the separate result of each branch of his farm.' [1]

The analytical method of approach to farming costs had already received authoritative support in this country:

'It has been stated that a properly designed system of accounts should have one aim and object only, namely that of enabling the farmer to ascertain the cost of producing the things sold off his farm, and the meaning of this must be fully appreciated. It is of the greatest importance to adhere strictly and exclusively to the method of getting at what it costs the farmer to produce whatever he sells, for this is the only information worth getting, and it gives everything that is required. The price when anything is sold can then be compared with its cost to the farmer, and the comparison enables him to tell at once how he stands with regard to profit or loss on any transaction. The principle is simple. It is that when a farmer begins to produce

[1] *A.C.C. Report.*

anything, he traces the cost right through the process of production until he realizes the value of the product by sale.' [1]

The intention is to arrive at the costs of farm products by a process of apportioning all the expenses of the farm in the farm ledger, as an integral part of the system of book-keeping for the determination of the annual profit or loss of the farm. This general principle is implicit in the body of rules drawn up by the Agricultural Economics Committee of the Ministry of Agriculture for the guidance of agricultural accountants.[2]

The same viewpoint is expressed in the Farmers' Bulletins issued by the United States Department of Agriculture. Thus:

'The difference between book-keeping and cost accounting should be definitely understood. Book-keeping is the keeping of records that will set forth the income, cost, and profit of the business as a whole or complete unit; cost accounting involves the finding of cost, returns, and profit on production units—on a pound of beef, a quart of milk, a bushel of grain, &c.' [3] Again, 'The business farmer wishes to know how much he is making or losing on his business each year, how much he is making or losing on each crop or class of animals, and how he can improve his business so as to make more money. The function of farm cost accounting is to supply this information. Cost accounting for the farm is the same sort of work large manufacturing companies do to learn whether they are making a profit on their different products. The farmer wants to know whether his wheat pays, whether his cows pay, or his orchard. These are some of the questions a set of farm cost accounts will settle.' [4]

Amongst Continental accountants Argenzano defined the object of agricultural cost accounting in similar terms.[5]

Whether the objects thus defined are possible of attainment in farm accounting has been a matter of controversy for a considerable period. In an article appearing in the *Journal* of the Royal Agricultural Society in 1858 [6] Professor John Coleman, of the Royal Agricultural College, Cirencester, condemns, as being unsuitable to practical farming conditions, a system of ledger accounts in which profits and losses on the various fields of the farm are arrived at by debiting labour, seed, &c., and crediting the value of the produce obtained. The burden of the criticism lies in emphasizing that, in a rotation, the various crops benefit

[1] Orwin, *Farm Accounts*, p. 7.
[2] See Appendix.
[3] *U. S. Bulletin*, 511, p. 2.
[4] *U. S. Bulletin*, 572, p. 1.
[5] 'L'objet de la comptabilité agricole est de déterminer le prix de revient des divers produits, et partant, de faire connaître les résultats économiques, positifs ou négatifs, de chaque culture et de chaque industrie annexe . . .' (*Offices de Comptabilité*, p. 27.)
[6] Vol. xix, pp. 122–43.

one another in turn by their effects upon subsequent cultivations and the residues they leave, and that these benefits and residues do not lend themselves to valuation in terms of money. It is summarized in the comment: 'It is clear to me that we must take our management as a whole, and throw the expenses over the rotation and compare with the produce.' Various Continental writers have taken the same view.[1]

A more limited function has been claimed for farm cost accounting by other writers on agricultural economics. In America Mr. H. C. Taylor has written:

'The Cost system should be confined to a few comparisons at a time, otherwise it becomes too much involved. If the comparison is between corn and tobacco, simply charge each of these crops for all it gets in the way of labour and supplies. . . . Accounts of this kind are invaluable because they show which of two more or less profitable crops will add the greater amount to the total profits of the farm. It should be kept in mind that in agriculture the purpose of cost accounts is not to find out the specific cost of the different products, but to ascertain the relative profitableness of the different types of farming and the different competing elements in each type of farming. Not cost but relative profitableness is the basis of answering all the economic questions in farm management.' [2]

Somewhat similarly Dr. J. M. Saulnier of the International Institute of Agriculture, Rome, has suggested this narrower use for cost accounts,[3] viz. to extend, but not to replace, ordinary financial accounts, and to limit comparisons of profitableness to crops or products which can replace one another within the rotation or system practised. The discussions in the following pages will lend much support to this proposal.

The analysis of costs in industry is, however, important from other standpoints, viz. to enable comparisons to be made between expectations and the results actually obtained, and to trace the way in which the various elements which enter into costs are used in the business, in order to test the efficiency of organization, and to eliminate waste. On small farms where all or most of the work is carried out by the farmer himself, or under his immediate super-

[1] *Offices de Comptabilité*, p. 28.

[2] *Agricultural Economics*, p. 417.

[3] 'Les comptes analytiques ne peuvent rendre quelque service que s'ils sont tenus séparément, en dehors des cadres généraux de la comptabilité agricole, et s'ils ont pour but essentiel d'établir des comparaisons permettant de voir quelles sont les cultures qui, tout en ayant dans l'assolement une valeur équivalente, sont le plus avantageuses au point de vue économique.' (*Offices de Comptabilité*, p. 30.)

vision, there may be little need for records to draw his attention to leakages and inefficiency in matters of detail; but on larger farms, where delegated responsibility is inevitable, there can be no doubt that records of manual and horse work on the various jobs connected with the farm, of food and raw materials used, of manurial treatment given and yields obtained, would furnish to the intelligent and practical farmer a great deal of information of vital importance for the efficient working of his farm. Such information, if it could be compared validly with corresponding figures from other farms, would be useful for testing the relative efficiency of alternative methods of working.

The detailed analysis of farming costs has received more attention in the United States of America and in this country than in other parts of the world. This is no doubt due to differences in the forms of organization under which the industry is carried on. In European countries peasant ownership has attained a high development, whilst in Great Britain and in the United States agriculture has followed more closely the general lines of industrial evolution, and the land, the capital and the labour are not usually in the same hands. In the United States, however, in the earlier stages of its agricultural development, the importance of the maintenance of fertility of the land has not always been clearly in mind. This is reflected both in the methods of cropping practised on virgin soils, and in the absence of any provision for the costs of keeping the land fertile in some of the costing systems suggested by American workers. In Great Britain, with its denser population and longer agricultural tradition, a relatively intensive form of agriculture is characteristic, and in the United States the development of more balanced systems of farming is already marked. This tendency is indeed inevitable generally with the growth of the world population and the diminution of new fertile areas open to the colonist and settler. It is under conditions of intensive cultivation that many of the difficulties of agricultural costing arise. It has been thought justifiable, therefore, to discuss the problems of cost accounting from the standpoint of British farming, as representing a somewhat advanced stage in agricultural development.

Late Development of Farm Costing.—Cost accounting applied to agriculture is of comparatively recent growth. Bailiffs' accounts

of medieval times have little relevance from the standpoint of costs, since the relationship of outlay to return will have had much less significance in the days before agriculture was commercialized. The trend of accounting practice in farming since the enclosure movement of the eighteenth and nineteenth centuries is of greater interest. It is certain that many old account books must be in existence in the hands of farmers, but the number available for public inspection is exceedingly small. There are, apparently, only two examples in the library of the British Museum, both of which refer to the period 1758–76, before the enclosure movement had attained any considerable importance. Some account books of the late eighteenth and early and middle nineteenth centuries have been examined.[1] In both cases the accounts relate to the home farm of a landed estate. They contain records of accounts between house and farm, and between the bailiff and the work-people employed. Of particular interest are the full records kept by the bailiff on the farm of S. Shaen, Esq., of the work done by the farm hands for the period 1851 to 1853. The work of each man is recorded daily, and particulars of live stock bought, sold, killed or died are recorded for the same period. There is no evidence that these records were intended to be anything more than a diary of work done, kept for the information of the owner; but their completeness is evidence of considerable care in farm management, and they would have provided material for study and analysis if circumstances had warranted any anxiety about profits in those prosperous farming days. The farm diary has, indeed, during the past century, been the characteristic feature of farm records in addition to the ordinary financial accounts. Entries of dates of sowing, seed sown, artificials applied, dates of harvesting and threshing, crop yields and the like, constitute the material which the farmer finds of perennial interest. It has been sound instinct that has emphasized this side of accounting, since the correct adjustment of type and quantity of seed, dates and methods of operations to the physical conditions of the farm, are fundamental for success. It is perhaps significant that while no article on farm accounting appears in the *Journal* of the Royal Agricultural Society until 1858, the *Journal* abounds with in-

[1] The accounts of S. Shaen, Esq., of Crix. Library of the London School of Economics. The accounts of T. Edge, Esq., of Strelley, Notts. Library of the Midland Agricultural and Dairy College.

stances in which differences in the out-of-pocket costs and in the returns from applications of varying amounts of seed or manure are given.

The methods of financial accounting advocated for the use of farmers have usually been of a fairly simple character. Receipts and expenditure, analysed either in a columnar cash book or in ledger accounts, and annual valuations, form the basis of simple Trading or Profit and Loss Accounts, acceptable to the Income Tax authorities in support of claims for the adjustment of assessments. The modern development of farm cost accounting is connected with the growth of farm management studies. The difficulty of interpreting a Profit and Loss account in which labour, foods, rent, rates and other outgoings are shown as totals for the year, and are compared with the gross sales under different headings, has been the motive in recent times for an attempt to analyse the workings of the farm in more detail. Cost accounting, statistical investigations, studies of climatic and soil conditions, provide the data upon which farm management studies are based. The Agricultural Economics Research Institute at Oxford commenced costing in 1913, and the interest of the British public in the cost of production of farm products was stimulated by the fixation of the prices of corn for encouraging the home production of food during the War.[1] In response to a need for more adequate data relating to costs, upon which to base decisions as to maximum or guaranteed prices for farm produce, and to facilitate the settlement by the Agricultural Wages Board of questions affecting wages, an Agricultural Costings Committee was set up in December 1918 by the Departments of Agriculture of England, Scotland and Ireland and the Ministry of Food.[2] There were, however, considerations of a more permanent character in view. Firstly, it was thought that if farmers could be encouraged to keep cost accounts, a higher level of efficiency in farm management would result. Secondly, it was desired to accumulate data relating to the costs and returns of farming.

The Agricultural Costings Committee, 1918–21.—In order to secure uniformity of method in preparing and presenting the data collected, the work was placed under the supervision of a Director and a Deputy Director of Agricultural Costs. The collection of

[1] Corn Production Act, 1917.

[2] *A.C.C. Leaflets.*

information from farmers was in the hands of four chief costings officers, one in each of the Northern and Southern divisions of England, one in Scotland, and one in Ireland. The United Kingdom was further subdivided into twenty-six representative local districts, in each of which a local costings officer was stationed, after a preliminary period of training at the Agricultural Economics Research Institute at Oxford. All returns from farmers, after being collected and checked locally, were sent to the head-quarters of the Committee to be worked up by an accounting staff. Farmers were asked to furnish annual inventories of stocks, periodical returns of manual and horse labour, of the numbers and character of live stock on the farm, of food-stuffs purchased, produced and consumed, of seeds and manures used, of cash received and paid, and other details of their farming operations. The necessary forms were provided by the Committee, and information was received under strict guarantee of anonymity. The results were to be incorporated in general statistical statements in which the identity of the individual returns would be lost, each farmer being promised an account of the results obtained on his farm.

The principles which should be adopted in the compilation of costs presented some difficulties, but it was anticipated that solutions would be found as experience accumulated, and that results would become more and more reliable as the work proceeded. The working principles evolved were summarized in the final report of the Committee.[1] They were briefly as follows. The work was to be framed for the ascertainment of the cost of production of specific farm products, and results were to be presented upon a uniform basis. 'Cost of production' was defined to include a charge for the unpaid labour of the farmer and his family, at rates at which equivalent labour could be obtained in the district, also a charge for paid management; but no charge was to be made for the managerial services rendered by the farmer, or for interest on the capital employed. In order, however, that results might be comparable between farm and farm, allowances for unpaid management and for interest on the capital legitimately employed were to be noted separately in the cost statements. Home-grown products used on the farm were to be charged at cost of production. The basis of valuation at the annual balancing was to be cost or market price, whichever was the lower. Cleaning costs, the

[1] *A.C.C. Report.*

cost of young grass, and the unexhausted values of manures were to be apportioned to the various crops in the current year's rotation of crops, with the exception of the cost of laying down permanent grass, which would be carried forward for a number of years according to local custom, special cases being considered as they arose. In determining the manurial values of food-stuffs the Tables of Voelcker and Hall, as revised to date, and their suggestions as to mechanical values, were to be adopted in England and Wales; in Scotland the Tables of a Committee appointed under the Scottish Board of Agriculture were to be used. As regards purchased dung this would be taken on the basis adopted in each particular district. In apportioning establishment charges it was considered that the basis should be 'according to the cost of all the labour (including horse, manual, and tractor)' for the various productive departments of the farm. Lady Day, or a close date, was regarded as the most suitable time for closing the accounts.

In laying down these principles the Committee recognized that valuation at cost was not possible until accounts had been kept for a sufficient length of time to enable costs to be ascertained in respect of all farm produce, and that care and discrimination would be required in interpreting the results disclosed by the accounts. In particular it was suggested that the profit or loss of any one branch could not be considered alone, and that practical considerations would naturally be present in the mind of the farmer when considering the results presented for his own farm. It was thought, notwithstanding, that detailed cost accounts, framed on the lines indicated, would assist the farmer in increasing the efficiency of his management, in obtaining the largest possible return from his farm, and in adapting his policy to meet constantly changing conditions. It was not the fortune of the Committee to be able to give its methods a practical test of efficiency for an adequate period of time. When, on the 31st March 1921, its work was brought to an abrupt conclusion on grounds of economy, a full year's records had been collected from 120 farms and were in process of collection on 200 other farms. Accounts were submitted to the co-operating farmers who had completed a full year's returns, but no general summary of results was issued.

The result of one special costings survey was, however, published by the Committee. At the request of the Food Controller an investigation into the cost of producing milk in Great Britain for a

period of twelve months from 1st October 1919 was undertaken. The necessity for this investigation arose out of the importance and urgency of the question of milk prices. The special difficulties surrounding an attempt to isolate the cost of a single product, without reference to the total costs of the farming system, are clear from the reports.[1] Some compromise on questions of principle was inevitable. Home-grown foods were, in the absence of ascertained costs of production, charged at average, or estimated, market prices. For winter feeding hay was charged at an average price of £14 6*s*. 5*d*. per ton, straw at £6 13*s*. 9*d*., roots at £2 5*s*. 2*d*. For summer feeding the corresponding charges were £9 16*s*. 2*d*. for hay, £5 14*s*. 7*d*. for straw, and £1 14*s*. 3*d*. for roots. These charges clearly contained in themselves considerable, but unascertained, profits to the farmer. Since home-grown foods accounted for about 55 per cent. of the total cost of winter milk in Great Britain, this method introduced an element of uncertainty of major importance. Moreover, differences in the total cost of milk from district to district, arising from necessary variations in local feeding practice, were accentuated. Other estimates, such as the cost of grazing and the proportion of general expenses chargeable to milk production, were involved. Manurial residues of foods fed were first calculated on the basis of standard Tables, and then reduced to net allowances, having regard to the conditions under which the farmyard manure was stored. Only about one half of the farms recorded were classified as dairy farms, and over 40 per cent. were mixed farms on which dairying was not the sole or chief department. In the former group milk is the primary object of production, and cultivations are subservient to the requirements of the stock; in the latter group cows are functioning with a dual purpose, viz. the production of milk for sale and also of manure for maintaining the land in condition for the production of saleable crops. No significance is attached to this difference in the statement of results.

It will not be claimed that any very clear light was thrown upon the cost of producing a gallon of milk, with reference to which prices might reasonably be fixed. The final statements of costs are hedged about with qualifying clauses. The farmer had already reaped a profit on the home-grown foods in the price charged to the cows; the mutual contributions of crops and stock in the

[1] Cmd. 1028, Cmd. 1305.

supply of forage and the upkeep of fertility were heavily, but unequally, weighted in favour of the producer by assessing a high value for hay and straw consumed and a minimum value for dung produced. It may be that an attempt by a mixed Committee to segregate the costs of a single product, with executive action in relation to prices in view, and without information as to the costs of the whole farming system, was perhaps inevitably beset by difficulties of the character indicated.

The more immediately fruitful work of collecting and collating the financial accounts of a large number of farms, for the guidance of the Royal Commission on Agriculture,[1] is not relevant to the present discussion, but reference to it should not be omitted from any account of the Committee's activities. Nor should its extensive propaganda for the promotion of the keeping of financial accounts be overlooked.

The Agriculture Act of 1920 provided for variations of minimum prices payable for wheat and oats, based upon changes in the cost of production of these cereals. The determination of these costs was to be undertaken by three Commissioners, but their work came to an abrupt end with the passing of the Corn Production Acts (Repeal) Act, 1921. The ground prepared by the propaganda of the Agricultural Costings Committee has not been allowed to lie fallow. The scheme of Advisory Services, created by the Ministry of Agriculture for promoting agricultural education and research, has given special recognition to the work of the Agricultural Economics Research Institute at Oxford, and has provided for the establishment of Advisory Agricultural Economists at the Universities of Oxford, Cambridge, Wales, Leeds, Reading, Manchester, Bristol, and Durham, at the South-Eastern Agricultural College of the University of London, and at the Midland Agricultural and Dairy College, the Harper-Adams Agricultural College, and the Seale-Hayne Agricultural College. Corresponding appointments are being made in Scotland and Northern Ireland. The activities of the Advisory Economists have been devoted to a considerable extent, and in some cases entirely, to the extension of agricultural accounting and costings work. To ensure uniformity of method in farm costings a body of rules has been drawn up, which is amended from time to time as experience widens and as difficulties present themselves. A copy of these rules entitled

[1] *Minutes of Evidence*, vol. iv, Appendix V.

'Instructions to Accountants', amended to 31st August 1926, is printed in the Appendix. The work is in its early stages, but some reports of results obtained under the uniform scheme of costing have been published.[1] The information they contain is not limited to the results arrived at by the application of the costings methods laid down: valuable statistical and economic data are included which may, in part, be derived from the financial accounts and records of the farm, independently of the methods followed for determining the separate product costs. In view of the importance attaching to this work a discussion of the principles involved, with special reference to agricultural conditions in this country, is desirable.

Modern Costings Systems. The Analytical Method.—The analytical method widely adopted by investigators in this country and the United States of America is, in effect, a development of the ordinary double-entry system of book-keeping, using ledger accounts for the various fields, classes of stock, and saleable products. It proceeds along the lines of analysing all expenditure, and distributing it as precisely as possible amongst the ultimate products for sale, so as to arrive at the profit or loss on each, and incidentally at the cost of production of unit quantity of each.[2] Since most farm products are joint products, some apportionment of costs is boldly made: e.g. in the case of wheat and straw, the outlays on the crop are apportioned between them upon some predetermined basis; or, as in the case of mutton and wool, the less important of the two products is regarded merely as a by-product of the other. Since each crop may benefit by the work done or by the manures applied in the cultivation of previous crops, some estimate of the value of cleaning or manurial residues is made. Since the feeding of live stock gives rise to dung for fertilizing the land, feeding stuffs are regarded as fulfilling a double purpose, and their costs are apportioned between the live-stock products for sale and the residual elements voided in the manure. Again, since some crops, such as clover, are not removed after harvesting, but are left in the ground to grow again, the costs of the crop are apportioned between the first cut taken and the residues carried forward. An apportionment of the last-named type may have to be made

[1] Venn and Carslaw, *Cambridge Reports*; Wyllie, *Wye Reports*.

[2] See Appendix.

within a single year, as when a hay crop is mown and the aftermath is grazed. Thus the costs appearing in a crop account will consist of the value of residual elements brought forward from previous crops, together with further costs involved during the year. Against these will be credited whatever may be allowed for the benefit conferred on subsequent crops, and for the estimated proportion of the total net cost which should be chargeable to any joint product arising. It is claimed for this method that although it freely introduces approximations where no definite standards of apportionment of costs are available, the error introduced is not important; and moreover that, at any rate, the method provides a basis for the determination of comparative costs under different systems of farming, provided that the apportionment of residual and by-product values is made upon a uniform basis in all cases.

Characteristics of the Farming Industry.—For the purpose of a full discussion of the utility of cost accounts to the farmer, and of the validity of the methods used, it is proposed, in the first instance, to consider the circumstances under which farming is normally carried on in this country at the present time. There are certain features of farming in which it differs from most other industries.

(1) *Dependence upon Environment.* (a) *Physical Conditions.*—Firstly, farming is, in the main, an extractive industry, of which the object is to draw from the soil, with its natural environment of warmth or cold, sunshine or rain, abundance or scarcity of moisture, favourable or unfavourable situation and aspect, the produce which, within the limitations set by its natural conditions, it is capable of producing. The character of the farming, whether predominantly grass or arable, and the kinds of stock or crops which can be kept or raised, are, in the main, determined by these conditions.[1] In this country physical conditions are very varied. Different geological formations give rise to a variety of soil types, and these are complicated by the presence of 'drift' soils over large areas. It frequently happens that two or more formations may outcrop within the limits of the same farm. Rainfall, elevation, summer and winter temperature are also very varied in their distribution, and may definitely restrict the crops that can be

[1] Watson and More, Book IV; *U. S. Bulletins* 341, 1088, &c.

grown. By introducing limiting factors these conditions may determine the degree of intensiveness of cultivation which can be maintained. Moreover, in a well-settled country the size of a farm cannot be expanded and contracted rapidly.

Some natural conditions such as elevation, rainfall, summer and winter temperature, are, for all practical purposes, unalterable on a large scale. Others may be modified, but normally at a cost which is beyond the purse of the individual farmer; drainage over a wide area is a case in point. The modification of soil type, e.g. by claying or marling, is possible in only a few areas, and labour costs in modern times tend to make such processes uneconomical. Physical features thus set limits to the alternatives open to a farmer.

The problem of the farmer, in the organization of his farm, is the distribution of his time and resources within a limited number of alternatives. The chief source of energy he uses—sunshine—is not under his control. He can only with difficulty, if at all, alter the size and character of his undertaking within a reasonable period. He therefore approaches any analytical accounting system with a certain amount of reserve, and can often see no great advantage in attempting to unravel, by the use of detailed records, the working costs of his farm. The value of any system of costings, from the point of view of the control of policy, would seem to be limited by the extent to which alternative methods are practicable both physically and financially.

(b) *Economic Conditions.*—Where the limitations to cropping and stocking are not absolute, they may be relative to yields and selling prices. On land on which the risks that low yields of wheat may be obtained, or that the grain may fail to ripen, are great, the price of corn must rise to a high figure before the crop can become of interest to the farmer as a primary objective in his farming. Or the expense of marketing may be the controlling element of costs. Market-garden products, like fresh vegetables, which are bulky relatively to their value, can be marketed most economically if produced near to populous centres, where a ready market is to hand and stable manure may be available at cheap rates. More valuable produce, such as strawberries or currants, may be able to bear railway charges for greater distances. Frequently the limits to farming practice are set by the available supply of labour. The seasonal requirements of a crop like potatoes may

preclude its cultivation, on any considerable scale, in areas where casual labour is not available. Moreover, the business of farming is one in which success or failure depends in such large measure upon personal knowledge on the part of the farmer of the land and its environment, that it does not, in the generality of cases, attract investment, nor lend itself to capitalization by joint-stock enterprise.

The economic environment is more liable to change than the physical. Movements of population are relatively slow, but changes in the methods and the costs of transport are more rapid. As new industrial by-products such as feeding-cakes, grains, and fertilizers become available, new developments in live-stock policy, or better yields of crops, may become possible. Whatever may have been the position in the past, there would seem to be a prima facie case at the present time for an attempt on the part of farmers to keep a close watch upon changes in working costs and selling prices, and for alternative or better methods of marketing their produce.

It would, however, be a mistake to assume that a complete system of recording and analysing in detail the expenditure of the farm provides a ready means of solving the farmer's problem of adapting himself to new conditions, or that such a full analysis is necessary for that purpose. Changes in farming policy are of necessity slow and tentative in character. Physical limitations to change are reinforced by the slow rate at which both farmers and labourers can acquire skill in handling new crops or new kinds of live stock. Any persistent tendency in price change is reflected in the income the farmer derives from the sale of his produce, and for a farmer who knows the capacity of his land 'ordinary considerations of yield and price give him sufficient guidance' as far as minor changes in cropping are concerned.[1] That farming practice is sensitive to change in economic conditions, without the use of elaborate accounts, is evidenced by the annual statistics of cropping published by the Ministry of Agriculture.

(c) *Uncertainty of Returns.*—The use of cost accounts for judging the efficiency of the internal organization of farms would seem also to be limited by the influence of environment. The effects of climate are seen in the uncertainty of the physical returns. The

[1] Hall, *Cost Accounts.*

yield and quality of crops for sale or for forage vary from season to season within fairly wide limits. Weather conditions may make a change of cropping inevitable, and involve the substitution of one crop for another. For example, the acreage to be sown with the various kinds of root crops is often settled according to the weather conditions prevailing during the time of preparation of the seed bed. Uncertainties in the case of live-stock products are of a similar character, since the quantity of stock that can be carried on a farm may depend upon the yield of forage crops. Moreover, with live stock, risks of loss through accident or epizootic disease introduce a considerable element of uncertainty. The occurrence of disease amongst stock, or a particularly wet or dry summer, may disturb the normal yields and costs of such produce as milk or meat. Cases frequently arise where contagious abortion in a dairy herd has the effect of increasing considerably the costs of maintaining the numbers of the stock; at the same time the disease reduces the output of milk to such an extent that the costs per gallon are of little value for comparative purposes. Monetary returns are rendered still more uncertain by the influence of crop conditions in other countries, and by the comparative inelasticity of the demand for products like potatoes, carrots, and malting barley.

In fact the total costs of working farms are found to fluctuate less widely than the returns. The nucleus of men and horses on a farm is relatively permanent. Labour is often, in effect, hired by the year. The major items of cost are incurred a long while before the extent of the harvest, or its value, can be determined. Thus, the financial results of the farm in any year tend to turn more upon uncontrollable yields and selling values than upon working costs. Returns to outlays will so often vary, as a result of climatic conditions, independently of the expenditure incurred by the farmer, that the relation between cause and effect cannot be established in the absence of results obtained in a large number of cases, or over a fairly long period of years.

The value of costings data for providing tests of efficiency is greatest where the conditions under which production is carried out are stable or under control. This is normally the case in factories, but it rarely happens in farming that the returns to the major items of expenditure in any one year can be interpreted without reference to some disturbing factor not entirely under the

control of the farmer. Records may have to be kept for a fairly long period in order to give 'normal' results that are independent of disturbing factors.

Very few complete statements of analytical profit and loss accounts, based upon authentic records of farms, have so far been published in this country, and reference may perhaps be permitted to the following Account, in order to illustrate some of the difficulties of interpretation which arise in practice:

Profit and Loss Account—Cost Book-keeping.[1]

	£	s.	d.		£	s.	d.
To Roots %:				By Contract %:			
„ Complete failure of one field	80	10	6	„ (Outside work)	11	4	10
„ Tractor %: Proportion written off for idle time	77	7	2	„ Rent (Shooting)	40	0	0
„ Bank Charges %	29	4	10	„ Discount %	1	18	4
„ Horses %: Loss on Sale	9	8	9	„ Sundries %: Rabbits, &c.	3	8	11
„ Poultry %: Loss on Sale	2	16	1½	„ Bonus on Purchases (Co-op. Socy.)	13	10	0
„ Hay %: Loss on Sale	39	1	5	„ Pupils %: Fees	19	14	2
„ Wheat %: Loss on Sale	10	4	3½	„ Interest %		6	0
„ Barley %: Loss on Sale	76	17	11½	„ Sheep %: Profit on Sales	223	0	8
„ Oats %: Loss on Sale	56	18	0	„ Pigs %: Profit on Sales	113	17	10
„ Beans %: Loss on Sale	8	3	9				
„ Tares %: Loss on Sale	80	13	9	„ Balance, being net loss	213	11	0
„ Cows and Calves: Loss on sale of milk and calves	169	5	2½				
	£640	11	9		£640	11	9

A preliminary examination of this Account reveals that, from the costing standpoint, the work is almost inevitably incomplete. The first item of loss (£80 10*s.* 6*d.*) is due to the complete failure of one field of roots. If these roots were grown primarily as food for stock it might be argued that as all home-grown forage is chargeable at cost, the outlays on the unsuccessful crop should be added to the loss on cattle, or subtracted from the gain on sheep. If, however, the complete failure is to be regarded as a distinct source of loss, then what is the position if a crop is a partial failure, or gives an abnormally low yield? Fluctuating yields are characteristic of all cropping, and failures are of common occurrence. It would appear to be logically necessary to determine in advance what is to be regarded as a normal yield, and to charge a propor-

[1] *Oxford Report*, 1925, pp. 12 and 13.

tion of the outlay to crop failure if that yield is not attained. On such a basis it would appear to follow that an abnormally large yield should be regarded as producing a profit on the root crop instead of providing cheap forage for the stock. It is, however, the fact that roots are often grown with the double purpose of cleaning the land and providing food for stock. From the former point of view a crop failure adds to the cost of cleaning the land. Since such failures are likely to happen in an unfavourable season, the farmer must, it seems, include this risk as part of his normal costs, and distribute the loss over the rotation if the total cost of any crop is to be determined. This, however, cannot be done until *normal* yields and costs have been ascertained.

The second item of loss in the Account (£77 7*s.* 2*d.*) is a sum written off for idle time of the tractor. Presumably in arriving at this figure it will have been necessary to determine in advance what a *normal* working time for the tractor is. The charge appears to be shown separately to avoid distributing the whole cost of tractor use and depreciation over the jobs actually carried out by the tractor during the year. On this principle, lost time with the horses, which is a very important item of cost on all farms, should be similarly treated, and logically, lost manual time due to bad weather should also be shown separately. As in the case of the crop failure, it would seem that a normal cost has been assumed. These two cases typify the difficulties which are almost inevitable in any system of costing based upon a complete analysis of the expenditure of the farm and its exact distribution for the determination, year by year, of departmental profits and losses, having regard to the uncertainty of farming returns.

There are, of course, many directions in which a study of costs may promptly repay the farmer for the time involved. Examination of the expenditure on food-stuffs will often reveal unexpected waste or extravagance in feeding. A high petrol consumption per mile run by the milk-delivery van may indicate that it requires overhauling, or even that it is being wrongfully used. Apart from the salutary effect which the recording of labour may have upon the efficiency of the workers, a scrutiny of the labour records may reveal unexpected defects in organization which make for inefficiency and consequently for high costs. Care must be exercised, however, as soon as costs are reduced to so much per unit of produce, because the unit cost may be influenced in a major degree by

yield, which may in turn be determined by causes entirely unrelated to the amount of expenditure incurred. For the efficient use of such data, either within the single farm or for comparative purposes, very full records of the conditions prevailing on the farm are necessary, in addition to particulars of costs and returns.

There is a further consideration which is relevant in this connexion. A costings system which aims at comparing outlays and returns will be incomplete if it does not introduce some method whereby account can be taken both of the quality of the produce and of changes in the level of prices. The quality of barley for malting varies considerably from season to season. The recording of quantity of produce, as well as value, does not solve the problem, because unit values may be influenced both by quality and by changes in the level of prices. An approximate means of correcting for changes in the general level of prices of the most important kinds of produce is available in the index numbers published by the Ministry of Agriculture. A comparison of values of unit quantity, reduced to a common basis by the use of index numbers, may afford some indication of quality also. The method, however, only gives a rough approximation, as the index numbers for different commodities are average figures, and they do not necessarily reflect local price conditions.

If comparisons are sought between the costs of carrying out similar operations by alternative methods on the same farm, a further *caveat* is necessary, because it may happen that the substitution of one method for another may have indirect effects to which it is not possible to attach values, but which have important results in determining the profit of the farm. The introduction of tractors for the performance of some of the duties carried out by horses is a case in point.[1] The advantage of being able to do work expeditiously and when weather conditions are favourable may be worth a great deal in terms of an improved output from the farm; or again, the use of a tractor may permit of cleaning the land without the introduction of a fallow, thus keeping a larger area of land in productive use.[2] In such cases the costs per acre of carrying out operations are of secondary importance, and comparison with the costs of alternative methods does not reveal their comparative value to the farmer. The real measure of relative advantage is found in the effect upon the profit of the farm as a whole, and

[1] Orwin, *Tractor and Horse Labour.* [2] *Rothamsted Report*, 1918–20.

this cannot readily be traced to an isolated cause through the accounts.

It seems to be clear, therefore, that one objection to the analytical system of cost accounting is that the costs and profits of the various branches of the farm activities have to be explained in most cases by a number of circumstances peculiar to the season, and the farmer is involved in undoing many of the calculations of the accounts in order to adjust the results to what he would regard as a more normal state of affairs.

(2) *Interdependence of Crops and Live Stock.*—The second characteristic of farming, which is important from the standpoint of costs, is that most of its processes are interdependent. Many of its products are joint products in the simplest sense of the term, e. g. mutton and wool, grain and straw, meat, milk and hides. But in a wider sense most farm products are joint products, since in the efficient production of the greater number some other saleable product is incidentally obtained. This interdependence is illustrated by the principles underlying the economical organization of the farming system. In any rotation of crops economy in production is attained by attention to such points as the following: each crop should, as far as possible, prepare the land for the next; the cropping should permit of a regular distribution of labour throughout the year; full use should be made of the residuals of crops by subsequent crops; the system should provide for the adequate cleaning of the land and for the maintenance of fertility. In carrying out these requirements, live stock are brought into use. Normally the greater proportion of hay and straw will be consumed on the farm. Both of these products enter largely into the composition of dung, which is returned either to the grass or arable land for the maintenance of fertility. Fertility is, however, also maintained by the natural accumulation of roots in the soil, particularly those of any leguminous crops such as clover, which normally find a place in the rotation with this object, *inter alia*, in view. The root crop, while it permits of the cleaning of the land by intercultivation or by its smothering effect upon weeds, is also utilized as food for stock either on the land or in yards or houses, for the production of meat or milk. Cleaning operations also take place in other arable crops in the operations of spudding and weeding. A well cultivated farm is worked on an interlocking system. The size and character of the

interacting components will be mutually adjusted to suit the prevailing conditions. A variation in any one component may automatically affect the rest in varying degrees.

For example, let us suppose that the price of wheat suggests an extension of the acreage of that crop on the farm. In the simplest case this may involve merely substituting wheat for another cereal crop, say barley or oats. But wheat is an autumn-sown crop and barley generally is spring-sown. In effecting this change the seasonal distribution of labour will be altered. Moreover, the rest of the rotation may have to be adjusted, since a spring-sown crop can follow a crop that is late on the ground in the previous season, whilst an autumn-sown crop involves clearing the land much earlier. Winter-sown oats may be replaced more easily, but the question would then arise of providing oat grain and straw for forage. Oat straw is more useful for feeding than wheat straw, and if it is not grown it may have to be purchased at comparatively high cost, or a larger acreage of hay may have to be grown to take its place in the live-stock rations. This second alternative may involve in turn some alteration of grassland management. If, however, an increase in wheat production should involve putting a larger acreage under arable cultivation, then the problem is still more complex. The balance of farming may be altered by a reduction in the acreage under grass. If more roots are grown in consequence, more stock may be required in the winter to consume them. This may involve an extension of buildings, or in any event a larger capital outlay on live stock.

Examples might be multiplied to show the mutual dependence of the various factors in farming. It is true that changes in the scale of particular enterprises within a farm are not all equally difficult. The more an enterprise is dependent upon purchased raw material, the easier it is to expand or contract it without reference to other aspects of the farming. The production of pork, for example, does in fact expand and contract fairly consistently with changes in the level of prices. In this case the greater proportion of the costs of production, often 80 per cent. or 90 per cent., lies in the provision of foods. Pig feeding may be practised on a very small piece of ground. Cases are frequent in which a large turnover of pig products is maintained, in the output of which home-grown foods play a very small part. But enterprises of this kind partake more of the character of factory industry than of

farming regarded as an extractive industry, and production costs are correspondingly easier to determine. The potato crop furnishes an example of an arable crop of which the production tends to rise and fall fairly consistently with price changes. But in this case the yield of the crop is maintained to a large extent by the use of artificial manures. The acreage under potatoes is comparatively small on many farms, and a small increase in area planted represents a fairly large percentage change; however, the acreage that can be grown on any farm is limited by the requirements of the crop for dung, and by its irregular seasonal requirements for labour. With market gardening, when farmyard manure can be purchased for the maintenance of fertility, more flexibility in cropping is possible than under ordinary farming conditions.

The Cost of Production of Joint Products.—The significance of 'the cost of production' of a product lies in its relationship to the price obtainable on sale. The larger number of farm products are, as has been explained, joint products, in that normally they cannot be produced separately, but are joined in a common origin, not only in the direct sense in which mutton and wool are connected, but because they arise as the result of a system of working in which certain mutual relationships connect the products of the farm. The intimacy of this connexion may not be equally great in all cases, but, with the exception of products which depend mainly upon purchased raw material, the joint nature of farm products is characteristic. Under these circumstances, the material elements of cost that are significant in relation to the selling value of any single product are those which would be involved in increasing or diminishing the output of that product without affecting the output of other joint products. Such cost would represent 'the expense of production of the marginal element of that product; it is the supply price of which we are in search'.[1] In some cases it is possible to modify the proportions in which farm products are produced, e.g. the relative quantities of grain and straw in a cereal crop can be modified by changing the variety or altering the manurial treatment; the feeding or manurial value of the foods fed can be regulated by the substitution of foods; the proportions in which saleable grain crops and forage crops enter into the rotation may perhaps be modified without affecting the number of

[1] Marshall, *Principles*, V. vi. 4.

live-stock that can be carried. If any of these variations are practicable within the limits set by the environment and circumstances of the farmer, the justification for carrying them into effect will be found in the relationship of the marginal costs and anticipated selling values of the additional produce obtained. Total costs of products, compiled by a somewhat artificial dissection of the total outlays involved in the system, are of somewhat doubtful significance.

In most cases, however, a change in farm practice will give rise to secondary effects of which the financial results may not readily be determinable. For example, a compilation of the expenditure upon labour, manures, &c., in the cultivation of sugar beet may, on some farms, reveal that the crop costs thus determined are in excess of the price obtained for the crop on sale: on other farms there may be a fairly considerable surplus of cash return over outlays.[1] Is it a fair inference that the crop is produced at a loss on the former group of farms and at a profit on the latter, and that the deficits or surpluses shown are a measure of that loss or profit? This question cannot be answered without reference to the circumstances surrounding the cultivation of the crop on each farm under review. If a farmer were to grow beet only he might justly reply in the affirmative; but for this to be possible it would be necessary to be able to hire and dismiss men and horses at will, since the crop finds irregular employment for both at certain seasons of the year only. But this is not what happens in practice. On practically every farm growing beet the crop has to fit in with other crops in a rotation. As a root crop it fulfils a function in assisting to keep the land clean for other crops and in improving tilth. The tops and leaves of the beet crop are used, either by ploughing them in or by consuming them with live stock, to help in keeping the land fertile for all the crops raised. If sugar beet be grown in lieu of some other root crop, the farmer will have regard to whether the land is benefited more or less, or the convenience of the farm is better or worse served by the beet than by the alternative crop. Again, he will consider if the reduction in the quantity of food available for the stock, in consequence of growing beet, can be made good economically in any other way. At present the sugar beet factories will sell pulp to the suppliers of roots at favourable rates. The advantage of the substitution of beet for mangolds or turnips in the rota-

[1] Bridges and Dixey, p. 16, and Appendix 2, Tables 1–4.

tion cannot be determined without reference to the increase or decrease in the advantage accruing to the arable land for the cultivation of other crops, and to the effect upon the net returns from live stock. The former would be somewhat difficult to determine, but it may be important in the case of barley following beet.[1] The latter has been estimated as high as £9 per acre in favour of the beet crop on farms able to procure pulp at current rates.[2] In 18 out of 35 cases quoted by Bridges and Dixey the beet crop replaced roots or green crops over the whole or part of the acreage planted with beet. It is apparent, therefore, that any statement of profit or loss on the crop which ignores the very important indirect effects upon the profits of the farm will be misleading, and will not in fact reflect the financial advantage to the farmer of growing the crop.

The Profit and Loss Account on p. 16 shows losses on Horses, Poultry, Hay, Wheat and other crops, and on Cattle, and profits on Sheep and Pigs. It would not, of course, be suggested that the profits and losses under the different headings arise independently of one another. For example, there may be an intimate connexion between the sheep and the barley. The sheep eat the roots on the fields, and their manure fertilizes the land for the corn. The cultivation of the roots assists to keep the land clean for the growing of the corn. The relative profits on sheep and corn will depend upon the proportions in which the expenses of the root crops are divided between the sheep and the succeeding crops. Indeed, throughout the account, the profits or losses shown on the individual crop and stock accounts will depend very largely upon the assumptions made in distributing expenditure between corn and straw, food and residual values, &c. To illustrate this point a statement of the cost of wheat production may be quoted from the same source (see p. 24).

The items involving assumptions of the character referred to are the charges for farmyard manure, beneficial cultivations from previous crops and residual values of manures and foods, which together account for over 18 per cent. of the total charges. Moreover, rent, rates and overhead charges, the apportionment of which between various crops is a matter of estimate, account for a further 25 per cent. This leaves only 57 per cent. for costs which are more or less definitely ascertainable charges involved in the

[1] Bridges and Dixey, p. 45. [2] Ibid., p. 62.

Showing Cost of Wheat Production (1924).[1]

	Total			Per Acre			Per Quarter			Per Cent.
	£	s.	d.	£	s.	d.	£	s.	d.	
Labour: Manual	71	6	7	1	6	11		9	0	19·25
„ Horse	39	19	5		15	1		5	1	10·78
Farm-yard Manure	23	3	9		8	9		2	11	6·25
Artificial „	13	13	10		5	2		1	9	3·69
Seed	46	16	4		17	8		5	11	12·62
Beneficial Cultivations from previous Crops	15	0	4		5	8		1	11	4·04
Residual Value of Manures and Foods after previous Crops	30	5	1		11	5		3	10	8·17
Rent and Rates	68	9	2	1	5	10		8	8	18·48
Depreciation on Implements	8	12	3		3	3		1	1	2·33
Overhead Charges	23	3	9		8	9		2	11	6·26
Thatching, Threshing, and Delivery (including coal, twine, &c.)	30	0	8		11	4		3	9	8·13
	370	11	2	6	19	10	2	6	10	100·00

53 Acres

Yield-Total	158 quarters
Per Acre	2·98 „

production of wheat as an alternative to some other crop within the system practised. Even the charge for horse labour will have been already burdened with its share of rent and overhead charges.

It would appear to be somewhat difficult to justify a claim that the actual net result in every department is revealed by the analytical method, or that the error introduced by the approximations involved is in any event negligible.[2] The relation which general expenses, labour costs, &c., bear to profits is less distinctly shown in the 'costings' Profit and Loss Account than in a Trading Account of the ordinary form. Farming provides a typical instance in which 'the assumption that (indirect) charges are capable of being distributed *pro rata* over the output . . . (whatever exact methods of distribution be employed) is so arbitrary as to render unreal, and largely imaginary, results that would otherwise be absolute statements of facts '.[3]

It has been suggested in a recent Report,[4] which lends general support to the views expressed in this section, that milk, beef or mutton, and, except partially, staple crops are exceptions to the general rule that the isolation of individual product costs is im-

[1] *Oxford Report*, 1925, p. 11.

[2] Cf. Orwin, *Farm Accounts*, 2nd ed., p. 6; also Wyllie, *Farming Costs*, Reprint, p. 61. [3] Dicksee, *Advanced Accounting*, ch. xix, p. 272.

[4] *Scottish Report*, p. 22.

practicable. If these were usually exceptions they would be of sufficient importance to make the general rule of very little significance. But it is only in special circumstances that these products are not, in effect, joint-products. Milk production can rarely be regarded as an independent process except on farms where the whole policy, affecting both arable and grass land, is definitely subservient to the requirements of the milking herd. In such cases it may be reasonable to regard all the other saleable products of the farm as by-products of which the selling value is in reduction of the costs of milk. These cases are by no means general, but, even where milk is the central product, it would seem to be unsatisfactory to make the costs of milk dependent upon the yields and selling prices of the secondary products like corn or potatoes, which may be grown in the rotation which provides the forage for the stock. Where beef and mutton are produced largely by feeding home-grown forage, the stock are often functioning for the upkeep of the fertility of the arable land, and the method of feeding may be determined by that fact. The production of staple crops is also almost universally conditioned by the maintenance of fertility by live stock in one form or another.

It is, however, true that the *comparative profitableness* of alternative crops or alternative methods of use of grazing or of home-grown forage may, with certain reservations, often be ascertained. The determination of relative profitableness does not necessarily involve a complete statement of costs. For example, there may be alternative methods of feeding stock, making use of the same acreages of grazing or of forage crops or straw. The costs of grazing and of the crops are the same in either case, and it follows that, apart from any secondary effects upon the farm system, comparisons between the variable elements of cost and return may be sufficient evidence of relative profitableness for practical purposes. Thus, if one system of feeding stock, on a given area of grass and of roots and a given quantity of straw, involves more expenses for concentrated food and a more rapid turnover of stock than another alternative system of feeding, the relative profitableness of the two systems can be ascertained without reference to the rent and costs of the grass and of the arable crops consumed. Only those costs which differ in the two cases need be computed, namely, the costs and selling values of the stock and the expenses incurred for the additional concentrated foods, together with any

incidental expenses. The outlays which are common to both cases may be inevitable within the system of farming practised, and must be met out of the gross returns. It is important to realize that the costs of those intermediate crops and by-products which are usually marketed through the live stock, often present the greatest theoretical difficulties to the cost accountant, and that it is frequently possible to make effective comparisons of profitableness without isolating such costs from the general expenses of the farm.

It may be said, therefore, that in general the individual farm product has no final cost that is determinable independently of the costs of other produce. It is true that a crop may involve particular operations of which the out-of-pocket costs for manual and horse work and for seed, &c., may be computed; it is also true that the amount of these out-of-pocket costs have a direct bearing upon the suitability of the crop for finding a place within the farming system, having regard to the yield obtainable under the conditions of the farm; but the expenses incurred on the crop are no real measure of its effective cost of production unless all subsidiary and complementary processes can be carried on without loss, and unless the quantity grown is limited to the amount that will fit conveniently into the whole scheme of the farming. The farmer's problem is, so to balance his enterprises within the system which nature permits him to practice, that the total net return is the greatest possible. Adjustments may have to be made slowly, and if made they must be based upon considerations of extra expenditure required to obtain a given increase in the output of particular products, bringing into account any incidental losses that may be incurred in the process. These adjustments are usually made by a skilled farmer almost instinctively. It is particularly true of farming that the farmer 'regards an increase in his processes of production rather than an individual parcel of his products, as a unit in most of his transactions', and that 'the analytical economist must follow suit if he would get in touch with actual conditions'.[1]

Alternative Methods. The Farm as a Single Unit of Account.—Some further proposals for avoiding the difficulty arising from the interrelatedness of crops and stock remain to be considered. It has

[1] Marshall, *Principles*, p. 376.

been proposed to arrive at the cost of production of the product of chief importance on the farm, e. g. milk on a dairy farm, by treating the whole farm as the unit of account, and crediting against the total expenses of the farm the returns from products other than milk. The difference is considered to be the cost of milk production.[1] A similar principle appears to underlie the practice of the Central Committee of Agricultural Accounting Societies in Austria in determining the costs of production of milk and beef respectively. For the former purpose the live-weight gain of the cattle and other receipts from the stock are credited against the total expenditure: for the latter purpose receipts from milk are credited against the same total and the cost of meat is arrived at.[2] The drawbacks of this method are admitted to be, firstly, that the 'cost' of milk so determined may be influenced to a very important extent by causes affecting the returns from other saleable produce which have nothing to do with milk production; and secondly, that a single product does not generally occupy a position of importance, so great relatively to the other products, as to make the method justifiable.[3]

Another suggestion is to arrive synthetically at the production costs of products obtained jointly within the farming system from the ordinary financial books of account, by assuming that the net profit or loss on a single product bears the same proportional relationship to the total profit or loss, as the selling value of the product bears to the total selling price of the produce of the farm.[4] The cost of production of unit quantity of any product is then determined by subtracting from the unit selling price the profit per unit so ascertained. Under this system, if the profit of the farm increases because one of the saleable products advances in value, whilst the total outlays and the prices and quantities of all other saleable products remain unaltered, each product will be credited with an increased profit. Thus the costs of the produce of which the selling prices remain the same will be computed to be less than before, and, since the total expenses are the same, the cost of the product advancing in value will be shown to be greater than before, whilst in reality no change in costs has occurred. For the method

[1] *Illinois Bulletin* 216.
[2] *Illinois Bulletin* 216.
[3] *Offices de Comptabilité*, p. 140.
[4] Pauli, W., *Produktionskosten*, Jena, 1913, quoted in *Offices de Comptabilité*, pp. 32–3.

to be satisfactory for affording comparisons between the costs of products it is necessary to assume a constant relationship between the values of the different kinds of commodities produced jointly. This assumption is not justifiable.

The considerations put forward will serve to emphasize the unsuitability of attempting to separate the costs of the several products of the farming system by an analysis of the aggregate expenditure of the farm. Even if farming conditions should lend themselves to a precise apportionment of costs between the individual products, which unfortunately is not the case, the relationship of the costs so ascertained to the selling prices could only be stated adequately by taking account of the costs and returns of other produce obtained jointly within the system practised. Limits are set to the acreage of a particular crop in a rotation, given suitable conditions for growth, by the seasonal requirements of the crop for labour, by the demand the crop makes for the use of horses and equipment, and by its demands upon the fertility of the soil. American writers on farm accounts have sometimes assumed that the labour supply on a farm is limited, but that the size of the farm can be altered at will by taking on extra land, so as to maximize the returns from the definite amount of labour available.[1] This may be true in relatively undeveloped areas, but in England it is more generally the case that the size of the farm is less easily altered than the amount of labour, particularly in areas where casual labour is available. Moreover, the tendency in American costings systems to overlook the problem of the maintenance of fertility is reflected in the assumption that the area under a crop giving a large margin of gross profit over direct outlays is only limited by its seasonal labour requirements. That is certainly not the position on most farms in this country. The acreage under a crop like potatoes is frequently limited by the need of the crop for dung, which gives rise to a corresponding requirement for the production of farmyard manure from straw with the aid of live stock.

If a costings system is to aid the farmer in making decisions upon questions of policy, it must be devised so as to bring clearly before him the additional costs in labour hours, horse hours, quantities of seed and manures in the case of crops; or in hours of labour, quantities of food, and in the numbers of animals bought

[1] *Texas Bulletin* 264.

and sold in the case of stock, which will be involved in any change he may make. But he must also be able to estimate the secondary effects, and these may be of greater importance. The results of any change involving more than a mere substitution of alternative crops which can replace one another within the rotation, or the substitution of one class of stock for another which does not involve any modification of cropping, can only be measured with reference to the total returns from the farm.

The necessity for keeping records for the purpose of maintaining the efficiency of working will be greater or less according to the measure of the farmer's personal control over the details of the farm work. The more closely he is in touch with the operations of the farm in detail, the less necessary to him are records of operation costs. It is important in this connexion to bear in mind that success in farming is, in a large measure, dependent upon the personal control of the farmer in matters of detail. At the same time it is to be admitted that even experienced farmers are often in considerable error in their estimates of both costs and quantities of produce, and that the keeping of records would generally be helpful.

(3) *The Lag between Expenditure and Return.*—A third feature of the farming industry, which is of some importance in the study of costs, is the characteristic lag between investment and return. The interval between outlay and return varies widely with different products, being considerable in the case of rearing stock and arable crops, and comparatively short in the case of some of the expenses incurred in the production of milk. An exact assessment of the influence of 'lag' upon production costs may require some mathematical skill,[1] and it may be questionable whether mathematical refinement in determining the outlays on the separate products of the farm is worth while in view of the difficulties already discussed. But it is important to take account of 'lag' if the determination of the amount, and distribution in time, of capital required is under consideration.

There would, however, seem to be no valid reason for making cost determinations dependent upon rotation expenditure incurred at a period even more remote from the harvesting of the crops than the time of preparing and sowing the land.

[1] Whetham, *R.A.S. Journal.*

The apportionment of residual values over a rotation by carrying forward a proportion each year necessarily means that the costs of this year's products will be influenced by expenditure incurred three or more years ago.[1] Crops grown in 1923–4 will appear to be comparatively expensive because labour and foods were dear in 1920–1. The inevitable effect of 'lag' in diminishing the value of costings data in terms of money values will be accentuated by the process of bringing forward balances of expenditure in earlier years, even if these should be determinable with accuracy. The results will necessarily be remote from current costs if any considerable change in the level of values has taken place in the meantime. It will hardly be suggested that statements of the profitableness of growing wheat now ought to be influenced by price conditions ruling in the past. Admitting that farming is a business of slow changes, and that its results must be averaged over a series of years, and allowing further that past experience is important in giving guidance for present policy, it does not follow that the level of expenditure in previous years should be allowed to influence the determination of costs under current conditions. Results thus obtained are always behind the times. If the cropping and manuring of a farm are worked upon a regular rotation, with fields of fairly equal size, the expenditure on the whole rotation in any year is a fairer indication of current working costs.

Similar considerations apply with reference to the apportionment of the charges for the use of fixed equipment and machinery on the farm. Cost determinations which bring into account costs of replacement of plant and fixed equipment can rarely be made with precision. If they are compiled with reference to the original cost of installation, which may vary widely from the present cost of replacement, the resultant 'cost' may contain elements of capital loss which would not arise with more recent installations. Costs so determined cannot influence the attractiveness of the industry for the present investment of capital. The farmer's direct interest lies in seeing that, within the range of alternatives open to him, he is spending *now* each £1 of his resources to the best advantage. In aiming to maximize his profits he will certainly endeavour to take advantage of whatever residues may be present in the soil or in the manure heap, and to make the best use of his equipment of buildings, live stock, and machinery; but he is con-

[1] Appendix, pars. 6 and 7.

cerned with the problem of using his land and stock and residues in the condition in which they now are, by applying his fluid resources to them in the most advantageous way. The value to the farm of residues in the soil may not be related at all to their cost. Indeed it is difficult to apply the conception of 'cost' to what may be essentially by-products of previous operations. The attachment of arbitrary values to the by-products which appear at all stages in farming processes, introduces an element of unreality into accounts. Whatever may be the value assigned to them, the farmer's interest lies in using them so as to obtain the maximum return from the additional expenditure applied. Cost records will be valuable to him in so far as they may enable him to estimate in advance the outlays involved in further operations. He may then estimate the probable return to his additional investment, having regard to what he anticipates the yield will be and the product will fetch.

It is suggested, therefore, that a first aim in cost accounting as applied to farming should be the collection of 'basic' costs, i.e. *quantitative* statements of labour, horse or tractor hours involved in operations, of seed and manures applied to the land, of foods fed to stock, and of the yields in terms of quantities of crops or live-stock produce obtainable from varying applications of capital in these forms, under the circumstances prevailing on the farm in an average year. These cost determinations do not necessarily involve the elaboration of a system of accounts that will fit in with the farmer's financial books. They form rather a system of records which can be used to interpret the financial results shown by the books of account. It is, however, necessary to emphasize that normal 'basic' costs can only be ascertained by considering costs over a period of years.

The Basis of Valuation. (a) *The Cost Basis.*—The reference to the value of implements in the preceding section calls attention to the importance of the basis of valuation. Some valuation falls to be made whenever a productive process is incomplete at the date of balancing the accounts, and in all cases where production is a continuous process involving the use of live stock—horses, a dairy herd, or a flock of sheep. It has been suggested that for arriving at departmental costs and profits, and at the profit or loss of the farm as a whole, the basis of valuation for

unfinished products must necessarily be the expenditure incurred to date.

'In making valuations of goods produced on the farm, the basis must be, in every case, the cost of production of the matter concerned. In no circumstances must the market price be allowed to exert any influence, or serious misconceptions may result. The worth of any article to the farmer is the amount which it has cost him to produce it, and the time to introduce the market value into the account is at the moment when it is sold, and not until then, so that the farmer may be in a position to make a comparison between the value to him, as shown by his books, and the value on the market, as shown by the price realized.' [1]

It is deduced that 'animals retained on the farm for breeding purposes, or for work, should be valued thereafter at the total cost of bringing them up to that stage and no more'.[2] A further deduction is that in valuing 'intermediate products', viz. forage crops produced for consumption on the farm and not for sale, there is only one possible basis of value, viz. the cost to the farm.[3]

The analytical system of farm costing, with reference to which these principles have been laid down, is a combination of financial and cost accounting. An attempt is made to determine the costs of individual products, and at the same time to arrive at the annual trading profit. This attempt seems to introduce a conflict of principles. Costs must necessarily be based upon actual outlays, but the expenditure of money does not of itself produce a valuable asset. Stock or crops for use or for sale may, for various reasons, have cost more than their worth to the farmer, and their valuation at cost will inflate the profits of the farm by failing to allow for an expected loss on realization. The high cost of home-grown produce can be observed without importing artificial values into the annual valuation for the determination of profit. A suitable basis for valuing cultivations and produce awaiting sale or use, for the purpose of the annual profit and loss statement, would seem to be the best estimate the farmer can make of the present value of the work done or produce in hand, having regard to the use that is to be made of it: e.g. if one field was dirty and has had to be fallowed at high cost, and another equally good field is in the same condition now without the preliminary cost of fallowing, there would seem to be little justification for attaching a greater value to the fallowed land than to the other for the pur-

[1] Orwin, *Farming Costs*, p. 37. [2] Ibid., p. 40. [3] Appendix, par. 11.

pose of the annual Balance Sheet. Its costs have certainly been greater, but if it is unlikely to produce a higher return from further expenditure than the other field will do, the asset acquired by the previous cultivations is of no higher value in the one case than in the other. Similarly, it would seem to be difficult to justify the valuation of a crop awaiting sale or use at a price in excess of what a farmer would willingly give for it in its present condition, even if its costs have been in excess of that price. The farmer will, however, be concerned with the cost of the cleaning operations on fallowed land, though he will regard such expenditure, not as being connected with any particular crop in the rotation, but rather as being determined by the character of the land or by the system of farming practised.

The valuation of breeding stock presents some special problems. The case of a dairy herd, in which young stock are raised on the farm for the replacement of the milking cows, is a typical one, and it affords a convenient illustration. It will be clear that any difference between the opening and closing valuations of an equivalent number of cows will necessarily affect the profit on the herd account. If the valuation of the cows falls the profits are reduced, if the valuation rises the profits are increased. Even if we could assume that the cost of rearing a down-calving heifer could be isolated with precision, would it be correct, either for the determination of profits, or in the process of determining the costs of milk production, to value home-reared animals at such cost? Let it be supposed, for example, that on a dairy farm the average initial cost valuation of, say, twenty cows is £35 each. During the year some of the cows are replaced, and it may be further assumed that the purchase price of fresh cows bought in is now £30 each, the rearing cost of home-reared animals brought into the herd is £25 each, and the selling price of discarded cows is £20 each. The valuation at the end of the year being on the basis of cost in the case of all the cows, the original animals still in the herd will be valued at £35 each, and the incoming purchased and reared animals will be valued at £30 and £25 each respectively. There will thus be an average depreciation on each animal sold and replaced of £15, i. e. the difference between the initial value and the selling-out value. There will also be a fall in the capital value of the herd, due to a lowering of present, as compared with past, costs of stock. Since milk production necessarily implies a

constant renewal of stock, the farmer will naturally desire his accounts to reflect any gains or losses due to changes in the values of his cows actually sold and replaced. No exception can therefore be taken to the cost basis of valuation (if costs are ascertainable) for the determination of the profits on the stock. But certain assumptions are implied, viz. that the animals are normally healthy, and that the proportions of home-reared and purchased cows have been stabilized. The case is, however, rather different when the replacement of purchased by home-reared cows is in process. That is, in these days, so frequently the position on dairy farms that it presents a case of some importance. The cost of rearing will, by hypothesis, exclude any profit on the use of the land occupied by the growing animals. If such animals are being added to the herd in replacement of purchased cows, and they are valued at cost of rearing, the herd account will appear to show that the land utilized for rearing is bringing in no return. At the same time the account will show less than a normal profit, because the purchased animals which are being replaced will stand in the accounts at a higher value than home-reared animals, and the depreciation will, in consequence, be greater than normal. The herd may, notwithstanding, be actually improving as a milk-producing unit in the meantime. In such cases a kind of secret reserve is in fact being built up, owing to no profit being taken on rearing until it is realized in extra milk or on the ultimate sale of the stock. In the meantime the average returns of the farm per acre are lowered in comparison with returns from other farms on which the proportion of home-bred cows has been stabilized. Thus, even for the correct determination of profits, the cost basis of valuation must be used with care in the not uncommon case of herd improvement by home rearing.

If the object in view is the determination of the current costs of milk production, objection to the cost basis of valuation of stock may arise on principle. For such purpose one is concerned with the difference between the current selling-out value of cows and the current cost of replacement, either by purchase or breeding as the case may be. If the costs of production of milk are burdened with the difference between the price of cows three years ago and their current selling-out value, the effect is to make this year's milk costs to include changes in the capital value of cows arising from differences between past and present costs of replacement.

Milk production on farms where cows are kept for several years usually involves carrying the risks of such changes for a period of three or more years. The lag is in this case considerable. Thus milk is a product which hardly lends itself to the precise determination of cost year by year. At best the trend of costs can be determined, and for that purpose the difference between current selling-out values of cows and current replacement costs would seem to be the most suitable measure of that part of production costs which is due to the expense of maintaining the herd.

(b) *Standard Values.*—The suggestion has been made to use 'standard' or fixed values for certain classes of live stock.[1] This means that the annual valuation of each class of breeding stock is based upon a standard figure of so much per head. For example, cows might be valued at £30 per head, two-year-olds at £20, yearlings at £12; ewes might be valued at £4, and so on. Each year the herd or flock is valued by multiplying the 'standard value' of each class of animals by the number of such animals on the farm. This method certainly avoids the errors involved in valuing all the breeding stock on the basis of fluctuating market values: moreover, it is simple and direct. The herd or flock is regarded as a machine for producing milk, or wool, or lambs, as the case may be, in which each unit worn out or disposed of is merely replaced by another. Under this system the cost of maintenance of the machine becomes the difference between current replacement and selling-out values. This principle of valuation has already been advocated where the object in view is to determine the current costs of milk production. But errors would arise, even for such purpose, if the number of animals should vary from year to year. If the herd is increasing in number, and animals purchased at say £40 are 'written down' to the standard figure of £30 at the end of the year, a fictitious loss is imported, which affects the cost of milk production adversely to a corresponding extent. On the other hand, if additional animals are home-bred and cost, say, £25 each, each added beast imports an artificial profit of £5 into the year's accounts in reduction of the cost of milk.

From the point of view of the farmer's Profit and Loss Account, however, the standard valuation ignores those very real changes in the values of stock which inevitably affect the farmer as a buyer

[1] Orwin, *Farm Accounts*, also Appendix, par. 11.

and seller of breeding stock, as well as a seller of their products. The standard valuation method, in fact, fixes an inflexible capital value for breeding stock, which falls short of the requirements both of the cost accountant and of the farmer seeking to determine his annual profit. But the advantages of a per-head valuation for flocks and herds are clear. It is easy and quite reasonably accurate to regard the animals as units of a certain average quality rather than as individuals with varying values: there is a constant change in the stock, but the herd maintains its character as a unit of production. It remains, therefore, to suggest a means whereby some greater flexibility in fixing the average unit value may be obtained. This does not present any real difficulties. If there are twenty cows on the farm of an average value of £30 each, and five are sold and replaced by cows bought for £25 each, the final valuation for the determination of profit might be the average of fifteen cows at £30 and five cows at £25—say £28 15*s.* each. No fictitious loss on the unsold cows would arise, and the average valuation for the year would tend to rise or fall according to the trend of values of purchased cows. This figure of £28 15*s.* per head would be the starting valuation in the next year's accounts.

The same method of averaging would apply if the incoming cows were home-bred, assuming their cost could be ascertained, but subject to the caveat already given in cases where a home-reared herd is being built up. On account, however, of the very real difficulties of ascertaining the *cost* of animals reared on the farm, as distinct from the cost of the milk or other produce obtained at the same time, a standard or invariable price could perhaps reasonably be used as the basis of valuation of home-reared animals transferred into the herd from time to time. This implies an assumption, which is indeed verified by experience, that costs tend to change relatively less than market values, particularly with home-reared animals of which the major expenses are for labour, grazing, and home-produced foods. Moreover, if the whole herd, cows and young stock, is regarded as the unit of account, the precise figure at which home-bred stock are transferred from one group to another is not important, as the debit and the credit are equal. It is, however, advisable to use as a standard value a figure which is reasonably near to the estimated outlays on an animal, including rent and other charges on the land occupied in rearing, and a small margin of profit, in order to avoid any serious

errors which would otherwise arise if the numbers of stock should fluctuate considerably.

The suggestion is, therefore, to use a standard figure for valuing home-reared stock transferred into the herd, and to adjust the average value of the animals at the annual balancing to allow for the effect of introducing new stock at current costs. This would be sound in principle in valuing for the determination of profit, and it would permit the cost accountant to estimate with some accuracy the effect, upon the farmer's costs and profits over a period, of the system of replacement of stock adopted. The general argument of this section applies to flocks of ewes and other breeding stock as well as to dairy herds.

Clerical and Accounting Difficulties.—The question of the practicability of a system of cost accounting, which is an integral part of the general financial system of the farm, still remains to be considered.

The amount of time involved in recording the labour of each man from day to day, and in subsequently analysing and apportioning its cost over the various operations of the farm, is an almost insuperable obstacle to so intricate a system as far as the individual farmer is concerned. The work involved is beyond the normal capacity of the working farmer both as to time and skill. The apportionments of labour are complicated by overtime and casual labour, and by the fact that the farmer himself and his family will probably give some unpaid help in the work of the farm. In the writer's experience the attempt by farmers to carry out this work completely on the analytical lines described involves constant and laborious evening work, and it is usually abandoned long before the annual balancing is completed. The employment of clerical help beyond what is necessary for the compilation of simple financial accounts is not within the means of a small working farmer, and the degree of accounting skill required often makes the work impracticable even on larger farms.

Attempts at Simplification.—Some attempts at simplification of method have been made. The principles of the analytical system are retained, and the scheme may be, in effect, to reduce the clerical work by introducing a series of further estimates in or er to avoid the detailed work of costing.[1] The 'cost' basis in valuing

[1] Holmes, *Short System.*

live stock is replaced by the introduction of 'standard values'. Reared heifers and young dairy stock are to be valued at one-half the standard values of the cows. For tillages and unexhausted values of manures, a fixed annual amount is to be taken. Home-grown foods are regarded as having fixed arbitrary values, e. g. roots £15 per acre, straw £1 per ton, and so on. It is possible, however, to sacrifice too much in the search for simplicity. The system described, whilst avoiding the detailed collection of costs by introducing a further series of assumptions, seems to embody all the features to which exception has already been taken on matters of principle, and to assume, in a number of cases, the results which it sets out to determine.

Another proposal is to avoid the labour involved in making a complete set of accounts by posting, to crop and stock accounts in a ledger, the labour, foods, and other expenses incurred, without keeping any cash account to complete the double-entry.[1] It is not apparent that there is very much to be gained by this suggestion, but its practical disadvantages are important. The loss of a double-entry check upon accuracy adds very greatly to the danger, which is considerable in any event where farming records are concerned, that items may be omitted altogether. Even experienced accountants find that some balance between debit and credit is desirable in financial accounts.

The reduction of clerical work in farm costings has been attempted by other methods. The writer has been courteously permitted to inspect the 'auto-countancy' system, invented and used by Mr. R. Borlase Matthews on his farm at East Grinstead. The system introduces the use of slips, which are duplicated and fixed into a guard book on the debit and credit sides, and which take the place of entries by hand in ledger accounts. To avoid the risk that any slip may be pasted into the wrong account, a series of numbers and guide letters are used. In the hands of an efficient exponent of system the method may have some real advantage. It is, however, probable that on a normal farm, in the absence of a clerk equipped with a typewriter and subject to careful supervision, the method would hardly be applicable. In the detailed analysis of even a week's labour, the number of slips would be so numerous that it is doubtful if there would be any effective saving in time in the hands of a class of users unfamiliar with modern

[1] *U. S. Bulletin* 572.

office routine. This is in no way to suggest that the system is without value for ordinary accounting purposes, but its extension to farm costs would seem to be somewhat difficult.

The Farmer's Outlook.—A farmer has to think in terms of averages over fairly long periods. In the main his system is relatively stable because of the controlling influence of his environment. He may compare, in his Trading Account, the sales of his various products from year to year, and hope that a decrease here will be compensated for by an increase there. He is inclined to look to an adjustment of rent to counterbalance any adverse tendencies which afflict him over a series of years. The system rendered practicable by his surrounding conditions is the fundamental basis of his farming. Should a minimum amount of labour and equipment be necessary for working the farm, cropping and stocking must be determined by the possibility of using that essential labour and equipment economically. Only if the supply of labour is flexible can the cropping be arranged without reference to the amount of labour required ; but even then the acreage under any crop has to be what the farm will carry, and that will depend upon convenience in the rotation, and the mutual requirements of stock and crops for feeding and for the maintenance of the land fertile and clean. An analysis of the working expenses involved in the production of crops and live-stock products, in so far as such expenses are fundamental to the working of the system, and not merely additional expenditure to ensure extra returns, cannot give rise to product costs which can be compared, with any practical advantage, with the selling prices of the products obtained. Comparative costs are of value for comparing the economy of various methods of arriving at the same end within the system practised, or for gauging the economy of the substitution of one class of stock or crop for another. But the determination of the profits or losses on separate products of the farm is not attained by an analysis of the total expenses incurred, because the amount of emphasis upon the several products will be dictated and limited by the requirements of the system as a whole for economical working.

Whilst tradition and an open-air life may have been factors contributing to the farmer's failure often to keep even simple financial accounts, the relative indifference of the farming community to

'costs' seems to be due to considerations such as have been described, arising from an environment in which natural conditions exercise a prevailing influence over activities.

An Analysis of the Farming System is a Necessary Preliminary to the Determination of Costs.—In view of the interdependence of stock and crops in farming systems and of the obvious necessity for making some analysis of the farm business, it may be desirable to inquire if the individual products are really the 'natural divisions'[1] upon which to base the classification of expenses; or whether, having regard to the dominating influence of soil, climate, and situation, a more fruitful method of approach to the problems of farm management might not be to inquire what part any crop or product plays in the farming system, i. e. what is its contribution towards maintaining the physical balance without which the farm could not continue to function? It might then be practicable, with the aid of cost accounts, to determine if any essential function is being carried out with the greatest economy and efficiency. For successful farming the system must be devised, not merely to produce an immediate return to the use of resources, but also to maintain the fertility of the land. The two objectives, viz. the production of saleable produce and the maintenance of the farm in a condition to produce maximum yields, must be encompassed simultaneously by the system practised. If it should be possible to isolate the costs of performing a particular function in the farm economy, e. g. the expenses involved, directly or indirectly, in converting straw into manure for the upkeep of the fertility of an arable farm, it would be possible to compare the cost incurred in arriving at that result by alternative methods. On the other hand, in attempting to follow the individual product cost through from beginning to end, and to compare that cost with the cost of some alternative product which might be purchased or grown, there may be a tendency to lose sight of the part played by the crop in the general farming scheme. For example, the cost of a ton of turnips may be computed by making a number of assumptions as to the apportionment of cleaning costs and manurial residues. When the cost is thus arrived at, it is regarded as entering into the cost of the milk or meat obtained by feeding the crop to live stock. The growing of turnips or some other 'root' crop may, however, be inevit-

[1] *A. C. C. Report.*

able if the land is to be maintained in a clean and healthy condition for producing saleable crops. It would be of little advantage to consider a reduction in the cost of milk by eliminating roots in favour of some other food, unless an alteration in the system could be contemplated. What may be of first importance is to try to discover what combination of roots and stock will permit of the functions of keeping the land clean and in good heart being carried out with the greatest financial advantage to the farm. That is, indeed, a problem of first-rate importance in arable sheep farming at the present time.

It has been suggested that if the analysis of costs is to be of value in testing the efficiency of the farming system and methods, the aim should be to determine if the functions involved in successful farming, under the conditions prevailing on the farm, are being carried out economically. Now the degree of emphasis on saleable crops of various kinds or on live-stock products depends, in the main, upon soil, climate, and situation relative to markets. In the Eastern Counties of England conditions are, in general, favourable to the growing and ripening of grain, and the major emphasis is upon the production and sale of cereal crops, a high percentage of land being under arable cultivation. In this area the live stock are used primarily for the maintenance of the land in a condition of fertility by converting the root crops and straw into manure. The kind of live stock employed is determined by the circumstances of the farm. On the higher and lighter lands sheep generally are used, because it is economical to avoid the cartage of roots and the return cartage of farmyard manure for long distances on gradients, and because the lighter land benefits, and is not injured by, the treading of sheep. On some soils indeed, sheep are at present indispensable for maintaining the land under cultivation. For the conversion of the straw into manure cattle may be wintered in yards, and their manure will usually be applied to the nearer arable fields and grass-land. The farmer may endeavour to increase the ratio of return to outlay on his cattle by feeding for milk production or for beef. According to the circumstances of the farm, or to his own opinion, his feeding policy may aim at producing the maximum of live-stock produce from the animals he can conveniently maintain, in which case he will hope that his extra expenditure on food and attention will be more than repaid by the extra return in produce; or he may feed mainly to improve the

quality of the manure. Incidentally he may achieve both purposes, but in any case the cattle will be functioning to maintain the condition of the land by carrying out the essential processes of converting straw into dung and utilizing part of the root crop.

In a similar way the breed and character of the sheep used for eating on the land the balance of roots and other forage crops will be such as, in the opinion of the farmer, will give him the result at which he aims most economically. The farmer does not always expect a return from the sheep sufficient to meet the expenses involved in producing all the food grown on the arable land for their maintenance, in addition to meeting the costs of labour and purchased foods. If prices are favourable he may, by judicious feeding and marketing, intensify his output so as to reduce very effectively the cost of the use of his sheep for converting his roots into fertility for succeeding crops. He may even cover all the costs incurred in growing the roots and forage crops. In any event the effective cost of manuring the land through the sheep will arise from comparisons of the outlays and returns on the sheep. The efficiency of the farmer's methods will be measured, not only by such considerations, but also by taking into account the increased productiveness of the land as evidenced by the larger yields of saleable produce obtained in a normal year. By looking thus at the function performed by the stock, and computing the net outlays involved in performing that function, it may be possible for the farmer to obtain a means of testing the efficiency of his methods, and of judging whether he can obtain his results in any better or cheaper way.

As one travels westward, climatic conditions and, as it happens in England, soil types also, are more favourable to the growing of grass, and less favourable to the producing and ripening of corn crops, than in the Eastern area. Without going very fully into detail it may be said, speaking generally, that in the more westerly areas arable cropping tends to be subservient to the requirements of the live stock for food and litter. Under these conditions, whilst the cattle and sheep do still, in effect, function to maintain the fertility of the land which provides their support, the emphasis is now altered as between the arable and grass land. The function of the corn crops is now to maintain the stock rather than vice versa. The corn crops may indeed produce a cash return if grain in excess of the requirements of the stock is produced; but, in considering

the place of corn in the economy of the farm, one is concerned to inquire chiefly into the conditions which tend to make the cash returns in excess of the direct outlays on the crops the greatest possible, consistently with their functioning to keep up the supply of straw and food for the stock.

As an illustration the concrete case of a dairy farm, on which the purpose of the arable cropping is the provision of bulky foods and straw for the stock, may be taken. It may be convenient to introduce a crop of wheat into the rotation for several reasons. It provides straw for the cattle and for thatching: it is a cash crop and brings a direct return in money: it fits conveniently into the arable rotation from the standpoint of labour distribution: it leaves, in the form of seconds of grain, a useful food for poultry or pigs. The convenience of the crop could only very approximately be estimated in terms of money. The farmer is interested to know if, after mowing his seeds hay, an expenditure of, say, £7 per acre on growing, threshing, and marketing a crop of wheat will, or will not, give him a cash return of equivalent amount whilst providing the straw he requires. If it does and leaves a margin, then he has obtained his straw and a surplus of cash towards rent and general expenses, and the wheat crop adds something to his profits, and increases the total returns from his land. Even if the crop does not yield a surplus in money after paying the direct costs involved, the farmer has still to weigh the other conveniences of the crop against the net outlay. To eliminate the crop might involve the purchase of straw, and so long as the deficit on the crop does not exceed the expense to which he would otherwise be put to provide straw, the crop may well find its place in the rotation. It may thus pay to grow the crop at a loss, if loss be interpreted to mean a deficit of return below even the direct outlays on the crop. What is in the end significant is the total return per acre from the combination of stock and crops.

This method of approach to the problem of costings on farms avoids the error inherent in an attempt to extract the total cost of the individual product. It is based upon, firstly, an appreciation of the effective part played by the product within the farming system, and, secondly, the measurement of the net outlays and returns obtained in the performance of that function. This suggestion is developed more fully in the constructive proposals contained in Chapter III.

Summary.—The argument and conclusions of Chapter I may now be summarized briefly. The farmer's business is moulded and limited by the physical environment in which he works. His raw material, and the energy upon which he depends, are in large measure natural and relatively unchangeable. Whilst he must arrange his cropping a long time in advance of harvest, yields and prices depend upon conditions which are, in the main, out of his control. Moreover, good farming, in a developed country, normally implies a balance between stock and crops, in the interests of the maintenance of fertility and the upkeep of the stock. This further implies a mutual interdependence between the several elements in the farming system. Each product is thus, in greater or less degree, a joint product, and is not the natural unit on which to base an analysis of costs and profits. The business of farming does not lend itself, as does factory industry, to the precise determination of the costs of separate products, nor to accurate comparisons of outlays and returns in a single year. The analytical method of costing, which aims both at the determination of the individual product cost and the separation of the profits and losses on the several branches of the farm activities, is thus unsuited to agricultural conditions. A study of costings systems actually in use reveals that, under practical conditions, the difficulties involved are fundamental in character.

The suggestion is therefore made, that an analysis of the physical factors underlying the farming system, and of the farmer's motives in arranging his policy, should precede the analysis of costs. The problem of the individual farmer is the organization of the most economical system suited to his particular environment.

Information as to costs, to be of effective use, must therefore relate to those alternative practices which are open to him. These may include some change of emphasis as between live stock and crops in the farming system; or a mere substitution of one crop for another, or of one class of stock for another, without disturbing the balance of farming; or the intensification or limitation of expenditure on products which already enter into the farming system, without affecting policy in other directions. For the first of these purposes the accounts must be analysed in a way which will reflect the natural division of functions on which the farm economy is based; for the second and third, some information as to the expenditure and return likely to be involved in each case is

required. The information collected should include quantitative data in terms of hours of work, of men, horses or tractors, quantities of raw material bought or used, acreages of crops grown, numbers of live stock purchased and sold, and yields of produce obtained, in order that the effects upon returns of changes in yields and in values can be estimated. Returns will usually vary more widely than costs.

Many useful comparisons of outlay and return from alternative practices can be made without computing the costs of those processes which arise in any case. The precision with which a farmer can compare cost and return will, however, depend firstly upon the extent to which his results are under control and are independent of weather and other uncertain factors; and secondly, upon the relative importance of the indirect effects of any change of policy. These indirect effects may have to be the subject of estimate in the first instance, and adjustments of practice made on a system of trial and error: usually costs must be collected over a period of years if 'normal' costs are to be obtained.

Finally, any system of costing for the use of the farmer himself must be relatively simple in form and in method.

CHAPTER II

COMPARATIVE COSTS AND THE MEASUREMENT OF EFFICIENCY

It is proposed to consider in this chapter the limits within which cost accounting data may be applied usefully for comparative purposes:

(*a*) for affording farmers some criteria by which to judge the efficiency of their organization; and

(*b*) for providing information upon comparative costs under different systems or on different scales of farming.

Cost accounting as applied to agriculture has been developed as an elaboration of ordinary financial accounting, and, as a result, the data to be obtained by the more detailed processes of costing have not always been distinguished from those which may be derived from simpler financial accounts. The term 'costing' has been applied, somewhat loosely, to the collection and tabulation of statistical data relating to the seasonal requirements of crops for manual and horse labour, to comparisons of farms of varying sizes with reference to their gross or net output, their profit or loss per acre, or per unit of labour or of capital employed. Whilst it is true that the compilation of data of this kind may in some cases be facilitated if costings records are kept, it is by no means necessary to go to the trouble of elaborating cost accounts for such purposes. Comparisons of output or of profit on farms of varying size or type can be made from ordinary simple financial accounts.

More detailed comparisons of efficiency, in management of labour and in the details of organization, may call for the use of cost accounts. A preliminary question to be answered is, within what limits does farming lend itself to such comparisons? The problems of the factory cost accountant are a good deal easier. In many manufactures the quality of the raw material can be standardized, the conditions of factory production may be almost completely under control. But it is characteristic of farming that no two farms are alike as regards size, lay-out, convenience of working, or quality of soil, and the weather is never the same in any two years. The quality of live stock and their responsiveness to feeding and attention may vary widely even within the same

breed. Farming clearly does not present a simple case for the establishment of general standards with reference to which the efficiency of management in detail may be judged, or for the determination of normal costs to which short-period results should be expected to conform.

Standards of Labour Efficiency.—When, for example, it is proposed to establish average labour costs per acre for various crops, which may be used as standards for the measurement of efficiency of farm management,[1] particular care is necessary. Averages obtained from a number of farms can only be regarded as standards for purposes of comparison if all the farms are reasonably similar in character and size. If compiled without reference to the conditions of production, averages have little value as standards of efficiency, and little, if any, significance for any other purpose except perhaps for making very broad comparisons between costs at different periods.

The published figures of the costs of sugar beet production furnish an example.[2] The average labour costs of the crop per acre were found to be £10 18*s.* 1*d.* on medium and heavy soils, £14 10*s.* 2*d.* on Fen soils, £11 4*s.* 1*d.* on light soils, and £12 15*s.* 9*d.* on all soils taken together. Reference to individual farms reveals that the figures within the light soil group varied from £7 12*s.* 10*d.* to £14 5*s.* 5*d.* per acre, and in other groups the average masked similar divergences. Comparisons of yield, manurial treatment, distance from railway, suggest explanations of the differences in labour cost, which do not therefore necessarily indicate any differences in the efficiency of the labour employed or in its organization. In the two extreme cases quoted from the light soil group the yields are 3·71 and 13·24 tons per acre respectively, and considerable variations in acreage cost of handling the crop are to be expected.

A major difficulty in comparing labour efficiencies in farming operations is that it is seldom possible to ensure similarity of conditions so that labour is the only variable factor. Irregularities of soil, even on the same geological formation, inequalities of situation, differences in convenience for handling live stock, are almost invariably found when farms, or even fields on the same farm, are compared. For example, on six different fields growing wheat on

[1] *Oxford Report*, 1925, p. 7. [2] Bridges and Dixey.

the same farm in one year, the hours of manual work recorded in ploughing varied from 9·8 hours to 13·2 hours per acre, using a two-horse plough in each case.

Some criterion of efficiency is necessary before comparisons can be made effectively. In many agricultural operations the difference between a good and a bad worker is not measured in terms of the time taken to do a job, but rather with reference to the effectiveness of the work for producing a result. In other words, both quality and time have to be taken into account. Clearly the depth of ploughing will influence the time taken, and it will also affect the yield.

The unit in terms of which the time spent in farm work can most suitably be expressed varies with the character of the work. Some costs vary more closely with the area of land worked than with the quantity of produce obtained, e. g. the costs of ploughing, harrowing, and drilling. Even with such simple operations, however, and on similar soils, costs may be expected to vary under different systems of cropping and manuring. It has been demonstrated that the amount of farmyard manure, lime, and artificials applied to the land may affect the drawbar pull of a plough very considerably.[1] If deeper cultivation should bring greater yields with some crops it might be more useful to calculate the costs per unit of produce than costs per acre. But since yield may be influenced by subsequent manuring and by the general policy of the farm for the upkeep of fertility, even these calculations must be used with reserve.

In other cases operation costs are influenced more directly by yield. This is the case in the lifting and handling of such crops as potatoes, carrots, and sugar beet. Labour costs per ton on a farm for such operations tend to be more constant than labour costs per acre. For example, on a farm growing potatoes on two fields of 7·2 acres and 5·9 acres the yields were 4·33 and 5·68 tons per acre respectively. The labour and horse labour in lifting, clamping, sorting, and delivery to station were as follows:

	Hours per acre.		*Hours per ton.*	
	Men.	*Horses.*	*Men.*	*Horses.*
7·2 acre field	86·1	31·1	19·9	7·16
5·9 „ „	104·7	37·8	18·4	6·65

For comparative purposes, therefore, the labour costs of field

[1] Rothamsted Report, 1921–22, pp. 12 and 13.

operations per acre can rarely be stated fully without reference to yield, and labour costs per unit of produce will similarly be related to the yield per acre. Cost is a function of both yield and area, and may not vary in relation to either taken alone. Similarly, the comparative efficiency of labour in attending to dairy stock cannot be measured in terms either of hours per cow-week or hours per gallon of milk produced, without reference to the yield of milk per cow.

Comparisons of efficiency of labour are complicated, in farming, by the fact that use has often to be made of the labour of men, women, or children. From the farmer's viewpoint the total money cost for equivalent work will be the critical test of relative economic efficiency, but his choice may be limited by the supply of labour, and a high money cost on his farm may reflect a difficulty in getting the cheaper kinds of labour rather than any inefficiency in organization. It has been proposed to introduce equivalents based upon estimates of relative physical efficiency. This may be necessary if the work calls for hard muscular effort. For some jobs, however, dexterity or experience count for more than strength. Women and boys may be able to compete successfully with men in terms of output per hour on such work as milking, weeding, sorting potatoes or carrots. Any reduction of the actual hours worked by women and boys on such operations, for comparison with the time taken by men, would clearly be wrong.

Given reasonably similar conditions there is no doubt that comparisons of operation costs may sometimes reveal sources of loss. The use of an old type of implement, unless its employment is necessitated by some particular circumstance, may add to the cost of a crop. For example, the cost of working a steerage drill requiring two men, one boy, and three horses is high, per acre of land sown, in comparison with the cost of using a modern disc drill, which can do the same work with one man and two horses in the same time. In one instance within the writer's experience, the costs of drilling corn with a three-horse steerage drill were three horse hours and three manual hours per acre. A modern two-horse disc drill was borrowed to complete the work, and on a field of thirteen acres the drilling was done with the expenditure of 1·67 horse hours and 0·83 manual hour per acre. Calculations of this character can, however, be made for the specific purposes in view, and do not involve more than the measurement of costs of the actual operations.

Comparisons have been suggested to decide if higher wages induce greater efficiency.[1] For this purpose, either as between different workers at the same time, or between workers at different times, direct comparisons between wages, including the value of perquisites, and output per man will not give valid comparisons without corrections for differences in the cost of living and other circumstances affecting real wages on the one hand, and for changes in the level of agricultural prices on the other hand. Conclusions upon matters of this character would have to be based upon data collected from a large number of farms over a fairly long period to be of real significance. Moreover, such data would be derived from returns of total labour and output of farms as complete units rather than from sectional records, and cost accounts would not necessarily be involved.

The Efficiency of Horse Labour.—Comparisons of efficiency of horse labour on farms present somewhat similar difficulties. If the efficiency of organization of horse work is measured by the number of hours, or equivalent days, worked per year by each horse, as compared with a theoretical maximum number of hours or days which might be worked under ideal conditions, there is considerable risk that erroneous conclusions may be reached. In the first place, the number of hours during which work with horses is possible varies considerably according to the characteristics of the soil. On clay lands some delay must be allowed after rain before the horses are used, to avoid 'poaching' the soil and rendering it more difficult to work; on more sandy soils it may be possible to carry on operations in all weathers, except during severe frost or snow. Clearly, therefore, the amount of rainfall and its seasonal distribution will be an important factor controlling horse work on the heavier soils. Thus, differences in the average time worked by the horses on farms may merely reflect differences in the physical conditions prevailing, and afford a very imperfect basis for comparing efficiencies of organization.

This is not the only difficulty. The final test, on any farm, is not the hours worked per horse, but the cost of getting the work done. It is true that, given a particular set of conditions, the larger the number of hours of work obtained per horse, the lower will be the cost per hour: the horses must be fed whether they are

[1] Orwin, *Farming Costs*, pp. 108–9.

at work or standing idle. But there are other factors which enter into the account. On some farms, where there is plenty of grass and where forage from the arable land is relatively costly to grow or to buy, it may pay the farmer better to keep a larger number of horses on grass, and work them lightly, than to keep a smaller number, work them more intensively, and feed them on oats and hay. In such cases the hours worked per horse will be low, but the costs per hour worked will also be low.

If the number of hours worked per horse per year is thus an imperfect index of efficiency of horse management, so also is cost per hour or per day. Whether it pays to cheapen the cost of horse work by feeding mainly on grass, or to increase the output per horse by more intensive feeding, depends upon the returns to be obtained from the alternative uses of the land. Generally speaking, the higher the net returns from the land are, the more carefully should the acreage devoted to horses be restricted, even at some sacrifice of costs. The lower the return per acre from the land, the greater can be the acreage devoted to horses, without lowering the average returns from the farm. Thus with regard to horse labour, neither hours worked, nor cost per hour, is the final index of efficiency. The total cost of a given amount of work is the test, and this will depend, in the main, upon the system of farming under review. As with manual labour, comparisons of efficiency can only be made satisfactorily, if the farms compared are of a similar character.

Agricultural Surveys an Alternative to Cost Accounts for some Purposes.—For investigations into the seasonal distribution of labour and the total labour requirements of farming systems comparatively, the 'survey' method of approach seems to offer greater advantages than cost accounting. This method applies also, subject to considerable care in interpreting the results in particular cases, to comparisons of operation and feeding costs on farms in a particular area which conform to a relatively uniform type. American investigations have established the fact that if the number of farms surveyed be sufficiently large, averages based upon the experience of farmers, expressed without reference to actual records, give results which are sufficiently accurate for all practical purposes.[1] There can be no doubt that regional surveys,

[1] *U. S. Bulletin*, 529.

by means of which data can be collected from a large number of farms of approximately similar type, are of considerably greater value for obtaining average figures of the character indicated, than more accurate cost accounts kept on a few farms with an equivalent expenditure of time. Average figures obtained from surveys may, or may not, furnish the individual farmer with a standard against which to measure his own efficiency under the particular circumstances in which he is placed; and if they are to permit of valid deductions concerning the conditions which favour economic success, by establishing correlations between size and profitableness, or between two or more alternative methods of organization and the average returns obtained where they are respectively practised,[1] they must be based on a sufficient number of cases to allow of the relationship of cause and effect being clearly shown.

Comparisons of Product Costs.—The processes of costing have been invoked to establish comparisons between the complete costs of a crop grown on different farms or in different areas. If the individual product cost is not validly determinable by an apportionment of total costs, a conclusion arrived at in Chapter I, costs so determined cannot be used validly for comparing the profitableness of the same crop on different farms, nor for determining the average profit on the crop on a number of farms worked on different systems. The difficulty of ascertaining the real profit on the growing of sugar-beet has already been referred to. Under varying farming conditions beet replaces different crops, and the effect of this substitution upon the total returns of the farm may vary widely in consequence. For example, as a substitute for potatoes it replaces a crop which provides little, if any, food for stock except pigs in a normal year, and sugar-beet contributes to the upkeep of fertility through its leaves and tops in a way that the potato crop does not. In replacing mangolds it may influence the costs of maintenance, if not the numbers, of live stock on the farm to a considerable degree. In replacing corn in the rotation it reduces the quantity of straw produced for litter or forage, and alters the seasonal distribution of labour on the farm.

Comparisons based upon a Uniform System of Apportionments.—It has been suggested that comparisons may still be made validly between the costs of producing the same crop on different farms

[1] *Oxford Report*, 1925, pp. 14–28.

by valuing, on a uniform basis, those residual and intermediate products which form the connecting links between the several crops and the live stock within the farming system.[1] Whatever basis be adopted for making apportionments of costs between grain and straw, milk and manurial residues of foods, and for other adjustments of a similar character, the objection still remains that the real influence of the production of one product on the total profit of the farm is not measured by such means. It may be important, however, to consider the various suggestions that have been made, in order to estimate to what extent valid comparisons of costs may be obtained by uniformity of method.

The apportionments which fall to be made in an attempt to analyse farming costs on the basis of individual products may be grouped as follows:

(i) Apportionments of labour and horse labour between the various activities of the farm.

(ii) Apportionments of manurial residues and cultivation costs between the several crops grown in a rotation.

(iii) Apportionments relating to the use of intermediate products or by-products which are the subject of transfer between the land and the live stock.

(iv) Apportionments of rent and general overhead expenses.

(i) *Apportionments of Labour and Horse-labour between the various Activities of the Farm.* (a) *Manual Labour.*—The fact that on any farm the cropping and general organization may be determined to some extent by the labour available has already been indicated. It is, moreover, the case that varying proportions of the total labour of the farm will be furnished by the farmer and his family. On small holdings the whole of the work may be done by family labour; on larger farms more of the farmer's time will be devoted to supervision. The reward for the farmer's own work is part of his profit; if that work is done by paid labour it becomes an element of cost. It is, however, apparent that if the costs of producing a crop or other product on farms of different sizes, or under different systems of control, are to be comparable, they must embrace the same items in each case. For comparing the total reward of the farmer for both labour and management on holdings of varying sizes the case is different, but cost accounts are not

[1] See Appendix.

required for that purpose. The net 'labour income' of the farmer, after deducting interest on the amount of capital invested, can be deduced from the financial accounts directly.

The apportionment of the cost of wage-paid labour on the basis of time worked on various jobs may be perfectly reasonable in factory costing, but it is not entirely unobjectionable in agricultural industry. A labourer's daily work is influenced largely by the weather. It may often happen that the labour force required on the farm is dictated by the needs of the farm at busy seasons, or by some daily routine work like milking. This may lead to a larger proportion of the labour being devoted to hedging or 'establishment' jobs merely because the men are available and there is nothing else for them to do. The excess of labour is really a charge against the crops or stock which give rise to its employment, or more correctly, against the farm as a whole. Uniformity in the basis of apportionment will not lead to accurate comparisons of the effective costs of the separate operations. This fact involves a danger in estimating the additional costs of added processes, such as the extra labour required for grooming and washing cows in producing high grade milk, or for the production of new crops like sugar-beet. The additional labour cost is more apparent than real if it merely absorbs time which would otherwise be spent on less productive work.

(b) *Horse Labour.*—Similarly, the number of horses on a farm may be determined by the requirements for horse labour at busy seasons. This may involve keeping the horses idle for a proportion of their time. The farmer's horse policy may be directly connected with the seasonal distribution of horse-work on the farm. An irregular distribution giving rise to a considerable proportion of lost time raises the cost per day of horse labour.[1] Under such circumstances it may be the practice to make use of breeding mares instead of geldings, in order to augment the returns from the horses by turning them to profitable use in rearing foals during slack times.[2]

To ensure uniformity in making comparisons of the cost of horse labour on different farms, it has been proposed to separate the 'Horses Stock Account' from the 'Horses Working Account', with a view to distinguishing the profits of breeding or dealing

[1] *Oxford Report*, 1925, p. 5.

[2] Watson and More, pp. 597–8.

from the costs of horse labour. This is urged on the ground that 'a farmer's success as a horse breeder or as a horse dealer is a matter entirely apart from the cost of horse labour on the holding'.[1] This is undoubtedly true in some cases, but is it always so? The effective cost of horse labour may be just as low if allowance is made for foals bred, as is the case where more hours per horse are worked in a year but no foals are bred. The separation in the accounts of the two uses of the horses may thus give rise to a wrong impression as to the efficiency of the farmer's horse management, unless the profits on rearing are brought into account in reduction of the costs of working. Moreover, such hypothetical problems as the apportionment of the costs of maintaining a working mare between the work done and the foal born are involved [2]—problems that do not arise if the combination of the two functions of rearing and working is regarded as necessary to the economical working of the farm.

A farmer's problem in labour and horse management is a complex one, that of using men and horses so as to involve the least waste of time and of effort. His system must be judged by success or failure to obtain a satisfactory total result. The flexibility of his organization is conditioned by his ability to adjust the supply of labour to his requirements. Uniformity of method in apportioning costs may cover up essential differences between one system and another, and invalidate the analysis of the individual farm costs.

(ii) *Apportionments of Manurial Residues and Cultivation Costs between the Several Crops grown in a Rotation.*[3]—The discussion of this group of apportionments involves some further references to farming technique.

(a) *Artificial Manures.*—Standard tables have been prepared from time to time for the assessment of the residual values of manures applied to the land, for the purpose of determining what an incoming tenant ought to pay, and the outgoing tenant to receive, in respect of unexhausted residues. The most important of these tables is that prepared by Voelcker and Hall,[4] but practice is not uniform all over the country and varying allowances are made in different districts.[5] Many problems connected with the conserva-

[1] Orwin, *Farming Costs*, p. 61. [2] Ibid., p. 39. [3] See Appendix, para. 6.
[4] *R. A. S. Journal*, 1914. [5] Jackson, pp. 233–6.

tion of the chemical elements of fertility in the soil have not yet been worked out, and it is admitted that estimates of residual value are, at best, approximations.[1] It is, however, to be noted that such tables as do exist have been compiled for the guidance of valuers in making their tenant-right valuations. In making use of these tables for costings purposes, other considerations arise. The farmer's motive in applying the manure is important. In some cases, e.g. with lime, the dressing may be applied at regular intervals of four or five years to correct any tendency to soil acidity. The cost of the lime and of its application may, for the determination of profits annually, be spread over the period between the dressings. It will not follow, however, that in costing the individual crops it would be equally fair to charge for the lime at a uniform rate per acre during the same period. Some crops benefit from liming, e.g. turnips, but others are unfavourably affected, e.g. potatoes. Dressings of other artificials are normally made according to the requirements of the crop to which they are applied, for the purpose of promoting maximum yields.[2] The quantities which should be given to the various crops, to create the optimum conditions for growth, are the subject of continual investigation by Experiment Stations and individual farmers, and the results are usually stated in terms of the yields obtained from applications of varying quantities of manure. The effects of unabsorbed residues of manures upon succeeding crops will depend upon the character of the soil, the character of the crops, and the influence of the season. Some crops may derive greater benefit from these residues than others. Good farming practice will, *inter alia*, endeavour to take advantage of the presence of residual elements, but their value for promoting growth will not be the same under all conditions. Further, the contribution of a well-manured crop to the fertility of the soil is not measured only by the chemical residues left. A good crop will leave a more highly developed root system and a greater quantity of straw, both of which will be available for improving the fertility of the land.

A practical illustration may be afforded by the manuring of the potato crop. The yield of potatoes is influenced by the quantity of artificials applied, and dressings of 10 cwt. and upwards per acre of mixed artificials are not uncommon. The proportions in which these dressings are made up will vary, but as an example

[1] Crowther, *Residual Values*. [2] Hall, *Feeding of Crops and Stock*, p. 162.

a 10 cwt. dressing consisting of 2½ cwt. sulphate of ammonia, 5 cwt. superphosphate of lime and 2½ cwt. sulphate of potash may be taken. The nitrogenous manure, being absorbed or washed out of the soil during the year of application, is normally charged to the potato crop. Phosphatic residues assume a relatively insoluble form in the soil by interaction with the soil elements. Messrs. Voelcker and Hall's Table suggests, for tenant-right valuation, carrying forward two-thirds of the cost of superphosphates after the first crop and one-third after the second crop. The crop following potatoes may be wheat, in which case one and two-thirds cwt. of superphosphate per acre will be chargeable to the wheat crop if the Table is used for the apportionment of costs. On normally fertile land, however, the wheat crop requires no dressings of phosphate,[1] so that the charge for residues would represent an expense which does not specifically benefit the crop, but is made merely because the crop happens to follow potatoes, which require a heavy dressing. The effect upon the potato crop costs of carrying forward two-thirds of the cost of the superphosphates is even greater, since it is proposed to charge only one-third of the cost to the crop, whereas the amount of the dressing applied was determined, at the time of application, by an estimate of what is necessary to obtain the maximum profitable yield of potatoes. A similar position arises with reference to the more expensive potash manure, although the proportion carried forward would be somewhat different. Cases will undoubtedly occur where a dressing of artificial manure, e.g. basic slag, is applied to a crop with the intention not merely of benefiting that crop, but also of maintaining or improving the supply of phosphates in the soil; but, as in the case of lime, the cost is then a general one rather than a specific charge against any particular crop.

If manurial residues are to be considered in computing costs of succeeding crops, it should follow that the increased fertility due to growing clover or any other leguminous crop ought not to be overlooked. One important objective in growing such crops is to enrich the soil with nitrogenous residues. So far as the writer is aware it has not been proposed to make any allowance for this fact.

The conclusion is therefore reached, that whilst the valuation of residues is necessary for the computation of tenant-right, and some basis must be adopted for that purpose, it is not necessary, and

[1] Hall, *Feeding of Crops and Stock*, p. 162.

indeed it is undesirable, to apply the apportionments suggested for tenant-right valuation to the determination and comparison of crop costs. It is suggested that it would be much closer to the farmer's intention in many cases to regard the cost of the dressing applied to a crop as being part of the outlay on that crop, and this would usually be done in determining the relative profitableness of dressings of larger or smaller amount. If it is desired to measure, for comparative purposes, the total effect of the manuring policy upon the output of the farm, it would appear to be necessary to take into account the manuring and the output of the whole of the rotation, and to include reference to the secondary effects upon the farming system, due to differences in the yield of live stock forage and straw available for the feeding of stock.

(b) *Farmyard Manure.*—Practice regarding the valuation for tenant-right of farmyard manure applied to the land varies considerably. It has been suggested that, for costings purposes, effective comparisons of the cost of crops, grown in a rotation in which farmyard manure is applied, could be obtained by apportioning the cost of the manure on a uniform basis between the three crops immediately following its application, and in agreed proportions; e. g. 50 per cent. against the first crop, 30 per cent. against the second, and 20 per cent. against the third.[1] Now the cost of farmyard manure is considered to be composed of two elements, viz. the cost of the straw or other litter used, and the residual value of foods fed to the live stock. These two elements contribute to the usefulness of the manure in different ways. The straw or other litter provides, when decomposed, the humus which aids in the maintenance of the mechanical condition of the soil and of its water-holding capacity, and it contributes in a minor degree only to the supply of plant food directly. Indeed, if applied in a 'long' or partially decomposed state, straw may absorb to itself available nitrogenous plant food from the soil, to the detriment of the crops robbed of that food. The length of time which the oxidation of the humus and its disappearance from the soil takes, varies widely according to the character and condition of the soil. The effects of its presence have been observed forty years after the application of the manure.[2] Thus, any scientific distribution of cost could not ignore the accumulation of residues in the soil, which will be in-

[1] Appendix, para. 6. [2] Hall, *Feeding of Crops and Stock*, pp. 239–40.

fluenced by the character and treatment of the land. The distribution of the charge for farmyard manure over the same period of three years, and on the same basis for every farm, tends to mask essential differences between the costs of maintaining and improving the fertility of different soils, worked on varying rotations.

The second element of value in farmyard manure is the residual value of foods fed to stock. The constituent of chief value is nitrogen. Part of this is absorbed and 'fixed' in a comparatively stable form in the humus; the remainder, in the form of 'free' nitrogenous compounds, may be rapidly lost, either in the liquid which flows away from the manure heap, or in volatile compounds of ammonia. Any free nitrogen left when the dung is applied to the land benefits mainly the crop to which it is applied. Its amount, however, is largely dependent upon the conditions of 'making' the manure. The place at which farmyard manure is applied in the rotation, and the quantity used, are dictated very largely by soil conditions in conjunction with the ability of crops to make use of the available manurial elements in the dung in the year of application.[1] It seems hardly reasonable to deduce that, because barley follows roots to which the dressing of manure is applied on some soils, and finds a later place in the rotation on other soils, its costs are greater in the former than in the latter case. Farmyard manure is 'as a rule a normal product of the farm and the only problem is to make it as carefully as possible, and apply it to the best purpose afterwards'.[2]

(c) *Cleaning Costs.*—Cleaning, like the maintenance of fertility, is a function which must be provided for by the system of cultivation practised. The necessity for cleaning arises on account of the carrying of weed seeds by the wind and by a number of other agencies, and because of the multiplication of weeds which have already obtained a footing in the arable fields. The work of cleaning is carried out to a minor extent by hand weeding, spudding thistles, and similar manual operations, but the major costs are incurred in connexion with the 'cleaning crops'—potatoes, mangolds, swedes, and turnips—and, in extreme cases, a bare fallow. The cleaning crops, on account of the operations for producing a suitable tilth for seeding, and of the greater depth to which the soil is stirred in the cultivation required by these crops,

[1] Ibid., p. 242. [2] Ibid., p. 246.

provide conditions suitable for the germination of weed seeds already in the soil. The young weed plants are killed by subsequent operations in the wide rows between the plants, or by the shading effect of the plant leaves. In the case of a bare fallow, the land may be stirred repeatedly by ploughing and harrowing, the young weed seedlings being buried beneath the soil after germination of the seeds. Thus the crops which provide opportunities for ridding the land of weeds, are also those under which conditions are unfavourable for the multiplication of weed seeds on the land. On the other hand cereal crops, and in particular peas, provide conditions under which weeds in the soil can grow and multiply before the harvest is cut, and they leave a legacy of rubbish to be dealt with by subsequent cleaning crops.

Although some crops may thus, to a greater extent than others, assist in the eradication of weeds from the soil, it is the practice to charge the cleaning crop with the major proportion of the cleaning operations, and to make a reducing charge to succeeding crops in the rotation until another cleaning crop is taken.[1] The principle underlying this method of apportionment seems to be to make the charge proportional to the estimated benefit received from the cleaning operations carried out in the previous cleaning crop, whereas the real *cost* of the crops to the farmer varies in precisely the opposite direction. A crop of peas taken during a rotation, which leaves the land foul, might properly bear a charge which should be credited against the costs of cleaning the land in the following crops. The difficulty of assessing, with any degree of accuracy, the contribution which any crop should make to the total cleaning costs to which the system of farming gives rise, gives further emphasis to the necessity for computing the costs of the system as a whole for comparison with similar costs involved in other, or alternative, systems. Indeed one factor determining the general treatment of the land is the requirements of the soil in relation to cleaning. The apportionment of cleaning costs by carrying forward decreasing proportions to succeeding crops in a rotation appears not only to distort the relative effective costs of crops grown on the same farm, but to invalidate comparisons with the costs of crops grown in a different sequence in other rotations and on other soils.

Problems of this character only arise because the distinction it

[1] Appendix, para. 7.

is proposed to make between the costs of the successive products in the rotation is an artificial one. In rotation farming each crop is an integral part of the system, a cog in a machine which cannot be replaced except by another cog which functions in a similar manner, unless the design of the whole machine is to be altered.

(iii) *Apportionments Relating to the Use of Intermediate Products or By-products, which are the Subject of Transfer between the Land and the Live stock.*—These include,

(*a*) Home-grown crops consumed by live stock on the farm, e. g. root crops, hay, silage and green crops, and pasture grass;

(*b*) Crop by-products utilized by live stock for food or litter, e. g. straw, inferior grain, small potatoes, the aftermath or second growth of rotation grass and clover;

(*c*) The manure produced by live stock and applied to the land.

The proposals of investigators as to the basis upon which transfers between the several sections of the farm should be made, to ensure comparability of results, have varied widely on questions of principle. English cost accountants generally have preferred the cost basis for charging crops and crop by-products to live stock, and manure to the land.[1]

(*a*) The determination of cost, in the case of crops for feeding, gives rise to the difficulties already discussed in assessing the costs of cleaning and of manurial residues. But objection is taken on principle to the cost basis by many practical farmers, and by American cost accountants generally, on the ground that, if the farmer has an alternative means of disposal of crops by sale, the arable land should be given credit for any potential profit that might have been earned, and the live stock should be charged the price the farmer would have to pay in the open market to buy the same product, or its equivalent as food. A further objection raised is that the cost basis burdens the live stock with a high charge for home-grown food if the arable land should fail to produce a normal yield, and the profits of the stock will vary from causes which are only indirectly connected with live stock management. There has been much controversy on this question, which may perhaps have assumed an undue importance because of the underlying assumption that the ultimate product cost, arrived at by the means proposed, is significant for comparison with its selling value. If the

[1] Appendix, para. 4.

argument in the preceding chapter can be sustained, the controversy loses much of its point. Moreover, it seems to have been generally overlooked that the yield of a forage crop may have a far greater effect upon the live stock returns than is indicated by the cost per unit of food consumed. The number of animals required for its consumption will be affected. The demand for animals for winter feeding is influenced to a considerable degree by the yield of roots, with corresponding effects upon the buying-in price of the animals to the farmer.

A relevant consideration is the primary function of the feeding crops in the rotation. If the acreage of roots and forage grown is dictated by the requirements of the arable land for cleaning and the maintenance of fertility, and the consumption of the crops by stock has in view mainly the performance of those functions, it would seem that the market values of the crops, or even the current value of the food units produced [1] have little significance. The outlays on the crops, added to the subsequent live stock costs, less the returns from sales of live stock products, constitute the net cost of the process. If, on the other hand, the needs of the live stock are primarily in mind in determining the arable cropping, and the cleaning crops are grown on an area in excess of the requirements of the arable land for cleaning and manure making, the really significant comparison will lie between the net returns to be obtained by using the arable land for producing food for stock or for producing crops for sale. The feeding value of the produce is important in this case.

In fact, the profitableness of crops cannot be assessed without reference to the organization of live stock necessary to maintain the land in good heart; nor can the profitableness of the live stock be determined without reference to the organization of the arable land necessary to maintain the supply of forage. No uniform basis for charging the produce to the stock, which overlooks the varying emphasis on stock and crops under different farming systems, will give truly comparable results.

The apportionment of the costs of grazing gives rise to another problem. Pasture may be grazed by cattle and sheep jointly. The attempt to decide exactly how much profit the cattle have made as compared with the sheep has involved the assumption that, for the apportionment of grazing, one cow can be equated to so

[1] Cf. Warren, *New York Farms*, p. 14.

many sheep. The live stock—horses, mature cattle, and young cattle—are reduced to sheep equivalents,[1] and the principle has been extended even to equating pigs and poultry to sheep.[2] The total live stock is reduced to sheep or cattle units, and the aggregate costs are apportioned having regard to the number of units represented by each class of stock. The practical objections to this method of assessment of grazing costs are, firstly, that the various kinds of live stock are not often on the grassland in the same proportions at all seasons; and secondly, that animals of different classes may not be competitive, but complementary, in the use they make of the grazing. For example, cows may graze the pastures during the spring and summer months when grass is at its best, and be followed by sheep or growing stock in the autumn and winter. The grass is of different values at different seasons, and this makes an apportionment of cost on the basis of the number of days of grazing unfair. It may frequently happen that the carrying capacity of the land for one class of stock, e.g. dairy cows, is not decreased by using another class of stock, e.g. sheep, for utilizing the grazing residues left by the stock of primary importance. Often, indeed, different classes of stock on a farm are not alternatives to one another. They may all fit into a plan which, by making the most effective use of each kind of animal, keeps the pastures in good condition. In such cases it would seem to be in accordance with practice to regard the whole of the expenses of maintaining the grassland as part of the general expense of the upkeep of live stock, and to use the cost accounts to try to decide what combination of stock will be most economical at the current levels of costs and selling values. A somewhat artificial apportionment of costs of grazing based upon days of grazing, or average numbers of stock, gives rise to comparisons between different classes of live stock which do not reflect their comparative usefulness. As between cattle and sheep, or between any other kinds of stock on the farm, the problem of practical importance is, up to what point it may be desirable and practicable to increase the number of one class at the expense of the number of another class. Usually this question cannot be decided with reference to the grassland alone. What really matters is whether the increase of income less the increase of outlay due to carrying a larger head of cattle, leaves a net increase which is greater than the net loss

[1] Orwin, *Farming Costs*, p. 90. [2] Ruston and Critchley.

of income due to a reduction in the numbers of sheep. The answer to this is independent of that portion of expenditure on the grass which is inevitable whichever alternative is adopted.

Thus, for obtaining useful comparisons of the economic efficiency of live stock of various kinds, no stereotyped method of apportioning total grazing costs is satisfactory. Indeed, it is chiefly in cases where the grassland supports stock which are associated with the working or maintenance of the arable land, e.g. working horses, arable sheep, or cattle fed largely on arable produce, and also supports a separate live stock enterprise for the utilization of the remaining grass, that some apportionment of grazing costs may be necessary.

(*b*) The utilization by live stock of crop by-products has given rise to proposals for apportioning the total costs of the primary products. The division of the costs of a cereal crop between the grain and the straw is a typical case.

Grain and straw are produced jointly. The grain may be sold, or used as food for stock; the straw may occasionally be sold, but more usually it is used either as food or litter for stock, and it forms the basis of the farmyard manure applied in due course to the land. Various methods have been used for dividing up the total costs (as ascertained by the system practised) between the grain and the straw. The straw may be regarded as a by-product, the value of which, if it is sold, is credited against the total outlays on the crop. The difference represents the cost of the grain, which thus will depend in part upon the price of straw. Where there is a market for straw an advantage undoubtedly accrues to the corn-grower. But in the larger number of cases the straw is either unsaleable or required for use on the farm. Market quotations represent the value of the relatively small proportion of the total straw crop which is in excess of the farm requirements; they could not be applied to all the straw on the farm without introducing assumptions of considerable magnitude.

To avoid this difficulty it has been proposed to assume that the cost of straw, whether of wheat, barley, or oats, is a standard proportion, say one-seventh, of the total costs of the crop in all cases.[1] The proportion is admittedly arbitrary, it has no physical or chemical basis, and the assumption is made with the sole object of getting comparative costs of cereal crops, produced under varying

[1] Appendix, para. 5.

farming conditions. The question arises whether the assumption of a rigid economic relationship between straw and grain is in accordance with the facts? As between wheat, barley, and oats the ratio of the values of grain and straw is certainly not constant. The object in view in cereal growing varies with circumstances. In the Eastern Counties cereal crops are, in the main, grown for sale, and the farmer aims at obtaining the maximum ratio of grain to straw. In fact the disposal of the straw is a critical problem on many farms. In the West and North varieties are selected with reference to their value as forage, and varieties of oats which produce a maximum ratio of straw to grain are favoured. In extreme cases the relative economic importance of the two joint products is entirely reversed. On dairy farms the acreage of wheat grown may be determined by the need for straw rather than by the price of grain. The assumption that costs can be divided in fixed proportions will tend to obscure the real part the crop plays in the rotation, and render any comparisons between the profitableness of corn growing in different areas unsatisfactory. Again, the ratio of grain to straw in a crop will vary according to the season.

It would perhaps labour the discussion unduly to follow out, in technical detail, the objections to a rigid basis of assessment of costs of other crop by-products. The essential objection to these uniform assessments is that the same crop does not assume an equal importance in the farming economy in all cases, and that the relative importance of each of two products obtained jointly will vary under different farming systems. The really significant 'cost of production' of any joint product is the cost of increasing its yield by unit quantity without affecting the yield of the other joint product.

(c) In view, however, of the importance attached in agricultural literature to the manurial residues of food fed to live stock, it may be desirable to refer briefly to this matter in its bearing upon costs. Investigations upon the artificial synthesis of manure from straw and chemical compounds have suggested that the chemical quality of farmyard manure tends to become constant if it is stored under conditions which are not uncommon on farms.[1] A large part of the expensive nitrogenous ingredients of animal excreta, upon which its fertilizing value in large measure depends, becomes chemically combined, by the processes of fermentation which are normal in 'making' manure, into compounds which can

[1] Hutchinson and Richards.

only be used by plants as food after further slow processes of decomposition have taken place in the soil. Any excess of nitrogen voided by the stock is rapidly lost in volatile compounds. One implication of this work is that the full fertilizing value of freshly voided liquid and solid excreta is not effectively available in farmyard manure, under practical conditions, for the fertilizing of the crops to which the manure is ultimately applied. Indeed the utility of farmyard manure as a fertilizer is, by common consent amongst agriculturists, largely controlled by the conditions of making and of storage. All kinds of soil and all farming systems do not lend themselves to equality of treatment of the manure. The reaction of the arable crops to dung made from equal quantities of food eaten by the stock would, in consequence, vary considerably. If it should be objected that that is no reason for considering the cost of the dung to the farmer to be greater in one case than in the other, the further consideration arises that, in the majority of cases, the amount of food fed to live stock is dictated by their requirements for food, the manurial residue being simply a by-product. This is certainly true in feeding dairy cows and young stock, and with regard to stock kept mainly for the conversion of straw into manure, it is recognized to be very wasteful to pass large quantities of expensive food through an animal merely for the purpose of obtaining manurial residues, of which the equivalent could be purchased as fertilizer at much lower cost and in more stable form. In town dairies the manure may actually be a nuisance rather than a potential asset. With animals scientifically rationed the whole cost of the food is, in a large number of cases, reasonably chargeable to the live stock for comparative purposes. The assumption that the effective value of the manure bears a constant ratio to the quantity of food consumed by the stock is contrary to experience, and may well vitiate comparisons between farm and farm.

(iv) *Apportionments of Rent, Interest and General Charges.*—In financial accounts for the determination of profit or loss, rent paid is normally charged against profit as an expense. Interest on the proprietor's capital will not usually be charged against profits since it represents part of his net return and it will, equally with any additional profit earned, be assessable to Income Tax.

A rigid adherence to these principles in an attempt to isolate the individual product cost leads to some anomalies in presenta-

tion of results and some difficulties in their interpretation.[1] In particular it tends to introduce elements into the computation of costs which render them unsuitable for comparison with one another, or for comparisons of the productivity of land on different soils and in different situations.

Leaving for a moment questions of principle, a practical difficulty arises because a tenant farmer pays rent, and an owner-occupier's return from the ownership of his land is in the nature of interest on his capital.[2] If costs are to be comparative, it is clear that the elements involved in the computations must be equivalent. If rent is included in one case it cannot be excluded merely on the ground that it is not paid in cash in the other case. The practical difficulty is not met by suggesting that the result in each case must be interpreted in the light of the capital sunk. If rent is included it becomes bound up so intimately with the costs of crops, crop by-products, and residual values, which are the subjects of apportionment and transfer between the land and the live stock, that adjustments for comparison with non-rent-paying farms would involve a great deal of clerical labour if not an entire reconstruction of the accounts.

Still greater objections arise on questions of principle. For including rent in costs it is urged that rent is an expense to the tenant farmer which cannot be ignored. If rent were a charge which is independent of the productivity of the land, that contention could not be denied. No reasonable exception can be taken to including rent in estimating profit or loss in a particular period. But the case is different when comparative costs are concerned. The rental value of land is not independent of its productivity. The table of results (see p. 68) obtained from an agricultural survey is suggestive on this point.

Broadly speaking, variations of agricultural rent indicate the differential advantages of different categories of land used in agriculture. The inclusion of rent in costs of production will thus tend to equalize those costs. The differences in costs due to varying conditions as regards climate, soil, and situation are therefore minimized and to some extent masked.

It has been urged in reply that differences in rental value are, however, due in the main to the investment of capital in improvements, and that they merely represent, therefore, a reward of

[1] Cf. Orwin, *Farming Costs*, pp. 55–9.

[2] See Appendix, paras. 2 and 3.

RELATION OF YIELD OF CROPS TO RENT OF FARM.[1]

Crop.	*No. of Holdings.*	*Yield per Acre.*	*Rent per Acre.*
			£
Hay	200	Under 20 cwt.	1·4
		21–30 „	1·9
		Over 30 „	2·5
Wheat	120	Under 3 qr.	1·5
		3–4½ „	1·7
		Over 4½ „	1·8
Oats	104	Under 3 qr.	1·5
		3–4½ „	1·6
		Over 4½ „	1·7
Barley	58	Under 3 qr.	1·4
		Over 3 „	1·6

capital invested by the owner or his predecessors in title.[2] This seems, however, to ignore the essential character of the rent charge. Some elements of rent may be, for a limited period, related to a specific improvement carried out by the landlord, e.g. a drainage scheme carried out on a farm under the provisions of the Agricultural Holdings Acts. But it is contrary to experience in all industries to suggest that the sinking of capital in land and buildings creates more than a temporary rental value which bears any relationship whatever to the money sunk. Capital investment in the past may, under changed economic conditions, impose an actual disadvantage upon present-day tenants.

Moreover, the rental value of land of identical character will vary widely on account of differences in its economic environment —in proximity to towns which provide a ready market for fresh produce, or in distance from a railway or other means of communication. As an example, the value of farms on the Bunter Sandstone formation may be compared. In Cheshire and Lancashire, in the vicinity of large centres of population, they may be let at high rentals of from £5 to £10 per acre as market-garden holdings. In Nottinghamshire much of such land is uncultivated or commands a very low rental. Indeed on some farms very poor fields are included in the letting without any rental for their use. These differences of rent are explained by, and result from, the differences in cost of products, including costs of marketing which vary widely on account of differences of situation.

Land, or any other useful object of limited quantity, will earn for its use what it will produce over and above a normal return to the farmer for his capital, labour, and managerial ability. It is

[1] *Oxford Report*, p. 27.

[2] Orwin, *Farming Costs*, p. 56.

not suggested that the word 'normal' in this connexion can be interpreted by the standards set by other industries. It is used to represent the expectations of reasonably good farmers in the area, judged by the standards of their class. Nor is it implied that in any single year, or on the average of two or three years or even longer periods, the rent paid will exactly equal the true economic rent of the farm. Farming being subject to such variable returns, adjustments of rent, equally with adjustments of practice, may be slow. Moreover, agreements may be in force. But these local or temporary differences are subject to the more deep-seated causes influencing the returns from the land. In times of severe depression rents fall in spite of agreements, and the tendency for rentals to fluctuate with changes in the levels of costs and of prices is recognized in legislation restricting increases of rent in certain cases, e.g. in the Corn Production Act, 1917, Sec. 8, and in the provisions of the Agricultural Holdings Acts governing changes in rentals.

Thus the inclusion of rent in the cost of production of a commodity, grown in different areas or under different systems of management, tends to invalidate comparisons of the relative economic advantages of such areas or systems for the production of the crop. It will permit only of comparisons of how farmers are faring at the moment under current price conditions and tenancy agreements. Such comparisons are important, but they should not be confused with comparative costs.

A further objection arises if comparisons between the advantages of growing different crops or producing different live stock products on the same farm are intended. Normally a flat rate per acre is proposed for the distribution of the rent charge over the farm fields.[1] This assumes equality of productiveness of all the land on the farm—a condition which would not apply on a very large proportion of farms; but it also makes a more important assumption, viz. that the area of ground and the length of time it is occupied by a crop are jointly proportional to the importance of the crop in the economy of the farm. If a small area of wheat be grown to provide litter for stock on a heavily rented dairy farm, to avoid the purchase of straw, it will not be justifiable to compare the costs of producing that wheat, including the high rental value of the land (which is due to the suitability of the land

[1] Appendix, para. 2.

for dairying), with corresponding costs on land devoted in the main to cereal growing.

It is clearly reasoning in a circle to suggest that where land on a farm is obviously of variable quality the rent charge should be varied from field to field according to the judgement of the cost accountant. This practice really involves forming an estimate of rental value, based upon costs and yields of produce, and then including that estimate in the final statement of costs.

Interest on Investment.—Whilst it is true that interest on capital, other than that actually paid, would not usually enter as a charge against profits, it would appear to be necessary, in comparing the relative economic advantages of two or more systems of farming, to take account of the capital invested in each. If comparisons of cost and returns on the several crops or products within a single farm could be made satisfactorily, it would be necessary to take into account the proportion of the farmer's capital required for each productive activity. This is common practice amongst American cost accountants. The objection to this position, viz. that the inclusion of interest in costs for comparison with selling prices introduces a false measure of profit, which would appear to be sharp practice where the public is concerned,[1] would be valid if costs for comparison with selling values could be determined by the methods proposed. But if the final economic advantage to the farmer of each of two alternative processes leading to the same net return in profit is to be determined, the investment of capital involved in each case must also be brought into account.

Insistence upon the entire exclusion of interest in the computation of costs seems to be another of the effects of attempting to combine cost accounting with ordinary financial accounts for the determination of profit. As has been shown to be the case with valuations, so in dealing with rent and interest, the principles which should guide the accountant are not identical for the purposes of costing and of profit determination. The former process is most usefully invoked to trace the expenses involved in a particular course of action and compare them with those involved in some alternative course, having regard to the results obtained in each case; the process of profit determination is dictated by the underlying conception of the meaning of profit, under which term

[1] Orwin, *Farming Costs*, p. 58.

is normally included both the reward of management and interest on the capital owned by the proprietor of the business. Rent must clearly be brought into account in determining profit; interest on the proprietor's capital should, by hypothesis, not be charged as an expense, although interest paid on money borrowed should be charged. But to insist on similar procedure in costing can only have the effect of masking differences of considerable importance in the effective costs of production when commodities are produced under dissimilar conditions.

Uniformity in the *principles* underlying the compilation of comparative costs is essential, but uniformity of principles does not mean that the same formulae should be applied in apportioning costs in all cases between the several products of the farm. Rather does it imply that due regard should be paid to essential differences in the structure of farming systems in analysing their working costs, and that costs of the same character should be included in each case. Whether the working capital of the farm is owned by the farmer or by somebody else should not be allowed to influence statements of comparative costs.

There would be little gained by a further detailed discussion of the apportionment of other overhead charges such as the costs of hedging and ditching, upkeep of roads and general establishment expenses. It is submitted, for the reasons given under each of the various heads already discussed, that uniformity of method does not overcome, for comparative purposes, the essential weaknesses revealed in the analytical system of costing when it is applied to the individual farm for the purpose of determining the separate product cost. On the contrary, to suggest that uniformity exists where in fact it does not, cannot fail to give unreliable comparisons.

An Illustration from Milk Production.—In some recent and carefully compiled comparisons of the costs of milk production, wide variations are observed in costs per gallon computed by the same methods on a number of farms.[1] Considerable differences also appear in the proportions in which food and other component elements enter into the computed costs. When, moreover, these total costs and their components are compared, with the object of establishing criteria for measuring efficiency in management, or correlations between factors such as yield per cow and profit per

[1] Wyllie, *Wye Reports.*

cow, it is found to be very difficult to establish relationships of cause and effect. Unfortunately, the results are reported without information as to variations in the physical and economic environment of the farms on which they were obtained.

It would seem that much variation of computed cost per gallon is inevitable when farms are compared. The limits to which intensiveness of output can be pushed profitably are clearly not independent of the conditions of production, and the unit cost of the milk and the profit per cow will vary accordingly. The case would be different if cows were normally isolated in sheds, and fed on purchased foods which could be obtained at equal cost by all farmers, and if the animals had no part to play in the general system of farming. But in practice the method of feeding the cows is not independent of the farm economy as a whole. The cow stands in a certain relationship to the rest of the farm, and the character of that relationship varies with circumstances. Cows may present the most profitable means of consuming the by-products of the arable land, by turning them into milk as an alternative to turning them into beef or mutton. This is the case where mixed farming is carried on and a market for milk is available. Under other circumstances milk production may be the sole objective of the farming, in which case the nature and quality of the produce most economically grown on the land will be the basis of feeding. This occurs in districts such as the Blackmore Vale or the Vale of the White Horse, where soil and situation combine to make cow-keeping the most productive means of using the land. In still a third group of cases where the object is to exploit some situational advantage, cows may be kept purely as milking machines and fed mainly or entirely on purchased foods, as in the Rossendale district of Lancashire. In each case, the limit to which it may pay to push the production of milk, to be sold at a given price, will turn upon the output which can be obtained from each successive unit of expenditure, and production should be carried no further than the point at which the outlay on an additional gallon becomes more than that gallon is worth. If the average unit price at which milk is sold were the same on all farms, the cost of the limiting or 'marginal' gallon would, theoretically, be the same, after making allowance for varying costs of marketing; but the margin of production would be reached at different levels of output under different conditions. The aggregate cost of each unit would

vary accordingly. Where arable by-products or cleaning crops are the basis of the feeding of the cows, it will pay to intensify the output of milk so long as each additional shilling spent in food, equipment and attention brings more than an extra shilling in return, without reference to the cost of the arable crops fed. Where the object is to exploit the land for the production of forage for cows, the limiting factors are the costs of home-produced food and the character of the cows best suited to the environment of the farm. In marketing the produce of the land as milk, the point at which it will cease to pay to increase the output of milk per acre will be reached much earlier on some soils than on others, and it may not be practicable to vary the number of cows so as to exploit the special advantages of high milking strains. On farms where the problem is to intensify the output of a given area in order to take advantage of its situation with reference to a market, and the land becomes a standing ground for as large a number of high-yielding cows as is consistent with convenience and the health of the stock, the limits to the output of milk are set by the capacity of the cows to give an economical return to the feeding of mainly purchased foods. In deciding the type of animal to keep the character of the available forage is important. It is not to be assumed that, for consuming a certain amount of grass or other forage, the number of cows can be maintained at a figure which would permit of all the forage being used to the maximum advantage in milk production. The proportions in which pasture grass, roots, hay or straw are available will rarely be ideal for maintaining, on a balanced ration, high milk-producing cows. The ratio of milking cows to young stock will vary according to circumstances. Building accommodation may be limited. Hence uniformity of feeding and management will not be attained in practice, and varying levels of output per cow and per acre will result. Milk production will often, indeed will usually, be adapted to make the best use of the produce available, rather than to get the maximum yield per cow. For the latter purpose cows would have to be treated as a kind of factory adjunct to general farming, in which it is merely necessary to find standing room for the animals and feed them for milk without reference to the produce of the land.

It has been suggested above that the 'marginal', and not the average, cost of milk per gallon would tend to equality if a uniform price were obtained for milk sold. But in fact the proportions in

which winter and summer milk are produced are not constant from farm to farm, and in consequence the average yearly price obtained will vary, in spite of nationally fixed winter and summer prices. Moreover, much milk is retailed by producers. It seems essential, therefore, that to establish any correlations between the intensity of output of milk and the profitableness of milk production groups of farms should be selected on which conditions are constant, and calculations made on the basis of those constants. Equal returns to labour and capital will only be attained by varying degrees of output on different soils and in different circumstances. The investigator in search of comparative costs must, moreover, avoid the large number of cases in which the farming system is an adaptation to a more or less complex mixture of soils, aspects, and elevations, such as is commonly found in areas where geological formations are changing.

The farmer's problem in milk production is a dual one: firstly, to ascertain whether cows are the best kind of stock to carry, and secondly, to decide what number and what type of cows will be most suitable under the circumstances. The answer to the second question will not always be the high yielder, because high-yielding cows need to be managed and fed with a view to high yields, and this may be inconsistent with their function in the farm economy. Moreover, high-yielding cows cost more to buy or to rear than poorer milkers, since their production involves careful selection and the weeding out of inefficient animals. Even if new systems of feeding may postpone the operation of diminishing returns to increments of outlay in feeding, a limiting factor arises in the costs of the stock. It is not necessarily to be expected that costs *per gallon* will prove to be lower with high-yielding cows than with poorer milkers, even where either type of cow could be used with equal convenience, because it may pay to produce a larger output at a lower margin of profit per gallon. Nor can any correlation between yield and profit *per cow* be anticipated where the conditions of production of milk are not uniform.

The important practical problem on which cost accounts can throw light for the milk-producing farmer seems to be, up to what limit, under the conditions prevailing on his farm, it pays to push intensification of output; and this limit will naturally vary from place to place. It is not the case that farming can alter its conditions of production, in a way that is possible in some factory

industries, simply by changing the number of units of output, and adding to the supply of raw material at uniform cost. The very essence of the farming problem in the use of stock lies in the fact that its raw material for feeding is produced under a state of diminishing returns from the land, and the tendency to diminishing returns acts with varying force on different soils and in different situations. For the investigator it seems to be important to assess the limits to which milk production can be intensified profitably under given conditions, and, if possible, to gauge what increase of output is likely to be induced by a given price change in the area covered by his investigation.

Process Costs more usefully compared than Product Costs.—If, then, comparisons of individual product costs, based on a uniform system of apportionments of the total costs, cannot be made usefully, it has now to be considered if an analysis of farming systems with reference to the part played by each element in the farm economy, as has been already suggested for the single farm, will provide a means whereby the conditions governing economical production in different areas, and under varying conditions can be stated and compared.

It has been emphasized that a crop may not function in the same way in the farm economy in all cases. Cereal crops, for example, may be the primary objects of cultivation for the sale of grain on arable farms; they may be grown for both grain and straw, as an adjunct to the grass-land, on dairy farms or in areas suitable for stock raising; they may occupy in intermediate cases a position of importance which may be either primary or secondary, according to the respective values of cereals and live-stock products, on farms where corn and sheep, or corn and cows, jointly share in the use and maintenance of the arable land. Similarly, live stock may function primarily as makers of manure for the upkeep of fertility, or they may be the chief productive agents on the farm, or again they may occupy an intermediate position as already suggested.

Whether the arable crops or the live stock tend to occupy the premier place in the farm economy will depend upon the natural conditions of the farm, its economic environment, and the price of the produce. The limits to arable cropping are primarily set by the costs of cultivation and by the yields that can be obtained.

But the sale of crops being by its nature exhaustive, limits are set to the exploitation of the soil in the production of selling-off crops by the need for resting the land and replenishing its stores of fertility. This will involve the use of part of the farm in growing crops which act as restoratives of fertility or as feeding crops for stock, and usually also some outlay of capital upon live stock. Moreover, weeds and fungoid and insect pests tend to increase if similar crops are grown too frequently upon the same land. Hence costs of a greater or less magnitude arise in counteracting these several tendencies to reduced yields—costs which may be grouped together under the term 'maintenance of fertility'.

Similarly, limits are set to the exploitation of land by stock. Considerations of outlay and yield also arise, but in this case a limiting factor may be a tendency for the land to become foul through overstocking, or for the herbage to deteriorate for want of rest. It is a common experience of poultry keepers that the land must be left free of stock and limed periodically, or even ploughed up in rotation, and the management of grassland to prevent deterioration of the herbage is of great importance in grazing areas. Land that is constantly folded by sheep is sometimes said to become 'sheep-sick'. The prevalence of disease amongst cows in town dairies contributed to the decay of this form of intensive stocking.

Where live stock are kept in conjunction with arable land, the root and forage crops grown in rotation with corn may be regarded in one of two ways: they may be looked upon either as a means of maintaining fertility by being consumed by the stock for the production of corn for sale, or as a means of providing food for stock as the primary objects of production. The emphasis which should be given to the one or the other aspect of the root crop will depend upon whether the returns to be obtained from the expenditure necessary to produce arable crops for sale on a larger proportion of the land are likely to be greater or less than the returns to be obtained by devoting a greater area of land to roots for stock feeding.

If, then, the costs of farming could be analysed so as to show where the balance of financial advantage lies in the cropping and stocking of the land, it would become possible to make comparisons between farms and farming systems in terms of the character and amount of the costs involved in maintaining their out-

put. On farms and under price conditions where the arable side of farming predominates, the costs of cultivation, and the costs of maintenance of fertility by different methods and having regard to the effects upon yields, could be the subject of comparative study. Under conditions which tend to place the greater emphasis upon live-stock products the relative advantage of grass and arable land would appear in terms of the costs of feeding and of the numbers of stock maintainable by the one means or the other. In intermediate cases the limits of prices and costs, within which the arable and live stock would tend to assume the greater economic importance, on varying soils and in different areas, might be measured. Moreover, the potentialities for economical production of the varying soil types, under the climatic conditions prevailing in different parts of the country, could be reviewed, and, if brought into relation with the areas of land over which similar conditions prevail, some estimate of the effects of price changes upon the output of products might be attempted. There will, however, in a country like our own in which a variety of geological, orographical, and climatic conditions exist, be a relatively large amount of land on which the farming is transitional in type between the systems prevailing in adjacent and more clearly defined areas. On such land generalizations will be difficult since the systems of farming practised will be adaptations to varying combinations of soils and situations.

It is proposed to consider the methods of approach to these problems, as they affect both the individual farmer and the investigator into the economics of agriculture, in the next chapter.

Summary of Chapter II.—The results of the discussion in this chapter are briefly as follows

Many comparisons of economic importance between farming systems, e.g. their gross and net outputs, profits and losses in relation to the size or type of farm, do not necessarily involve the use of cost accounts.

Labour and other costs of operations or processes can only be used satisfactorily for comparisons of efficiency of labour or of management where conditions are similar and other factors are under control. It is rarely possible to assume with safety in farming that results may not have been affected unequally by factors not under the control of the farmer.

The assumption is not justified that a uniform basis of apportionment of costs between two or more joint products, or between the initial and residual values of foods and manures under different farming systems, will give rise to costs of resultant products which are comparable with one another.

An analysis of costs with reference to the function of the stock or crops in the farm economy may afford more useful comparisons.

CHAPTER III

THE ANALYSIS OF THE FARM BUSINESS

THE discussion in the previous chapters has led to the conclusion that the avenue of approach to the analysis of the farm business is not the determination of the individual product cost. Objections to that method arose from the dependence of the industry in its various forms upon the physical environment in which it is carried on. This fundamental fact of agriculture has important consequences. Financial success turns upon the skill with which the advantages of soil, climate, and situation are exploited, and it is limited by their character and extent. The necessity for adaptation of the farming system to local conditions involves a mutual interdependence of crops and stock, which tends to restrict changes of practice within definite limits. The inevitable fluctuation in returns from season to season, combined with the equally inevitable lapse of time between seed-time and harvest, makes the business of farming one which must follow general tendencies in price change rather than attempt to adapt itself rapidly to temporary conditions. All these consequences operate with greater or less effect upon the policy of the farmer according to the extent to which his output turns upon natural, as distinguished from artificial, aids, but they remain the fundamental conditions of production over wide areas. As a result, the rent charge tends to be an element of very considerable importance in the total expenditure of the farm, and also one of which the amount is likely to vary with the ups and downs of agricultural prosperity.

It is important to realize that each farmer's problems are peculiar to his farm, or at any rate to his district, and also to remember that there are many things about a farm which are new and interesting to the investigator, but which are taken for granted by the farmer himself as part of the environment in which he moves. His interests are specific rather than general—whether some particular course of action is likely to pay better than his present practice; whether, for example, it will pay to increase his output of milk, or to apply a dressing of slag to his grass land, or to introduce sugar-beet into his rotation. His environment he takes for granted,

the general scheme of the farm is not in question. For the individual farmer the problems on which cost accounts can throw light are more limited than those which face the economist, since the former is engaged in dealing with one specific set of conditions, whilst the latter is concerned to state his results in comparative form. It will therefore be necessary to suggest that a comparative study of farming costs must be preceded by an analysis of the farming system, in order that the economist may see the problems through the eyes of the farmer, and state his results in a way which has a definite relationship to the practical problems of the industry.

It has been indicated that cost accounts should be directed to the computation and comparison of the costs of carrying out the functions necessarily involved in maintaining the land in a condition suitable for production, and in producing saleable products. In the case of the farmer seeking to make his activities more profitable, the practical questions may be simply to determine whether one method of carrying on the work of the farm is more economical in cost than another, or within what limits of price one possible alternative in production may be more profitable than another, or how far it may pay to increase the intensiveness of production by additional expenditure on labour, food, or manure. There is, all the time, the necessity for detecting and stopping leakages or waste in any direction. In effect, cost accounting is of value to the individual farmer chiefly as a means of checking waste, of *estimating the effects of change* within the system of farming of which the general results, on a certain price basis, are already familiar, and of comparing his achievements with his estimates. Changes of a radical kind must usually be tried on a small scale before results can be assessed. Cost accounts may be made to indicate the direction in which some modification of system is likely to be beneficial, and to provide the basis for forecasting changes in the outlays involved by extension here or curtailment there, but the full results must be worked out by a process of trial and error. Radical changes of practice, moreover, generally imply alterations of buildings, or the provision of new equipment or fencing, or even, for many purposes, an increase in the size of holding. Developments of such a kind are of interest to the agricultural economist, concerned to forecast the probable trend of agricultural change in response to broad underlying

causes; they interest, as practical ventures, only men of initiative and foresight, backed with ample capital or credit, who are willing and able to take speculative risks. They will, as a rule, only be made when farmers with experience of other areas introduce into a district a system of farming which has already been tried elsewhere. When the Scottish farmers settled on the Essex clays, and took to milk production on lands hitherto devoted to corn, they applied knowledge already acquired in Scotland to an area, the traditional farming of which had broken down owing to a rapid and considerable fall in corn prices. If the economist, by studying comparatively the results obtained by farmers practising various systems of organization in a similar physical environment, can establish the conditions for success, he may save the farmer much expensive experiment and risk of loss.

It will be convenient to divide the present chapter into two parts, the first dealing with problems of adjustment within the farming system, and the second with the analysis of the system itself. The first part will mainly concern the farmer in the practical day to day management of the farm. The second part will interest the farmer in times of stress, but it will be of more general interest to the economist seeking for comparisons between the conditions which underlie the success of systems of farming (*a*) in similar, and (*b*) in different, physical and economic environments.

PART I. ADJUSTMENTS WITHIN THE FARMING SYSTEM

The extraction of costs with a view to estimating the effects of gradual change, or of adapting existing facilities to serve new ends, is a much simpler matter than the allocation of all the expenses of the farm to one or other of the final products. Moreover, it is an objective which seems to offer to the farmer greater possibilities of usefulness, in that the solution of some practical problem is always in view. It is not claimed that anything better than reasonably good estimates of the effects of change can be secured. Any attempt at absolute precision would involve formulae containing a number of dependent and independent variables, for resolving which a high degree of mathematical skill would be required. The results would always be contingent upon the weather, the quality of work, and other indeterminate factors. But precision of a high order is neither practicable nor necessary for the purpose in view. A rougher instrument, so long as it is designed

on sound principles, will suffice to measure the outlays and returns of farming practice with as much accuracy as can be useful in an industry controlled largely by weather conditions. To forge that instrument is our immediate concern.

It will hardly be necessary to emphasize that an analysis of expenses and returns cannot be satisfactorily attempted unless it is based upon a careful system of records. The amount of detail required will depend upon the kind of farming, the size of farm, and the thoroughness of the farmer's personal control. But in any event, if anything more than isolated inquiries into particular questions, such as the costs of working machines of different kinds or the returns to different dressings of manures, are desired, the basis of the cost accounts must be complete records of receipts and expenditure from day to day. No analysis of the farm business can be made satisfactorily without at least a simple but efficient method of recording and tabulating the financial transactions of the farm. It would go beyond the scope of this book to lay down a system of farm accounting for the determination of profit or loss. That has already been done adequately, and methods are sufficiently clear from text-books, the publications of the Ministry of Agriculture, and from many well-conceived proprietary account books for farms.[1] All complete systems lead either to a 'Trading A/c.', in which the opening and closing valuations, purchases, expenses, sales, and other receipts are summarized so as to show the profit or loss for the year, or to a 'Profit and Loss A/c.', in which the results of the year's working are summarized in greater or less detail under a number of headings. The objective in cost accounting for the farmer is to get behind the general results of the year's work as revealed by the Trading or Profit and Loss A/c., in order to see where improvements might be made in organization, or in what directions development should be attempted, having regard to actual or anticipated changes in prices or in the economic environment of the farm.

It is convenient to visualize the farm as being an organic unit, having a general structure within which a number of productive processes are being simultaneously carried on. The maintenance of the structure involves certain annual costs which result rather from the system of farming than from the actual acreages under

[1] e.g. Taylor, *Farm and Estate Book-keeping*; and Ministry of Agriculture, *Miscellaneous Publication, No. 50.*

the separate crops, and in addition there are other expenses of which the amount and direction will be determined by the cropping and stocking of the year. The analogy between the farm and an organism suggests a classification of expenditure according to whether the outlays are of an overhead character connected with the system of farming as a whole, or are outlays depending upon the distribution of productive effort during the period under review, i.e. upon the acreage of crops grown, the numbers of stock carried, or the gallonage of milk produced. The former group of expenses may be termed 'overhead expenses', the latter may be termed 'prime costs'. It will be necessary to return to a discussion of this classification later.[1]

But the analogy between the farm and an organism, and the interlinked character of its processes, also suggest that successful working depends upon the efficient performance of certain functions. An animal requires provision for maintenance, and additional provision for work or production. It makes use of energy-producing foods of different kinds to provide for its manifold needs, and it grows, produces young, and gives out energy for work, or produce for sale, by a series of mutually linked physiological processes. Similarly a farm must be maintained in good heart or it will cease to be efficient for production; it must be provided with power in the form of manual, horse, or mechanical energy, acting separately or in combination, and aided by implements of various kinds; the expenditure of the farm provides for maintenance of fertility, and perhaps for some strengthening of its resources, and for producing saleable crops and stock. Just as no complete physical separation of the animal processes is possible, the joint character of many of the processes of farming is inevitable. The expenditure must provide for all the processes involved in carrying out the essential functions of maintenance and production on the farm.

But there are other factors making for success besides the creation of an efficient machine. It is of primary importance that the machine should be working to the right end, viz. for the production of saleable produce of high value relatively to the outlays involved. In other words, the farming system must be rightly conceived and well balanced in its several parts. Whether it is, or is not so, will appear in a general way from the total profit or loss arising over a

[1] Page 135.

series of years; but it is clear that a costings system, if efficient, should throw light upon the directions in which change is likely to improve the net returns of the farm, and should indicate the price limits within which one product should be favoured at the expense of any possible alternatives.

Finally, given efficiency in the organization of power, and a correct adjustment of farming type to the prevailing conditions, it may be that the degree of intensiveness of output is the critical problem, i.e. how far to increase costs with the object of increasing yields, say of milk or of grain, whether to speed up or to retard the business of fattening, and to find for the farm generally the point at which a halt must be cried to outlays in the improvement of output.

How then should these problems be approached with the aid of cost accounts? It would seem that each requires a method suited to the character of the question to be solved.

I. *The cost of power.*—The provision of power embraces manual labour, horse labour, tractors, and other machinery. There is firstly the question of the proportions in which each should be used; there is secondly the question whether the total cost of power is justified by the output obtained. On the smaller holdings and fruit farms the introduction of small motor units creates the possibility of replacing hand-digging and hoeing by mechanical tillage; on dairy farms the introduction of milking machines and hay sweeps for reducing the labour bill is a problem of current importance; on the larger arable holdings the use of bigger machines drawn by larger teams or by tractors has already revolutionized Colonial and American agriculture, and is thought to be a possible development in this country also, as a result of the demand for a higher standard of life for the agricultural workers. The initial cost of the power unit involves some investment of capital, and the determination of the working costs of power plant is always a matter of estimate for the first few years of use. Great precision in forecasting is not attainable, and it is generally to the savings of labour and the speeding up of operations that one looks for the immediate benefits of change.

(*a*) *Labour costs.*—Estimates of the time required to do a certain job, and of the time to be saved by the introduction of a machine, are most satisfactory if based upon records, and it is perhaps not an over-statement to say that entering up some kind of labour

record should be a normal part of the daily routine on the majority of farms.

UNIVERSITY OF READING

LABOUR SHEET. Week ending *November 12th*, 1926. Farm X

	NAME, *Cowman.*			NAME, *Carter.*		
DAY.	JOB. Stating stock or field and nature of operation.	LABOUR HOURS.	No. of Horses or Tractors.	JOB. Stating stock or field and nature of operation.	LABOUR HOURS.	No. of Horses or Tractors.
SAT.				Drill wheat on Potters Piece	8	3
SUN.						
MON.				Drill wheat on Potters Piece	8	3
TUES.				Carting farmyard manure for potatoes — Peas Furlong	8	3
WED.				Carting farmyard manure for potatoes — Peas Furlong	8	3
THURS.				Fetch two loads cake from Station	8	2
FRI.	Summary for week: Dairy Cows Young cattle	 45 15		Carting farmyard manure for potatoes — Peas Furlong Stable time for week	8 10	3
	TOTAL HOURS	60		TOTAL HOURS	58	

CASH PAYMENTS (before deducting Insurance)	1	17	6	CASH PAYMENTS (before deducting Insurance)	1	13	8
INSURANCE (Employers' Contribution)			9	INSURANCE (Employers' Contribution)			9
ALLOWANCES				ALLOWANCES (Cottage)		3	0
TOTAL	1	18	3	TOTAL	1	17	5

Seeds, Manures, &c., applied or used; produce carried or threshed.

Description.	Quantity.	Field.	Acreage.
Sowed Yeoman Wheat (Bought) @ 60/- p. qr. . .	50 bush.	Potters Piece	20
Carted dung for potatoes	117 loads	Peas Furlong	8
Received Dec. Cotton Cake	4 tons		

No stereotyped form of labour sheet is, however, necessary. On small farms where only two or three men are employed the farm diary may well be used for making the entries of work done from

day to day. Where men are wholly employed on one kind of work, e.g. in attending to the dairy stock, daily entries are unnecessary, and detailed records of time on jobs such as milking, separating, &c., are only required when the introduction of some labour-saving device or new process is under consideration. It then becomes important to know what the effect would be upon the time worked by the men. For recording the work of the horsemen and labourers, whose duties are varied from day to day, a form such as is reproduced on page 85 is found to be convenient, though there are many equally useful rulings for the purpose.

The entering of work done takes up some little time each day. On some farms the labourers themselves fill up their daily work-sheets, but more frequently the farmer or the foreman makes the entries. But of the usefulness of such records there can be no doubt, and, generally speaking, the larger the farm the more valuable do the entries become as a means of keeping the work of the farm under review. Their value is not solely, nor indeed mainly, for the purpose of apportioning labour costs among the various products obtained. As records of the dates of operations, of the time taken on the different jobs, of the seasonal fluctuations in hours of work, of the cost and incidence of casual work, and of the time devoted to jobs of an 'overhead' character, they are invaluable. They provide a basis for the fixing of piece-work rates in suitable cases, and permit of a close scrutiny of labour organization. It is for many purposes desirable that when the farmer, or bailiff, or some unpaid member of the farmer's household, carries out work which is not of a purely managerial or supervisory character, it should be recorded in the same way as ordinary paid labour. Whatever may be the method of treating such labour in the financial accounts, it is clear that the time must be brought into account when comparative or operation costs are concerned, or the labour requirements of the farm are under review.

The clerical work in apportioning the labour costs in terms of money, and distributing them in the books of account, is one of the chief hindrances to the adoption of cost accounting by the farmer. For many practical purposes a complete allocation of the labour cost is unnecessary. So long as time-work and piece-work records are complete, the labour on any particular job can easily be picked out and a money cost attached to it according to the workers' rates of pay and perquisites. No greater accuracy is

obtained by meticulous care in dividing up the total wages, since the original records are often only reasonably correct, and on field work the time actually taken in any year may not be representative on account of abnormal weather conditions. Moreover, the labour cost must be considered in relation to the seasonal distribution of the farm work, the alternative work available for the men to do, and its regular or casual nature.

The introduction of labour-saving machinery is only an economy if it makes for an effective saving of outlays or permits of more work being done by a given staff. It is that fact, combined with the capital cost and the appendant charges for interest and depreciation, which militates against the adoption of machinery and power plant on the smaller farms where there are only a small number of jobs over which to spread the cost. The widespread adoption of new methods often connotes the throwing together of holdings into units of larger size. The estimation of the effect of the introduction of labour-saving power or machinery on a farm upon the costs of the processes to be carried out is a fairly simple matter, provided that labour records have been kept and the working life of the machine can be determined with reasonable accuracy. But the effect upon the profit of the farm is much less certain: that will depend, not only upon the direct savings in costs of the processes to be performed by mechanical power, but also upon whether the labour displaced can be dispensed with or put on to other equally productive work, and again upon the value, in terms of saleable produce, of speeding up the work of the farm. A working farmer, contemplating the introduction of a milking machine, wisely deferred his decision until plans for coping with work at hay harvest could be tested. Where the minimum number of hands is determined, in the absence of casual labour, by the needs of the busy season, the problem may be to find an outlet for surplus time rather than to economize labour in the daily routine.

It is only in cases where there is reason to think that the balance of the farming is seriously wrong, or needs to be adjusted to meet changed price conditions, that an apportionment of the total labour costs may be necessary. If the disease is serious more complete steps to diagnose it may be required. The method of procedure in such cases is the subject of inquiry in Part II of this chapter.

It would go beyond the scope of this book to enter upon a discussion of such questions as the relationship between the rate of pay and the cost of work, usually referred to under the phrase 'the economy of high wages'. But it is frequently the hope of those who enter upon the keeping of agricultural cost accounts that the figures of labour cost will be available to prove or disprove the economic possibility of an advance in the rate of wages. Some warning seems to be necessary in this connexion. Cost accounts simply reveal what has happened in the past, or is happening to-day, on the basis of the rates that have been, or are being, paid, and using the personnel available to the industry at those rates. Merely to substitute higher rates, and to calculate the increased cost of work on the basis of the same equipment and the same workers, may be valid enough for very short period computations, but the indirect effects of wage change in the long run are of greater importance. Such are the stimulus to the use of more machinery, and the tendency for better men to offer themselves for employment in the industry at higher rates of pay. A long view must be taken in discussing questions of this character, and the immediate effect of wage change upon the farmer's problems, though important and often difficult to meet, cannot always be the deciding factor.

The Cost of horse labour.—Horses are still the most generally used means for providing motive power on farms. The cost of their work involves the costs of maintaining the horses themselves and their equipment, the manual labour employed in working the horses, and the depreciation and upkeep of the horse implements. The costs of horse maintenance include some expenses which are easily measured, such as outlays for shoeing, harness repairs, veterinary charges, purchased food, and the labour in attending to the horses and their equipment. In addition there are expenses which are not measurable with precision, but which are the subject of estimates, viz. depreciation of the animals and of harness, and the costs of home-grown foods and grazing. The expenses represented by cash payments present no difficulty, they should appear in the cash records, but care is required to see that no outstanding tradesmen's bills are overlooked. The labour in attending to the horses and in harness cleaning is readily computed from the time-sheets or diary, or estimated with reasonable accuracy from the farmer's knowledge of the average time spent on stable work.

The depreciation of the horses is arrived at by comparing their value at the beginning of the year plus the cost of any horses bought, with the closing valuation and the amount realized on any sales during the year. For this purpose any purely dealing transactions should be left out of account, but if the horse policy involves breeding, or the buying in of young animals for working in anticipation of subsequent sale at an enhanced value, it is desirable to bring any transactions arising as a result of such policy into account, together with the feeding costs also incurred. The basis of valuation of the horses for determining the costs of horse labour should be the purchase price reduced by a suitable allowance for depreciation. Where the horses are maintained by breeding, it is convenient to value the home-bred animals at a figure which represents their estimated purchase price when broken in, and the younger animals at some standard values according to their age. The values attached to home-reared animals are admittedly approximations, but they will not greatly influence the cost of horse labour, since only a small proportion of the initial value is allowed for depreciation in each subsequent year.

The amount to charge for home-grown oats, forage, and grazing requires some consideration. It must be borne in mind that the problem is to measure the effective cost of horse-work as a part of the total costs of power, and as a possible alternative to power in some other form. It is a material point that, except where horses are bred merely for sale, they are really part of the equipment of the farm, and as such they absorb a certain acreage of land that would otherwise be available for producing saleable goods. Viewed in this light any saleable oats or forage consumed by the horses reduces the quantity for disposal, and the *effective cost* to the farmer of such food consumed is measured more accurately by its selling value than by its computed cost of production. Even the selling value of the consumable produce withdrawn from sale may not be the full measure of the loss of potential income due to growing crops specifically as horse food. There is always the possibility that the land might be used more profitably. If the oat land could produce a crop of wheat, potatoes, or sugar-beet consistently with the general convenience of the farm, or if the hay or grass could be used profitably in maintaining additional dairy cows, then neither the 'cost of production', if ascertainable, nor even the selling price of the produce consumed, completely reveals

the real cost of horse keep to the farmer. For this reason it is suggested that in computing the total cost of maintaining horses as a source of power, the charge for home-grown forage and grazing should be determined according to circumstances in each case. Where the land devoted to growing forage could conveniently be put to some other more productive use, the charge for horse forage might properly be not less than the cost at which such food and keep could be obtained by purchase or hire respectively. If it is regarded as sold to the horses, the uneconomical character of its production on the farm would appear in comparison with the returns obtained from other alternative crops or stock, and the use of the land could be considered on its merits without reference to the needs of the horses. On the other hand, on farms on which oats are taken chiefly for rotational convenience, and might be considered to be expensive if charged even with all the costs directly incurred in growing the crop, the horses ought not to be charged with more than the crop could have been bought for, as otherwise they are being penalized by the needs of the rotation practised on the farm. Again, where the grazing land occupied by horses would have little or no value for any other purposes, or the horses utilize the grazing residues of other stock, a nominal charge would suffice. Apart from the impossibility of determining the costs of forage with precision, the reasonableness of proceeding upon such lines will appear when the introduction of a tractor, as an alternative to one or more horses, is under consideration. The freeing of the land occupied by the displaced horses renders it available for other purposes, and its produce can be sold. The measure of the saving of horse costs is not the cost of the crops previously utilized, but their selling value, or the additional net return to be obtained from the land when put to other productive uses.

It may, however, be urged that the current market value of forage is no criterion of what that value would be if all the forage consumed were placed on the market.[1] It is perhaps fair to reply that the number of farmers who would be likely to find themselves in a position to dispense with horses at any given time would be very limited, and if only a small replacement is possible then current values of forage, less marketing costs, may reasonably be used. Possibly there would be less objection to using the 'Farm

[1] Orwin, *Farming Costs*, pp. 43–5.

Values' published monthly by the Ministry of Agriculture, which are based upon the market prices of equivalent food in other forms, and which would not be greatly affected by changes in the amount of any one product offered for sale.

There is, therefore, when the economy of horses as an alternative to some other form of power is the issue, no need to attempt the solution of the problem of eliminating the cost of grazing or of home-grown horse forage from the other costs of the farm. The replacement cost of home-grown foods, added to the other outlays on the horses for purchased foods, attention, harness, &c., becomes a reasonably close basis for measuring the savings to be effected by a reduction in horse strength.

The labour sheets already referred to make provision for recording the hours worked by horses or tractors in association with manual work. There is much to commend the recording of horse-work from day to day. It is an advantage to be able to scrutinize the seasonal requirements of the several crops and enterprises within the farm for horse-work, and it is almost essential to be able to do so if the effects of replacement of horses are to be determined with accuracy. The small amount of time taken to extract, from the labour sheets or diary, the total work done week by week by the horses will be well spent if it serves to remind the farmer of the incidence of slack and busy seasons, or suggests to his mind economies in the organization of horse labour. Many records of this kind have been analysed, and it is found that the average working week per horse on some farms is as low as fifteen to twenty hours, on others an average of thirty-five to forty hours is achieved. Some of the reasons for these differences have already been discussed, but if it should happen, as is frequently the case, that in only two or three weeks during the year the horses are worked at full strength, it may be well worth while to endeavour to find additional work for them to do, even if no very great return can be expected. The small farmer often meets the problem by doing cartage work when the horses are not required on the land. The larger farmer carefully arranges his manure carting to be done at slack times, or economizes horse labour at hay and corn harvest by stacking and threshing on the fields, and carting the hay and straw in more leisured times. In this connexion the effect of horse-labour costs upon the financial results of growing some new crop, such as sugar-beet, may be instanced. If that crop can take the

place of a fallow, or serve to spread the costs of horse maintenance over a larger number of hours, it may be that no real addition to total expenditure arises.

So far it has not been found necessary to suggest the calculation of the cost per hour of horse-work, nor the apportionment of horse costs among the jobs carried out. It will be suggested later that such calculations are not without value for comparative purposes, but for the farmer seeking to estimate the relative economic advantages of alternative kinds of motive power, or of the addition, say, of a tractor to his present strength, the main consideration is simply what saving is possible in getting the work done, or what extra cost is involved.

It remains only to add that the economy of the working horses is not determined solely by the total costs of horse maintenance. Their work is performed in association with manual labour and the use of machinery. If an extra horse will permit of using double-furrow ploughs with a three-horse team, which can plough an acre in say 5–6 hours, instead of a single-furrow plough with a pair-horse team which may take 7–7½ hours per acre on similar land, the saving in manual labour should be set off against the extra cost of horse maintenance. For making any real comparisons of the costs of work it would seem to be necessary to add together the costs of power of all kinds, and compare the total with the total output of work obtained.

(*c*) *Mechanical power.*—In modern times the tractor, motor-lorry, and steam cultivator are seriously challenging the universality of the farm horse, and where the scale of cultivation or production is sufficiently large to justify the use of mechanical power, it may be of some importance to be able to compare the relative economy of the alternatives available. It has already been pointed out, however, that what finally settles the question is the general improvement of working rather than the cost of the actual operations performed. A tractor, by speeding up the work on the land, may promote the general efficiency of cultivation. Moreover, it is convenient for many purposes—for cultivation, for pulping and grinding food for stock, for driving a thresher or chopper. The costs in the aggregate of running the tractor are more important than the separate costs of the jobs performed, and the total outlay must be weighed against the value of the convenience obtained.

It is, indeed, frequently the case than no very exact comparisons in detail between costs of motive power, or of the use of implements of various kinds, can be made. There are some machines, the cost of which is high, and the use of which on any but large farms will be insufficient to make their purchase worth while. This applies to threshing sets and steam ploughing and cultivation sets. The use of such plant is more often hired from contractors. It may cost a farmer, say, 25*s*. per acre, in addition to coal, to hire a steam plough with the men to work it, whereas he may, with the use of horses, be able to do the work more slowly at a lower out-of-pocket expense at the time. But if the work could not be done quickly enough with the horses available, 25*s*. per acre may be a very low rate to pay for the convenience, the high cost being some compensation for speed of work.

The accuracy of the computation of the cost of running a tractor or other prime mover is always conditioned by some estimate of working life and average cost of upkeep. The running expenses for fuel and oil, taxes, and the time of the man engaged in working it are ascertainable from the cash and labour records. But repair bills are incurred at irregular intervals and are of unequal amount, and since repairs and depreciation tend to be large relatively to other running costs, an estimate based on some years of experience is often the best that can be attained. That fact should not, however, be allowed to excuse any failure to scrutinize the running expenses with care. Comparisons of the amount of petrol and paraffin consumed from time to time will frequently reveal unexpected waste or need for repairs. It is, indeed, in matters of detail that cost accounts can often save money. Simple records of the petrol used per mile in running a delivery lorry led, in one instance, to the detection of abuse within a few weeks of commencing to note down the issues of petrol and the mileage covered, and the mileage quickly rose from eight to nearly eighteen per gallon.

(*d*) *Implements.*—The cost of use of implements of various kinds cannot be dissociated from the labour or power which their use involves. The comparative labour cost of doing a job with one machine or another is arrived at by observation, but the time saved by an implement is not the final test of its economic efficiency. The factor which militates most frequently against the adoption of labour-saving appliances is the limitation to the amount of their use set by the size and character of the farm. This

is reflected in the cost of use of capital and depreciation of value. The cost of repairs should be averaged over a period of years, since the repair bill will not usually be incurred during the year in which the wear occurs. The simplest way of expressing the cost of use of capital is to make some allowance for interest on the amount invested. There is no objection to this course for the purpose of computing the comparative costs of doing work with various implements, although the charge would be invalid in accounts for determining the profit of the farm as a whole. An inventory of implements of the kind advocated by Mr. C. S. Orwin[1] is convenient, implements being grouped according to the purpose for which they are used, and space provided for the value assigned from year to year. New implements can be added and those discarded or sold struck out. The rates allowed for depreciation should be those suggested by the farmer's experience, the schedule agreed upon between the National Farmers' Union and the Inland Revenue Authorities being used as a guide. It is generally the rule to charge repairs as an expense for the year without making additions to the value of the implements repaired. It may often happen, however, that a cart, tractor, or binder, overhauled at considerable expense, and standing already at a low value in the accounts, could safely be revalued and part of the cost of renewals capitalized. The list should, indeed, be scrutinized from year to year, and depreciation allowances revised as may seem reasonable from time to time.

To sum up briefly as to the costs of power, it has been shown that the costs of work carried out by labour, by horses, and by machinery are all closely related, and in some degree mutually dependent; that a certain minimum number of units of each may be required if the farm is to be worked at all, and that these units, being incapable of subdivision, cannot be adjusted very closely to the needs of the farm. The small farm suffers most in this respect. To make full use of the essential labour may not be consistent with using machinery to the fullest advantage. In effect, it is with the *total* cost of power that the farmer must be finally concerned. For computing that cost the ordinary financial accounts and inventories provide the greater part of the information required: the cost of labour, including perquisites, is easily determined from the cash records; the outlays on horses and horse

[1] *Farming Costs*, pp. 20–1.

equipment are found from the same source, home-grown forage can be assessed for this purpose at replacement cost, and depreciation can be estimated from the annual inventories; the running expenses and depreciation of tractors and implements are similarly ascertained. The aggregate cost of power is of considerable importance. The problem is then to scrutinize its components for leakages and waste, and to compare the effects of adjustment in one way or another upon the total cost and upon the output of the farm. Such comparisons may not be made with close precision, and it will frequently be realized that the limitation to the fullest economy of power lies in the size of the holding or of some enterprise within the farm. Whilst the solution of such difficulties may not be obvious, it must clearly be helpful and suggestive of the directions in which economy is to be sought, if some quantitative measure of the work performed and of the costs involved is available. The case of one farmer may be instanced whose dairy farm of 300 acres, entirely grass, lies on clay lands adjacent to a geological formation which gives rise to good arable soils. By acquiring some arable fields within a mile of his farm he has been able to add about one hundred acres to the area farmed with a very small addition to his labour force.

Such, in practice, are among the uses of the study of the costs and distribution of power on the farm. To the economist seeking information of general interest to the industry, the labour force, horse strength, and equipment of farms of the same type but of different sizes are, severally, incomplete indications of the economy of working; all these elements must be brought together and the aggregate outlays brought into relationship with the size and output of the farm. In establishing correlations of this kind the capital outlay in horses and equipment clearly cannot be ignored, and whilst an interest charge is an imperfect measure, some allowance for interest should be brought into account as representing the annual cost of the use of capital.

But experience of farm workings suggests a warning. The annual cost of power on arable farms may show somewhat considerable variations without any real changes occurring in the costs of work. This arises because processes may be in a more forward state in one year than in another. If casual or contract labour happens to be employed for the work in question, e.g. threshing, and the ricks are threshed in April in one year and in

March in the following year, the effect in raising the total costs of manual labour and machine use for the year ending on Lady Day may be quite considerable. Or again, the labour cost may fall because of a decrease in the acreage under potatoes or carrots, which require a good deal of casual labour. The total cost of work must always be considered in relation to the amount of work done.

II. *The prevention of waste.*—Failure in any direction to make the fullest possible use of land, power, and equipment gives rise to waste, but losses of a more direct and easily controlled kind are all too common. Account books for entering purchases and sales should invariably leave room for the *quantities* as well as the values of raw material purchased and of produce obtained and sold. Farmers will generally find it of advantage to compare from time to time the quantities of foods bought with the quantities used, in order to check waste. Similarly, home-produced grain kept for feeding should be weighed at threshing and its disposal recorded. It is frequently a matter of surprise to find, on otherwise well-managed farms, how much home-grown and purchased food, in excess of the rations laid down, has disappeared. No suggestion of dishonesty is implied in this statement; it is merely that unweighed rations and want of responsible supervision may throw out of gear the best schemes of economical rationing, and result in an excessive consumption of forage. Where foods are bought for specific classes of stock, so that the whole cost is chargeable to cattle, sheep, or pigs, the check should not be neglected. But it becomes even more essential for accurate costing to record issues of food when several classes of stock draw from the same supplies. A simple memorandum book, kept in the barn or in the foreman's pocket, for recording, in quantities, purchases, threshings, and issues, giving a page to each class of food-stuffs, is all that is necessary, and a check by taking stock at regular intervals will quickly put a stop to irregularities.

III. *Modifications of cropping and stocking.*—The limitations of change lie in the fact that, in a well-balanced system of farming, each crop or process to which power and other expenditure is applied is playing some part, performing some function, in the farm economy, and that whatever change of method or of

emphasis is proposed, the performance of that function with equal or greater efficiency must be provided for. Some consideration of the functional part played by stock and crops should therefore precede an attempt to analyse the costs of working. As one passes from land more suited for arable cultivation to land less suited for that purpose, the problems of the farmer on which cost accounts can throw light change in character.

(*a*) *The costs of arable cultivation.*—In the arable districts where corn or potato-growing predominates, the farm workings will include, not only the immediate operations incidental to the growth of the several crops for sale, but also some organization for keeping up the productive capacity of the land. The practical problem here is to maximize the acreage under saleable crops, and to minimize the area under crops grown to clean the land and to provide forage for stock. Conditions being generally unsuited to luxuriant vegetable growth, the yields of forage crops per unit of outlay will be lower, and the costs of feeding live stock on pasture and home-grown hay and roots will be higher, than in moister areas. The use of live stock for converting straw into manure, with the aid of purchased concentrates, may be expected to result in higher costs per lb. of live-weight gain, or per gallon of milk, than would arise in areas more suited to the growth of forage. Except where favoured by a local market, or by the proximity of some source of cheap industrial by-products for feeding, the returns from sales of live-stock produce are likely to be relatively unfavourable at prices influenced by cheaper conditions of production in other areas. Hence the use of cattle or sheep in arable areas may involve some cost to the farm for the provision and distribution of manure. The scrutiny of that cost is a matter of immediate concern to the farmer. In some cases it is of critical importance in farm management. The market-garden holding provides the case in which *all* the elements of fertility may be purchased in the form of stable manure, shoddy, and other organic, as well as chemical, fertilizers: here the cropping may be arranged solely with reference to the requirements of the saleable crops, and a good deal of flexibility in organization is possible. But on most arable farms the upkeep of fertility involves a live-stock policy, which must be dovetailed into the system of arable cropping. There are some exceptions, as for instance, where land is about to

become absorbed for building purposes, but they are not of great importance. The effect of arable farming, if the maintenance of the fertility of the land is neglected, is well known to be a progressive deterioration of the productive powers of the soil. In modern times the derelict farms that marked the gradual extension of settlers westward in the United States of America offered a striking example, and in our own country the Agricultural Holdings Acts provide safeguards against the abuse of unrestricted freedom of cropping. There are cases in which arable cultivation has been maintained for a considerable period without live stock, by the use of artificial manures. The conditions necessary for the continuance of such a system are of interest, but at the present time examples of long standing are rare. If, however, live stock may under any circumstances be eliminated from the arable farm, the accounting problem merely becomes simpler, since the costs of maintenance of fertility can be directly determined in terms of outlays on purchased manures. How, then, should the examination of the costs of maintenance of fertility proceed?

The costs of maintaining fertility.—It may be helpful to state briefly the physical conditions which underlie the process. Farming is a cycle of withdrawals from the soil and replacements of the elements withdrawn. Each crop or animal product sold carries away some of the nitrogen, phosphates and potash which are essential to vegetable growth; these elements must be replaced. Some part of the restoration of the nitrogen takes place spontaneously by the action of soil organisms in association with certain plants, which have the power of fixing nitrogen from the air and rendering it available as plant food.[1] In particular this process is associated with the growth of clover and other leguminous crops, but additional supplies of fertilizer are provided in the excreta of animals fed on purchased foods, or by direct applications of dressings of artificial manures. Again, in cultivated soil a continuous process of oxidation of organic matter goes on. It is replaced by the conversion of straw and hay into manure through the agency of the live stock. Even before cakes and other imported foods were available, or the fertilizing value of leguminous plants was understood, the arable land was left fallow to recuperate after its two cereal crops, cattle and sheep were folded on the stubbles, on the

[1] Russell, *Soil Conditions*, p. 184.

weeds of the fallow land and on the unploughed balks of the arable fields. It was one of the customary duties of feudal tenants to let their sheep lie on the lord's land for its improvement.

Historically, the functions of 'resting' the land and the maintenance of fertility of land in arable cultivation are associated with the uncropped fallow and the use of cattle and sheep. The introduction of root crops and drill husbandry linked these two functions with the cleaning of the land. The root crop enables a proportion of the land, which would otherwise be fallowed, to provide forage for the live stock during the winter months. The clover, usually sown in a cereal crop which acts as a 'nurse' crop, assists in replenishing the supply of nitrogen by leaving its nitrogen-charged residues in the soil, and at the same time it provides additional bulky food for consumption by live stock.

Thus, in relation to arable farming, the live stock, together with the root-crop, the hay and the grass-land required for grazing, are jointly involved in the function of the maintenance of fertility and the cleaning of the land. Some expenditure of a more direct kind may be incurred in addition, e.g. weeding operations in the arable crops, or applications of lime in aid of the general productive condition of the land.

With the development of 'high farming', the tendency has been to increase the productiveness of both land and stock by introducing artificial manures and purchased foods, but that fact does not alter the character of the fundamental connexion between the live stock and the arable land. If dung cannot be purchased, the farmer, for a given acreage of land under saleable crops, must provide for the conversion of a minimum quantity of straw into manure, or feed some of the crops to live stock on the fields where they grow. Often both processes are necessary. The nature and minimum quantity of the manure will be determined by the kind of soil and by the character of the crops grown. Some soils are sharp and hungry, and they permit of rapid oxidation of the organic matter they contain. Other soils are more retentive, and they conserve the organic matter applied for a longer period. As regards the crops grown, experience will have indicated the minimum needs of each crop for dressings of farmyard manure to ensure the best yields. Thus a given acreage under corn or potatoes, under the conditions prevailing on the farm, will connote the production of a certain number of tons of dung. This fact may

well set a lower limit on any farm to the number of live stock of a kind suitable for the conversion of straw into manure, or an upper limit to the acreage of dung-requiring crops, e.g. potatoes, the farm can carry.

On the lighter soils, and in some situations, e.g. where gradients, distance from the homestead, or the 'hungry' character of the land render the application of the available farmyard manure either too expensive or insufficient, a proportion of the root and forage crops will be consumed by sheep folded on the crops. The minimum number of sheep, and the frequency with which it is necessary for them to pass over the land, are again determined by the character of the soil. Thus an upper limit may be set to the proportion of cereal crops to forage crops in a normal season. The upper limit to the number of sheep—apart from considerations connected with the provision of the capital required—may be set by the risk that the land may become unhealthy for stock if sheep are too closely or too frequently folded, and by the liability of the root crops to disease if grown too frequently in the rotation on the same fields.

These examples illustrate the principle of 'balance' in farming systems. The scales may be weighted a little more on one side or on the other, and, within the limits imposed upon him by the inherent character of the farm, the farmer has some choice in his alternatives. But if he passes the physical limits, either on the side of saleable crops or on the side of live stock, the economy of the farm is distorted and waste occurs; waste due either to loss of productive capacity by failure to maintain fertility, or to the accumulation of materials which, in one way or another, inhibit the processes of growth. These limits may be pushed back by advances in knowledge and in technique, but at any given time they constitute the boundaries which cannot be passed without sacrifice of productive capacity.

Where there is no question of exploiting live stock by the sacrifice of saleable crops, the problem may be simply how to maintain fertility with the minimum of expense. The aggregate costs of the process, if they could be separated with any precision from the costs incidental to the production of the saleable crops, would include the outlays on the cleaning crops or fallows and on the rotation grass, together with all other expenditure on the stock used in consuming these crops and in trampling or consum-

ing the straw, less the amount realized for live-stock products sold and for any surplus of saleable roots or seeds hay. But, under the conditions prescribed, the farmer is fortunately spared the necessity for computing the costs of the cleaning crops and straw at all. The acreage of unsaleable produce will usually be minimized in any event, a considerable proportion even of the seeds hay may be sold, and the point at issue may simply be how to convert straw and roots into fertilizing manure in the cheapest possible way. In such cases the 'cost' of the straw or roots hardly enters into the question, since the expenses to which they give rise must be met in any case as part of the total arable costs. If the alternatives be fattening bullocks or growing stores, the cost of buying in the required numbers of animals, the cost of purchased foods, and the selling value of the wintered stock in each case will be the main items to bring into account. If different amounts of saleable hay are used by the two classes of stock, the differences of income from that source should be reckoned, and any variation in labour costs too might have to be considered, though this would probably be comparatively small. A somewhat important consideration, however, is the number of animals necessary. Lightly-fed stores produce much less available nitrogen in their excreta than heavily-fed bullocks, and, if yard-room is limited, the method of feeding which will give rise to excreted nitrogen compounds, in quantities sufficient for promoting the decomposition of the straw used as litter, may have to be adopted. Where there are no such limitations of space the relative selling values of store and fat stock will often be the deciding factor.

An example of a calculation of this kind, made in 1909–12, is given by Professor T. B. Wood in *Agricultural Progress*, vol. i, 1924, at p. 31, from which the following figures have been extracted:

Financial results of 20 weeks feeding:

High-cake lot—6lb. cake or meal per day.

11 steers sold for £23	9	0 =	£257	19	0
Cost at £14	12	0 =	160	12	0
Gross return			97	7	0

Low-cake lot—1 lb. cake per day.

11 steers sold for £20	5	0 =	222	15	0
Cost at £14	15	0 =	162	5	0
Gross return			60	10	0

Cost of extra cake in high ration, allowing for smaller quantity of roots consumed	£47	17	0
(Oat straw, hay chaff with roots fed ad lib.)			
Gross return of high-cake lot above low-cake lot . .	36	17	0
Balance against high-cake lot	11	0	0

The dung from each lot was applied in large plots side by side. The high-cake dung plot produced in the next three years seventeen tons of mangolds and four bushels of barley more than the low-cake plot, which at 1912 prices were estimated to be worth £7.

The introduction of sugar-beet provides a case of current importance and also one in which the crop may, or may not, influence the costs of maintaining the live stock. If beet is substituted for mangolds sold off the farm, the relative cash advantages of the two crops are measured by the differences in outlays compared with the differences in net selling values. Both crops permit of similar cleaning operations being carried out. Some advantage may be claimed for beet in the function of maintenance of fertility if the tops and leaves ploughed in are of higher fertilizing value than the leaves of mangolds, but it is difficult to put a precise money value on this advantage. The differences in outlays are mostly of a direct character—in costs of labour, fertilizer, seed, cartage and carriage; many of the jobs on both crops are done by piece-work, and simple cash and labour records provide most of the information required. If beet is substituted for mangolds or other root crop grown for feeding to stock, the cash advantage of the beet crop must be set off against the cost of replacing the mangolds as forage.

An example from a Lincolnshire Fen farm may be quoted. Twenty-two beasts were wintered in 1924–5, of which 12 were grazed during the previous summer. All were sold during April–May 1925. The purchase price of the 12 bought in the spring of 1924 was £284, and of the 10 bought in October £260—total £544. Purchased cake cost £245, and the animals realized on sale £734. Thus the stock failed to pay for the purchased concentrates by £55. In addition they consumed 11 acres grazing, 18½ acres hay and 9 acres mangolds. If the labour, horse-work and other direct expenses on the home-grown crops consumed are brought into account, the deficit on the stock was approximately £285, which represented the expenditure incurred in the process of maintaining fertility by means of bullocks. During the following summer 20 beasts were grazed, and the number was increased to 32 for wintering in 1925–6, all being sold in April–May 1926. The 1925–6 bullocks cost £461 and £270—total £731 for 32 head. This time cake costing £267 and 6¼ tons of beet pulp costing £34 were purchased, 16 acres of grazing, 18 acres of hay and 5¾ acres mangolds being consumed. The 32

animals realized £973, the cash deficit being £59, and the aggregate deficit, if out-of-pocket costs on the home-grown food be added, amounted to £288, which is approximately the same as in the previous year. However, the introduction of 4¼ acres of beet, in place of mangolds, altered the position considerably. Most of the work on lifting, topping and loading was done by piece-work, and the records show a surplus of returns over direct expenses on the crop of £9 3*s.* 5*d.* per acre, i.e. £38 19*s.* 6*d.* Moreover, the crop left its tops and leaves for ploughing in to replace the mangold leaves. The crop, on 4¼ acres, thus contributed nearly £40 towards aggregate costs incurred in the maintenance of fertility, and a further replacement of mangolds is being made. The aggregate cost of fertility maintained by bullocks is still considerable, and the conversion of straw into manure by artificial means has been tried. The water-supply was, however, insufficient for the successful treatment of more than a proportion of the straw.

Should the growing of beet and the ploughing in of the tops make it possible to dispense with a number of animals as manure makers, the advantage of doing so would depend upon the outlays and returns in connexion with the stock. If beet is substituted for corn the land is left cleaner, and more forage but less straw is available: on some soils where sheep can consume the leaves and tops and where the disposal of straw presents some difficulty, e.g. upon the chalk farms in some areas of the south of England, the crop may operate both to improve the returns from the arable and cheapen the feeding costs of the live stock; but where straw is needed for litter or forage any cash advantage on growing beet would be offset by the cost of replacement of the straw.

It will be clear that no mere comparison of outlays with the selling value of the beet gives any real measure of the profits of growing the crop. Those profits are not absolute, they are relative to profits obtainable by some other method of using the land. The crop must be regarded as a means of carrying out some essential function on the farm more or less economically than some alternative means, and be judged accordingly.

There will often be no possibility of substituting sheep for cattle as fertilizing agents on arable land. Sheep are not suitable for the conversion of straw, they are usually penned on the root crops, and can only be used where their treading would not damage the texture of the soil for further cultivation. Consequently their use is determined primarily by the conditions prevailing on the farm. Where sheep act as 'manure barrows', and the choice lies between one class of sheep and another for consuming the same acreage of roots or grazing seeds, the costs of these

crops, being common to both, need not enter into comparisons of advantage. It is only when one live-stock policy may involve growing more forage than another that it becomes necessary to bring into account the costs of that forage. This leads to a consideration of cases where dairy cows, or a breeding flock of sheep, are kept in association with arable land, and where the stock may sometimes bring returns of sufficient importance to make the question of an extra acreage of forage crops at the expense of corn of some moment. The alternatives are, in these cases, more live stock and less saleable crops, or more crops for sale and less live stock.

(*b*) *Costs where crops and stock are in the balance.*—Conditions giving rise to problems of this character are to be found where a local demand for milk introduces the possibility of utilizing roots and forage, in conjunction with purchased foods, for feeding cows, or where forage crops fed to sheep may offer the prospect of returns better than those which saleable crops appear to offer. It is in these marginal cases that the question may be, whether to limit the root crops to the acreage necessary for functioning as cleaning crops, for the upkeep of the fertility of the arable land, or to maximize their area as forage crops for stock. It would seem to be more useful to estimate whether the acreage of forage crops should be minimized or maximized in the interests of profitable working, than to try to divide their costs in an arbitrary manner between stock and saleable crops.

To illustrate this case, the use of sheep on arable land on the Dorset Downs may be contrasted with the similar use of sheep for consuming arable crops on the light soils of the Lincoln Heath, or on the Bunter Sandstone formation in North Nottinghamshire. On the Downs the cropping of the arable may be made subservient to the needs of the sheep for forage. Good corn crops are grown, but the rotation is weighted with forage crops, in excess of the requirements of the land for cleaning or for the upkeep of fertility by the manure from the stock, to provide as much forage as possible. This policy may, in extreme cases, be carried so far as to cause the land to become infected with fungoid pests to which the root crops are liable: the economic limit of stocking may thus arise through the reduced yields and the poorer feeding quality of the forage grown. On the Heath, where sheep play the part of 'manure barrows' for improving the otherwise poor yielding capacity of the land, the cereals and other saleable crops may be

grown to the limit of the capacity of the farm. This limit is determined by the poor yields which result if the number of stock kept per acre is too small, or if cereals are grown too frequently in the rotation. Whether the sheep, or the corn, should be maximized to the limits imposed by the natural conditions of the farm, or how far the one should be pushed at the expense of the other within those limits, will clearly depend upon prices, but the answer to such questions may often be somewhat uncertain. Problems of a similar kind arise in connexion with the use of other types of land for corn or milk production. On many farms both aspects of the case are interwoven.

This type of problem clearly calls for the determination of the costs which would be incurred or saved by a small change of emphasis between crops for feeding and crops for sale. In comparing the probable results of the relatively small increases and decreases in the scale of cropping open to the farmer from year to year it will, for all practical purposes, be reasonable to take as the basis the costs and yields ascertained on the present scale of output. And since more sheep for folding may mean more forage crops, the whole of the additional outlays in growing those extra crops may properly be brought into account against the sheep in estimating the effects of the proposed change. Should the change be carried out and persisted in, any effects upon the yields of corn would appear, when 'normal' results could be detected and a fresh balance struck at the new level. In practice, the main use of the cost accounts in this kind of case will be to indicate within what limits of price it will probably pay better to shift the emphasis a little on to corn or sheep respectively.

The fact that arable forage crops usually serve both to clean the land and to provide food for stock has given rise to the practice amongst English cost accountants of charging sheep folded on roots with only a proportion of the costs of operations on the root crops, one-third is the proportion often used, together with the cost of the seed, the remaining two-thirds of the operation costs and all manures applied being carried forward as a charge for fertilizing the land for the succeeding crops.[1] But this somewhat arbitrary apportionment seems to overlook two important facts, viz. first, that if the roots are grown to clean the land a certain minimum acreage falls to be grown each year, and however

[1] Appendix, par. 7.

they are disposed of their costs are part of the cost of cleaning the land; and second, that if it is worth while to grow more roots merely in order to carry more sheep, the whole costs of the extra roots ought to be borne by the sheep. The sheep being the means employed to consume the roots and to fertilize the land, it would seem to follow that if we link the whole costs of the roots with the other expenses of the sheep, we arrive at a resultant net return on the stock which represents either the cost of cleaning and upkeep of fertility, or, if reduced to so much per acre, the extra return to be expected if a few more roots are grown for the use of the stock. It is only when the net return per acre on the stock reaches a point at which it compares favourably with the net return per acre obtainable by using the land for growing corn, that any extension of the root land beyond the necessary minimum is likely to pay.

It has, however, been so strongly urged that crops are closely interlinked in rotation cropping, that it may be asked whether any precise division of costs between crops that are cleaning crops and others for sale can be made. The cultivations made between two crops may aid both in cleaning the land and preparing a tilth for the second crop. This objection would be important if an absolute division of total expenses were necessary. But this is not the case. What is in view is the measurement of the costs and returns likely to result from a change of emphasis in the farming. There is much less difficulty in determining the extra outlays involved in change of a relatively small magnitude, such as the outlays of time and material necessary to grow *a few more acres* of roots or *a few more acres* of corn, than in tracing out the primary and secondary effects of expenditure in bulk. It is conceivable that the effect of increasing the acreage under roots by 10 per cent. would be to reduce the total number of cleaning operations required to some small extent, but for practical purposes such differences can be ignored with safety if the increase is small in proportion to the whole area cropped. It is consistent with the rate of change in farming practices generally, and with the interdependence of agricultural operations, to make one's objective in costing the measurement of the costs of increases and decreases in the scale of operations. For practical purposes the average expenditure in growing ten acres of a crop may be taken to be the same, acre for acre, as the costs of growing nine or eleven on the same farm.

Comparisons between the costs of alternative crops which do not influence the live-stock policy of the farm are comparatively simple. The expenses of working any single crop may show some variations from season to season, but within comparatively narrow limits, and, generally speaking, differences in yields and in selling values are of more importance. There are, however, few crops which can be replaced on a large scale without some reactions upon the system of farming.

In questions of minor change the problem is always a practical one; it is a question whether to put a particular field in corn, roots or potatoes in the coming season; whether to sow a one-year's seeds mixture or seeds for a longer ley when putting in the rotation grass-seeds. The decision is taken with the consciousness that the results may not be what are expected or hoped for, on account of the uncertainties of the weather. The figures the farmer needs to guide him should therefore indicate rather the maximum immediate outlays, which cover all his risks, than some hypothetical proportions of those outlays which leave the rest to bear fruit in the uncertain future. This does not imply that the farmer can ignore the effects of present policy upon future yields—the limitations imposed by the maintenance of fertility have been emphasized already—but rather that the possible extra returns from future crops should not be discounted in advance. If, other things being equal, there is a greater chance that one crop will leave more residues for subsequent crops than another, there is no doubt where the choice will lie, but in forecasting it is best to be on the safe side. The land in its present condition must be the starting-point, and the problem as it presents itself to the mind of the farmer may be something like this: If the flock is increased by twenty sheep some additional acreage of roots will be needed; these roots will involve certain operations of which the normal costs must be computed, together with the extra expenditure on purchased foods. At the prices anticipated for the extra wool and the extra sheep for sale what net returns can be expected? Alternatively what outlays and returns might be expected from some other crop, leaving the sheep enterprise on its present scale? The material for answering these questions is already to hand if the farmer's records are sufficiently complete. His labour records should permit of a fairly close estimate of the labour required for roots or corn, although if he can see his way to get the extra work

on the roots done by economizing labour in other directions, no extra out-of-pocket cost may be involved. The horse-labour requirements of the alternative crops are similarly ascertainable and can be considered in relation to the availability of horse-power at the season when it will be called for: in this case also, unless some added horse strength is involved, its costs need not be brought into account on either side. The requirements of the stock for purchased food will be known, though estimates will always be subject to the yields of home-grown forage, and the normal yields of saleable crops are also known. A considerable element of speculation is inevitable; the results would have to be closely watched and compared with the estimates, and the trend of values kept clearly in mind.

The following figures from the accounts of a Downland arable sheep farm may be quoted as an example:

	1924–5		1925–6	
Cash returns per 100 ewes — draft ewes, lambs and wool (adjusted for changes in valuation of flock)		£710 16 8		£615 0 5
Outlays per 100 ewes: Concentrates	379½ cwt.	£234 4 9	440 cwt.	£268 8 0
Roughage and Folded Crops (labour, seed, horses and other direct outlays)		180 6 0		166 14 0
Manual labour on ewes and lambs	2,160 hrs.	64 12 0	2,120 hrs.	72 10 0
	Total	479 1 9	Total	507 12 0
Surplus per 100 ewes		£231 14 11		£107 8 5
Area folded per 100 ewes		46 acres		47·8 acres
Surplus per acre folded		£5 0 9		£2 4 10

Gross returns per acre on corn crops.

	1924–5			1925–6		
	Yield	Price	Total	Yield	Price	Total
Wheat	3·6 qrs.	58/-	£10 8 10	2·2 qrs.	44/10	4 18 8
Barley	3·9 qrs.	45/-	8 15 6	4·3 qrs.	41/-	8 16 4
Oats	5·6 qrs.	32/-	8 19 2	6·3 qrs.	30/-	9 9 0
Average outlays on cereal crops per acre (Labour, horse-labour, seed, threshing and sundries)			£3 17 0			£3 16 8

	1924–5	1925–6
Surplus per acre Wheat	£6 11 10	£1 2 0
Barley	4 18 6	4 19 8
Oats	5 2 2	5 12 4

Barley is the chief crop, and the conditions were clearly more favourable to corn relatively to sheep in 1925–6 than in 1924–5. In 1926–7, with falling sheep values, the trend was still more definitely in favour of cereal growing.

Note.—These figures illustrate the comparative constancy of expenditure as compared with the fluctuations of yields and of prices.

Outlays on crops disregard rent, rates, and overhead charges in all cases.

(c) *Costs in Live-stock Production.*—Where conditions are favourable to the production of live stock and live-stock products, the costs of maintaining fertility hardly call for special consideration. Major emphasis on stock will usually connote a considerable proportion of grass, and if, as in parts of Devon and Cornwall, soils are suited to arable cultivation but conditions do not favour the ripening of grain, the produce of the land passes through the bodies of the stock and the manure is used in the growth of forage. Except on milk-producing farms, where some replacement of minerals sold off in the milk may be necessary, dressings of slag and other artificials applied to the grass-land are probably directed towards improvement rather than maintenance. The feeding of artificial foods brings fertilizing elements on to the farm. Limitations to change on grass-land are set rather by the need for a grazing policy that will maintain the character of the herbage, by the unsuitability of some soils for grazing young stock, and by the risks of disease in the case of sheep where conditions are damp underfoot.

Assuming, therefore, that the farming policy is in the main adapted to the conditions prevailing, the stock-farmer's interest in cost accounts will, as on the arable farms, be chiefly connected with the extra costs or the savings involved in change of a limited kind, and the corresponding changes in returns. For such purposes expenses which go on in any event need not be brought into account.

Where natural grass is the basis of feeding, costings problems are comparatively simple. The main expenses, apart from the initial costs of the stock, are connected with the use of the land—rent, rates, and tithe. Other outlays on labour and current expenses are small, and profits depend chiefly upon the increase

in value of the stock on the pastures. It may be possible to substitute one class of stock for another, sheep for cattle, calving heifers for store bullocks, but graziers are usually alive to the suitability of their various pastures for stock of different kinds and ages, and some combination of stock may be necessary to maintain a proper balance of grazing. The relative buying and selling prices of stock are the main indices of change.

The question of cost accounts becomes more important, and rather more involved, where the natural produce of the soil is reinforced with purchased foods, or where the provision of winter keep for stock has to be faced. In the former case, where animals are being fattened for market, the choice of foods, within the limits set by the requirements of the stock, is chiefly a matter of price. The difficulties in tracing, by means of cost accounts, the relative economy of different methods of feeding and management are practical rather than theoretical; they arise from the facts that batches of animals on the farm overlap one another in time, that their need for purchased food is dependent upon the variable growth of the pastures in different years, and that unequal development of the animals themselves often results in transfers from one group to another in the course of their stay on the farm. The period covered may be as long as two or three years in the case of growing stock.

There seems no solution of these difficulties except the patient recording of food fed to the stock, coupled with records of the length of time the animals are kept and the purchase and selling values of each group. Values which the farmer considers reasonable at the time can be put upon single animals put back into less forward batches because of insufficient growth. Generally, for comparative purposes, charges for the use of the grazing need not be brought into account, so long as the numbers of stock that can be carried on the area available are equivalent. Labour, too, on such farms, will hardly be apportionable between the different kinds or batches of stock on any satisfactory basis. The costs of purchased foods and the selling values of the animals at different stages of their growth will deserve most attention from the farmer.

Except where animals are bought for summer grazing only, they must be provided with forage during the winter, and the relative economy of various methods of winter feeding becomes important.

The calculations of cost arising are straightforward enough. The relative amounts of purchased food, and of saleable home-grown produce consumed, compared with the live-weight gains expected, will provide the basis of the calculation. But the interpretation of the result is not so simple if the stock are to be kept for a further period of grazing, since cattle wintered on a purely maintenance ration may thrive more rapidly on grass than stock that have been fed better during the winter, and the total costs and returns over the whole period of growth are, in the end, the only significant figures. This means that, where live stock are carried, the annual balancing of the accounts must usually involve estimates of the present values of the animals. But cost records must be spread over the longer period required to bring the stock to maturity and disposal, and sound policy will be based upon the system which, taking an average of cases, seems to be best in the long run. If the treatment of each batch of beasts is economical, the aggregate result will be the best attainable.

Discussion of the varied problems of arable and grass farming will have served to illustrate the individual character of the problems which each farmer has to face. The number of different combinations of arable and grass land of varying qualities is almost as great as the number of farms in some areas in the United Kingdom in which contour, geological formation, and climate show a wide range of variation. Unequal advantages of situation relative to markets also arise from the distribution of population. Each farmer must take into account the circumstances of the farm, and the questions to be answered are almost unlimited in their variety as one goes from one farm to another. But the principle to be applied is clear. Extra outlay must be set against anticipated extra returns in a normal year, and for this purpose those expenses which are common to two or more alternatives, and are unaffected by the substitution of one for another, need not be brought into account. The simplicity or complexity of the calculations will depend upon the extent to which dependent activities are involved in change, and the more complex the adjustments, and the longer the periods of time incurred, the more tentative will be the estimates of final advantage.

Thus modifications of farming policy will usually be made in ways which disturb the general organization of the farm as little as possible. Fields are seldom of equal size, and the rotation may

not, in consequence, be precisely the same as to acreage under the several crops in successive years. There may be a field on the farm which does not occupy an essential place in the general economy of the farm, but which can be used in alternative ways; or it may be that with some slight adjustment of cropping, fields sown down for one year might be allowed to remain in grass for two or even three years, thus adding to the proportion of grass-land and diminishing the arable acreage, and giving rise to some change in the stock-carrying capacity of the farm.

Any change of emphasis the farmer may make must be tentative in character and must generally leave the way open for a return to the well-tried system. It is, however, most desirable that he should be able to analyse the workings of the farm to show in which direction, under current or anticipated price conditions, an increase of emphasis will be likely to improve the returns from the farm as a whole. Where to trim off £1 of expenditure, and where to place it instead, is the essence of the farmer's problem. Cumulative changes of small magnitude become in time the major change which is indicative of new conditions underlying the industry.

(*d*) *Specialized Farming.*—So far we have been concerned chiefly with farming as a means of using a certain area of land. But the industry has, in present times, a twofold character. Primarily it is an extractive industry in that the soil remains its characteristic basis. In the main its plan of working is dependent upon its natural environment. In a secondary sense it is assuming the character of factory industry, in that industrial by-products, such as feeding-cakes, brewer's grains, basic slag, and sulphate of ammonia are used to an ever-increasing extent to reinforce the inherent productivity of the soil by the provision of fertilizing elements and additional food for live stock. The folding of sheep upon roots, or the feeding of cattle on roots, hay, and straw, without the aid of concentrated foods, would usually result in a comparatively small increase of live weight, or output of milk. Hence purchased cakes, meals, or home-grown grain may be fed in order to obtain additional returns which more than compensate for the increased outlays. In some few cases the 'factory' element may become predominant. For producing pork, for example, young pigs can be bought, and a large number can be accommodated in sties and fed on purchased foods and dairy by-products, without the use of more land than is required for the necessary buildings.

In so far as this element in live-stock management becomes predominant it ceases to be in essential character a farming operation. It may even be divorced from the occupation of land for cultivation at all, and in such case for accountancy and costing purposes it may be treated on factory lines.

Pig Fattening.—In costing pigs fed for pork or bacon, under the conditions governing commercial production on factory lines, it is rarely practicable to segregate each batch of animals in the accounts, and to keep records of the feeding of each lot distinct. But this difficulty is minimized by the fact that the turnover is more rapid than with growing cattle, and each yearly period may see several lots of pigs completely fattened and sold. The segregation of the costs of each batch becomes unnecessary. If records of the numbers of stock bought, sold, and on hand from week to week, of labour, and of the food purchased and in stock are kept, the average cost of feeding per pig-week is readily computed, and comparisons from year to year will reveal clearly the causes of unequal profits. The disturbing factors of interrelatedness of products and uncertainty of prevailing conditions are absent in this case.

A practical example from the accounts of a farm on which about 200 pigs annually are fattened in sties on purchased foods and purchased dairy by-products will serve as an illustration.

(Totals for year divided by number of pig-weeks)

Costs per week	1924–5		1925–6	
	s. *d.*		*s.* *d.*	
Labour	3·7		4·1	
Meals (28·9 lb.)	2 8·5	33·5 lb.	3 1·3	
Sep. Milk and Whey (8·6 galls.)	7·2	9·7 galls.	8·3	
Sundry Expenses	0·4		0·3	
Total costs per week—excluding overheads	3 7·8		4 2	
Average time in sties (weeks)	30·4		16·8	
Average costs per pig	111 0		70 0	
Average purchase price per pig	29 2		38 0	
	140 2		108 0	
Average selling price per pig	127 8		135 11	
Return per pig (loss)	12 6	(gain)	27 11	

At the prices ruling in 1925–6 pigs selling at 127*s.* 8*d.* in 1924–5 would

have been worth about 150*s*. The gain per pig would still have been less by 18*s*. than in 1925–6, and the number of pigs that could be accommodated in the sties for an average period of 30·4 weeks would be little more than half the number kept for 16·8 weeks only.

Dairy Farming Costs.—Dairy farming provides a series of examples in which the farm and the factory meet with varying degrees of emphasis on the one side or the other. The proportions in which home-grown forage or purchased foods enter into the rations will vary according to the part played by the milking herd in the economy of the farm. It has already been suggested (pp. 71–75) that the end to which cost accounts can most usefully be applied on milk-producing farms is not the determination of the cost per gallon, nor of the cost per cow, since profit will depend upon the number of gallons produced or the number of cows carried, and both of these numbers may be variable within limits according to the particular method of management practised. The aim is to maximize the net return from the herd as a whole, and here, as in other cases, the practical problem of the individual farm is to try to ascertain from the costs accounts in what way, if at all, the margin between outlay and return can be increased. The means available to the dairy farmer to this end may be (*a*) to cheapen the costs of producing the same quantity of milk, (*b*) to increase or decrease the output of milk, or (*c*) to add to or diminish the processes carried out in marketing the produce.

The method of approach to the problem will depend upon the circumstances of the farm in each case. The factors limiting change must be kept clearly in mind. Housing accommodation for stock may fix the maximum number of milking cows, the function the cows have to play in relation to the maintenance of fertility of the arable land may restrict the choice of foods, the character and location of the grazing fields may determine the proportions in which milking cows and young stock can be carried conveniently, or distance from a retail market may preclude the possibility of marketing otherwise than wholesale and in bulk.

The records necessary for a critical survey of milk production are records of labour, of foods consumed, of milk yields, of quantities of milk sold, used in the house, allowed to the men and fed to calves, and of the changes in the numbers of animals in the herd. These figures should, wherever possible, be related to the purchases and sales recorded in the cash-book. It is useful also

to note the dates on which the animals are turned out to grass, and the fields grazed by the cows and young stock respectively. Usually, fields of different qualities will be grazed by milkers and growing stock respectively, and it will be unnecessary to calculate the number of animal days spent on each field. With these records available the solution of a few typical problems may be approached.

(i) Farm A is situated in a grass-land area devoted to milk production coupled with cheese-making. It is nine miles from a small market-town, but there is a railway station within 2½ miles. Wholesale disposal is thus inevitable. The basis of feeding is pasture-grass, a small acreage of arable is cropped for straw and roots for winter feed. Cows are calved in the spring and there is a heavy surplus of milk produced in the summer months. The land is stocked to the limit with high-milking cows, young stock being kept at a bare minimum for replacing rejected cows. Answers were sought to two questions. At what prices for milk and cheese are the two methods of disposal equally advantageous? Can the output of milk for sale either as milk or cheese be increased with economy at current prices?

In the years under review each gallon of milk converted into cheese and sold as such realized 11·7 pence. The extra expenditure on cheese-making, including labour, haulage, upkeep of cheese-making plant and sundry expenses, was 0·67 of a penny per gallon. Thus, summer milk would have to be sold at 11·03 pence per gallon to bring the same returns as cheese-making. But the farmer still has the whey, of which the feeding value, compared with other food at current prices, would be, say, 1*d.* per gallon, but only if it could be sold or utilized. It was fed to pigs. The outlays and returns on pigs, excluding any charge for the whey, left a surplus equal to 3*d.* per gallon of whey fed. A combination of cheese-making and pig fattening, at the prices then prevailing, left a total return equal to milk selling at 1*s.* 2*d.* a gallon. This was approximately the winter price and considerably in excess of the summer price obtainable.

An attempt to increase the total output of milk was made. This was accomplished by more intensive feeding of the cows and by buying in some extra cows for the winter. The expenses affected by this increase were the costs of labour, foods, and some loss on resale of the extra cows; other outlays remained nearly constant. The output per cow increased from 616 gallons in the first year to 697 gallons in the second year. The increase in outlays on the dairy stock totalled £217: the increase in returns £202. The result does not give a final answer to the question of maximum profitable output, since there was a slight fall in cheese prices and the proportion of liquid milk sold in winter declined on account of the dates of calving, but it suggests that the farm is somewhere near the economic limit of output at the current level of values.

(ii) Farm B is situated on poor gravelly soil near a large industrial town. The output per acre from the land, of both arable produce and milk, is low, and advantage is taken of the situation of the farm to increase returns by

retailing milk. The average price realized per gallon in the year under review was 22·1 pence. The average wholesale price of the milk during the same period would have been about 14*d*. The farmer wished to know if retailing really paid and whether, given a larger retail turnover, it would pay to intensify the production of milk on the farm. The extra costs incurred in retailing were extracted. These included labour, upkeep, depreciation of the motor delivery van, bottling costs and sundries. These were found to amount to £350 in the year, or approximately 5·8 pence per gallon. The actual sales of milk amounted to £1,340, and the selling value of the same quantity at wholesale prices was estimated to be £875. The excess of retail over wholesale selling prices was thus £465, and the extra profit due to retailing £115. It was clear from a scrutiny of the retailing costs that a much larger bulk of milk could be handled with little additional cost for van depreciation and upkeep. It was also clear that if additional milk could be purchased at wholesale prices and retailed the profits of the business could be augmented, and further, that it would pay to push up the yields of the cows on the farm even at higher cost per gallon so long as the added total cost of the extra gallonage did not exceed the additional selling value derived.

The present grazing area being fully occupied by the cows, the two alternatives open to the farmer for increasing the home production of milk are (*a*) to try to improve the yield of milk per cow by buying a better class of cow, or by altering the system of feeding, and (*b*) to increase the cow-carrying capacity of the farm at the expense of some of the saleable arable crops. The first alternative could be tested on a small number of cows, but it is again to be emphasized that it is the additional expenditure against the additional return that is to be watched—the average cost per gallon is not the criterion without reference to the total gallonage obtained. The second alternative involves some estimate of the relative returns per acre of land devoted to forage and to saleable crops respectively. As a parallel example has been given in connexion with sheep and corn (pp. 108–9) the method of working need not be followed out in detail. But in this case more cows mean more buildings, and a primary consideration is the further capital outlay required.

(iii) One other example may be cited. Farm C is an all grass farm in Dorset devoted entirely to milk production, and the present policy is to maintain the maximum number of cows in milk. Retail sale is out of the question, the land is too wet for arable cropping, the basis of feeding is grass in summer and hay *ad lib.* in winter, supplemented with cake according to the yields of the cows. The cows are kept as long as they are giving good yields (the herd is recorded), and the number of young stock reared is kept as low as possible—20 heifers of various ages being reared to maintain a herd of 50–60 milkers. The average milking life of a cow is thus about 6–7 years. To avoid the risk of disease no cows are bought. The average output per cow is low—about 550 gallons. The farmer's problem is to find out the economic limit of production of milk at current prices, which averaged about 1*s*. per gallon for the year. The problem is complex. A more rapid turnover of cows, due to a more thorough elimination of the poorer milkers,

would mean carrying a higher proportion of young stock, and the number of cows in milk would have to be reduced unless greater reliance is placed upon purchased foods. Thus, a higher yield per cow might be obtained, but there would be fewer cows. There might be some saving in labour, but this is problematical since already the labour required at hay harvest sets a lower limit to the number of men. If less hay and more concentrated foods are fed to encourage high yields, on lines recently advocated, the farmer is doubtful whether the milking life of the cows would be as long; if not, a higher depreciation cost would be incurred and the rate of turnover of cows would be still more rapid. The problem can only be faced by a process of trial and error, coupled with careful records of foods, labour, yields and returns, due regard being paid to changes in the level of costs and selling prices in interpreting the results. Detailed calculations of outlays per gallon are hardly called for, and totals under the several heads for the year would suffice.

There can, indeed, be no final answer to any of the questions relating to the output which will bring the maximum profit: everything turns upon the value of the produce and the unit costs of labour, foods and other factors of production. The important facts to be noted are the quantitative results obtained by using certain quantities of the factors of production at different levels of production. The economic limits to output can then be determined by substituting values at current prices.

IV. *Manuring for Maximum Profit.*—A question which frequently arises is up to what point does it pay to apply artificial manures for stimulating higher yields. As affording what are perhaps the most easily demonstrable cases of the operation of the 'Law of Diminishing Returns', the yields from increasing applications of manures of various kinds have received much attention, and have been shown to follow certain well-defined tendencies.[1] The technical problem of determining the yields that are obtainable from various dressings of simple or mixed fertilizer is not our immediate concern; from the costings standpoint comparisons of cost and return are not difficult. All that is involved is to set out in schedule form the extra yields obtainable with each additional increment of manure, and calculate the costs and returns at current or anticipated values. The costs of application of a few additional hundredweights of manure will usually add little to the costs of applying smaller dressings, but the costs of harvesting and handling yields of different weights may be significant and must

[1] Spillman and Lang.

be brought into account.[1] It will, for most practical purposes, be unnecessary to complicate matters by trying to assess the secondary effects of the heavier dressings upon subsidiary crops. The farmer will not overlook the additional fertility remaining in the land, but he will rarely go beyond the optimum dressing for the crop in order to stimulate following crops, to which specific dressings are more satisfactorily applied. With manures applied to grass-land the estimation of returns is usually very approximate, since they must be judged by results over a series of years to which no precise money values can be applied.

More General Problems.—The calculations suggested for estimating or checking the results of change within the farming system have taken for granted that the system is well conceived as a whole in relation to the environment of the farm. That, it is claimed, will generally be the case, since in the opposite event the financial results will quickly call a halt to operations. For the purpose of the investigator into the factors underlying success in farming in different areas, and on varying scales of production, the limited internal problems of the farm are of great importance. But it may be necessary for comparative purposes to extend the analysis to the system itself. The fact that corn-growing is successful under certain conditions, and milk production under others, is clearly to be expressed in varying returns to a given amount of expenditure, and it may be important to be able to define within what limits, and on what price basis, an extension of production in one direction or another could be anticipated.

Even from the viewpoint of the individual farmer, struggling with adverse tendencies due to rising costs or falling prices, the question of large-scale adjustment may have to be considered, and for this purpose the whole of the facts of the farm—its size, its capitalization, its equipment, its layout may have to come under review. It is therefore important to formulate the lines on which both the economist and the farmer may safely proceed in the dissection and analysis of the system, so that the conditions vital to success, or at any rate the circumstances predisposing to failure, can be rightly assessed, and comparisons made which will be relevant and useful.

[1] See chart illustrating the maximum profitable manuring of potatoes, *R.A.S.E. Journal*, vol. lxxxv, p. 355.

To the farmer, faced with an unprecedented fall in values or an unprecedented rise in costs, who finds his present system of farming unprofitable, whatever minor adjustments he may make, it is primarily important to be able to discern in what ways, if any, he can adapt his practice to new conditions. It would undoubtedly be of advantage if a body of knowledge should exist which would serve to guide farmers at such times. History affords its precedents, but knowledge has made advances in the meantime; transport has developed, bringing both ease of distribution and competition from other areas, and popular demand may have changed both in force and in direction. Whatever guidance history can afford must be modified by current experience, and it is at this point that the agricultural economist may find an important place in the advisory scheme. For his guidance to be of value, however, it must be based upon a fairly wide knowledge of farming, and if experience is to be useful in specific cases it must be not merely general in its character, but related to the actual conditions of the area. The primary difficulty the economist encounters is to select a farm or a few farms for investigation which really are representative of the district.

The second difficulty is that any very exact analysis of costs and returns on crops and stock must extend over a period of years if 'normal' results are to be obtained.

For determining the influence of size of holding, percentage of arable and grass, or proportion of land under various crops upon the net output of farms, statistics from a large number of farms of similar character will be required. For this purpose the 'survey' method of collection of data must be the basis. This fact suggests that, for the purposes of economic investigation, the function of cost accounts may be the amplification of the general data provided by regional surveys. If a broad view of the farming carried out in a district, of fairly homogeneous soil type, and climatic conditions, were to reveal the predominance of farms having certain characteristic features in relation to size, type, class of stock, &c., a study of a few typical farms by means of detailed costings records over a series of years would serve to establish, and to measure, the factors upon which the economic success of the type is founded. It would seem to be of greater value to proceed in this way than to attempt to establish comparisons in detail

between individual product costs, on farms of entirely different character and surroundings, in view of the varying significance that any particular crop or type of live stock may have in the farm economy under different conditions.

The Selection of Farms.—It may be useful, therefore, to suggest the studies which should precede the selection of farms for detailed cost analysis. It is apparent, since physical conditions underlie practice, that areas having fairly uniform soil and climate must be the starting-point. In this country districts having homogeneous characteristics are not large, but some of them are extremely rich and important agriculturally, and worthy of special investigation. A method of selection of farms in a given area for detailed study is suggested as follows. The area is first defined with reference to its soil type. It is already possible in some counties, where systematic soil surveys have been made, to delimit areas by the parishes in which soil type is fairly homogeneous. For example, in Berkshire four such areas are clearly defined. These are the most suitable for study in the first instance. Between them are groups of parishes in which the soil conditions are transitional between those of the more clearly defined adjacent areas. In these intermediate areas no uniformity of farming system is to be expected, and their study should be deferred until the more homogeneous areas have been investigated. In this way one of the main factors underlying the variations of farming, the soil, will be eliminated as a disturbing factor, and climate over relatively small areas will also be fairly uniform.

The definition of areas by parishes is convenient in that statistical investigation of conditions is possible without troubling farmers to fill in forms, most of the information as to cropping, stocking, and labour being given annually in the June returns. There would seem to be no possible objection to the use of such information for compiling a statistical account of the farms in an area defined by a group of parishes. The farms would be classified with reference to certain characteristics—size, proportions of grass and arable land, numbers of live stock of different kinds, and acreages under various crops. It should then be possible, by representing graphically the distribution of farms according to size, to arrive at the acreage which is representative of the largest number of farms; and the dispersion of farms of other sizes about the modal type. The 'mode' could be ascertained

similarly for percentage of arable, numbers of stock, &c., and the extent of correlation between the different features explored. The main characteristics of the farming of the area would thus be presented quantitatively. This statistical information might require amplification by inquiries as to yields, marketing, and other details, by personal visits to the farms, but the investigation of financial transactions on the majority of farms would be unnecessary. Farmers are as ready as any other class of business people to give information which is not of a private character, and which is required for a purpose which has the promotion and assistance of the industry as its primary aim. The experience of many who have undertaken surveys of a more detailed character is evidence on this point. The selection of farms for closer investigation is the next step, and it is proposed to obtain the co-operation of three or four reasonably well-managed farms having characteristics which conform to the type found to be predominant in the district, and of some few farms showing extreme variations from that type. The actual number taken would have to depend upon the conditions found to exist in the area, and upon the amount of clerical help available. Given goodwill and confidence on the part of both farmers and investigators no difficulty on the score of finding farmers willing to keep costings records is to be anticipated. Many dozens of such farmers are already keeping costings accounts in collaboration with the Advisory Agricultural Economists in different parts of the country, and have been doing so for the past three or more years.

With the detailed costs of a selected number of typical farms exhibiting the more usual, and also the more extreme, characteristics within the area, it should be possible to assess with reasonable accuracy the conditions which underlie the successful working of the systems of farming practised. The effects of variations of size, of cropping and of stocking upon the investment, labour requirements, expenses and returns of the farms could be ascertained, and the circumstances making for economy weighed. It would then be possible to estimate, with sufficient accuracy, corresponding information for farms of intermediate size and organization, and to obtain a fairly full view of the effects of changes in costs and selling values upon farming on different scales of production. Such information should be invaluable to the farmers of the district, and also to the State in considering its

plans for the advancement of the industry. For example, if the larger farms should reveal that increase of scale makes for economy in the costs of labour and of implements, the adaptation of practice to increases in the costs of these factors would have to take the form of extending the bigger farms at the expense of the smaller. The returns and expenditure on farms practising different degrees of intensiveness in stocking and cropping could be compared. If there were a marked tendency towards change in the levels of prices of different products the effects upon holdings of varying size within the area could be assessed with some confidence. Cost accounts might thus be made an avenue into the heart of agricultural conditions.

The investigator using costs accounts as a means for pursuing economic studies can adopt a more finished technique than the farmer. His accounts will record facts from year to year rather than the impressions of the farmer, and several years of work may be required before the normal outlays and returns, even in terms of physical units, can be established. The system of accounting adopted should permit of a strict double-entry check upon apportionments and postings, quantitatively as well as in terms of values. But the limitations of any attempt to obtain representative results are apparent. When the best work has been done on a typical farm the results will still be in large measure dependent upon the personal capacity of the farmer as manager, and upon the calibre of the men employed. To keep the accounts of a sufficient number of farms of each type is no light task, though it is not beyond the powers of advisory workers equipped with sufficient clerical help. The value of whatever work is done upon sound principles is, however, cumulative, both on the single farm as the work proceeds from year to year, and for comparative purposes when normal results have been reached.

The Preliminary Analysis of the System.—A thorough comparative study of farms in the same area would be concerned with the farm organization in all its aspects, and the use made of each factor in production, land, labour, capital, should be the subject of close scrutiny. A method which has been found to offer some advantages for comparative study is to set out in tabular form (1) the cropping of the land and the disposal of produce; (2) the investment of capital in the several directions within the farm; (3) statistics as to the total labour, horse and tractor strength em-

ployed and the distribution of its use throughout the year. Typical statements are shown on pages 124, 126, and 129. Table I shows, for the financial period under review, the following information in consecutive columns:

(Column 1.) The acreage of unsold produce in stock at the opening valuation. In the case of cereal crops the acreage is normally that of grain, threshed and unthreshed, since grain is usually the primary product; the acreage of straw, if this is considered important, can be noted at the foot of the column. The acreage of home-grown produce used as seed, and sown before the valuation date, may also be included in column 1 as being in stock, but if, for convenience, home-grown seed is charged to new crops at market-rates it can be considered as having been sold. It is perhaps generally a rather unnecessary refinement to carry forward home-produced seed already sown as being in stock, but it may be of some importance to do so in special cases, e.g. on some Eastern County farms, where a definite area is set aside year by year for growing Scotch seed potatoes to be used as once-grown seed in the following year, and where it may normally take say 55 acres of land to produce a saleable crop from 50 acres. The return per acre is influenced to the extent of 10 per cent. by taking account of the seed area.

(Column 2.) The use made of the land during the year under review. If any catch crops have been taken these are conveniently noted at the foot of the column, to avoid disturbing the total acreage of the farm, which should tally with the total cultivable area of arable and grass.

(Column 3.) The acreages in stock at the date of the closing valuation, corresponding to Column 1.

(Column 4.) The acreage disposed of by sale or use during the year, which is equal to the sum of Columns 1 and 2, less Column 3. This area is, in practice, found to vary within fairly wide limits on the same farm from year to year, on account of differences in dates of threshing and in the areas of consumable roots. Column 4 is important because the financial results for the year turn upon the produce disposed of rather than upon the acreage grown, and comparisons between one year and another may be vitiated unless that fact is brought into account. It is realized that it would be consistent, in the case of growing stock, to try to make some apportionment of the grass- and hay-land between stock brought to maturity during the year and stock still in process of growth, but in practice that is a refinement which involves somewhat uncertain approximations, and it is rendered unnecessary if the proposal to adopt standard values for growing stock is adopted.

Columns 5–10 show how the total acreage represented by Column 4 has been disposed of during the year.

TABLE I

TYPE OF FARMING. Sheep and Corn.

Crop.	*In stock at beginning of year.* (1)	*Grown during year.* (2)	*In stock at end of year.* (3)	*Area utilized.* (4)	Disposal of Produce.					
					Sold. (5)	*Used as Seed.* (6)	*Fed to Cattle.* (7)	*Fed to Horses.* (8)	*Fed to Sheep.* (9)	*Fed to Pigs.* (10)
	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Wheat	23·0	18·75	—	41·75	38·45	3·0	—	—	—	0·3
Barley	30·5	74·5	1·7	103·3	79·58	6·3	·12	7·0	5·5	4·8
Oats	30·0	49·5	24·4	55·1	25·10	1·4	·07	15·5	13·03	—
Seeds Ley	14·5	79·75	31·0	63·25	—	—	—	—	63·25	—
Mangolds	4·8	4·0	2·3	6·5	—	—	—	·4	5·85	·25
Swedes	—	45·5	—	45·5	—	—	—	—	45·5	—
Turnips	—	37·0	—	37·0	—	—	—	—	37·0	—
Kale	—	5·0	—	5·0	—	—	—	—	5·0	—
Vetches	—	19·0	—	19·0	—	—	—	—	19·0	—
Total Arable	102·8	333·0	59·4	376·4	143·13	10·7	·19	22·9	194·13	5·35
Meadow Hay	10·0	20·0	—	30·0	7·0	—	6·0	7·0	10·0	—
Pasture	—	169·0	—	169·0	14·0	—	25·0	16·0	114·0	—
Total Area of Arable and Grass	112·8	522·0	59·4	575·4	164·13	10·7	31·19	45·9	318·13	5·35

Acreage to which Cattle Manure was applied . . . . . 5 acres arable.
Acreage folded by sheep . . . . . 126·75 acres roots and forage crops, plus 60 acres aftermath.

The totals of columns 5–10 may be expressed as percentages of the total areas of arable and grass, and of the combined total of column 4, thus:

	Acreage.			Percentages		
	Arable.	*Grass.*	*Total.*	*of Arable area.*	*of Grass area.*	*of Total area.*
Wheat sold . .	38·45	—	38·45	10·2	—	6·7
Barley sold . .	79·58	—	79·58	21·1	—	13·8
Oats sold . . .	25·10	—	25·10	6·7	—	4·4
Cereals used for seed . . .	10·70	—	10·70	2·8	—	1·9
Total Cereals .	153·83	—	153·83	40·8	—	26·8
Hay sold . . .	—	7·0	7·00	—	3·5	1·2
Horses . . .	22·90	23·0	45·90	6·1	11·6	8·0
Sheep	194·13	124·0	318·13	51·7	62·3	55·3
Cattle	·19	31·0	31·19	—	15·6	5·4
Pigs	5·35	—	5·35	1·4	—	0·9
Grass let . . .	—	14·0	14·00	—	7·0	2·4
Total	376·40	199·0	575·40	100·0	100·0	100·0

If these percentages are averaged for a period of two or three years the weight of each form of activity in the farming, in making use of the available acreage, is clearly shown, and the connexion between the several activities of the farm appears. On the one year's figures the cattle are shown to make practically no use of the arable land and to contribute but little to its fertility. They can therefore be considered as the means for exploiting the lower grass-land of the farm. Sheep consumed more than 50 per cent. of the acreage of arable crops, they grazed upwards of 60 per cent. of the grass, largely Down, and they fertilized, by folding, upwards of 186 acres of arable. The arable-sheep policy can therefore be regarded as a distinct problem. Pigs made no use of the grass, and consumed arable produce which would be otherwise saleable: the pig policy can therefore be considered on its merits as a distinct enterprise.

Table II shows the investment in farm-stock at the beginning and end of the year. This Table does not purport to show the farmer's capital invested in the farm, since that is a figure which is influenced by overdrafts, loans and credits, which may fluctuate from week to week, and which will, on some farms, vary in its distribution among the assets somewhat considerably at different

TABLE II. VALUATIONS OF FARM STOCK

	No.	*Value at Beginning of year.*	No.	*Value at end of year.*	*Average Value.*	*Average Value per acre.*	*Percentage of total Value.*
		£ *s.* *d.*		£ *s.* *d.*	£ *s.* *d.*	£ *s.* *d.*	
Horses	11	319 12 10	12	361 10 2	340 11 6	12 10	5·4
Cattle	19	261 0 0	17	311 10 0	286 5 0	10 10	4·6
Pigs	7	48 0 0	11	31 0 0	39 10 0	1 6	0·6
Sheep	783	3,479 10 0	866	3,765 15 0	3,622 12 6	6 16 8	58·1
Stores		37 8 1		90 3 0	64 5 6	2 5	1·0
Implements		847 1 0		895 11 6	871 6 3	1 12 11	14·0
Produce — Cereals		592 12 6		264 9 11	428 11 2	16 2	7·2
Produce — Forage		144 6 10		126 10 1	135 8 6	5 1	2·2
Tenant Right — Cereals		262 18 3		243 8 11	253 3 7	9 7	3·9
Tenant Right — Forage		175 16 3		205 17 3	190 16 9	7 2	3·0
TOTAL		6,168 5 9		6,295 15 10	6,232 10 9	11 15 2	100·0

periods of the year. For farms of similar type, however, the value of the farm assets at corresponding dates will be a fair basis for comparisons. By taking the average of the valuations at the beginning and end of the year a figure which allows for changes in current values is arrived at. More refined estimates of the average investment in farm assets are possible of computation if the weekly sales, purchases, and other outlays are taken into account, and may be worth the trouble involved if the provision of working capital is a serious problem. The basis of valuation must, of course, be the same in all cases if the figures are to be used comparatively.

For this preliminary statement a professional valuation, or one made in consultation with the farmer on the basis of current market values for stock and produce, may be used. Implements will be taken on the usual basis of cost, less depreciation. Tenant right is sometimes valued at the same figure each year, and sometimes on an estimate of cultivation costs plus residual values; it is convenient, for the sake of uniformity, to take as the basis the estimated outlays on seed, artificial manures and cultivations to date. The two annual valuations being averaged, the figures can be expressed as so much per acre of cultivated land under each head, and the several items shown as percentages of the total.

Without going much further some comparisons may arise between farms of similar type for which such figures and the ordinary financial accounts are available. As an illustration two Nottinghamshire farms, both on the Keuper Marl formation, within a few miles of one another and on similar soil, of almost identical size and general type, may be compared. The figures given below cover the same period of one year in each case.

Year ended Lady Day 1925

Consistent features:	*Farm A.*	*Farm B.*
Soil type (Keuper Marl) . .	Medium loam	Medium loam
Total area	232 acres	234 acres
Distance from same Market Town	4 miles	3 miles
Area grazed	84½ acres	84½ acres
Dairy Herd—all ages . .	69	62
Farm Horses	7	7
Acreage devoted to dairy stock .	148 acres	132 acres
Value of Farm Stock per acre .	£12 3 0	£12 5 0

Inconsistent features:	*Farm A.*	*Farm B.*
Arable land cropped . .	73½ acres	122½ acres
Grass-land mown for hay . .	74 acres	27 acres
Arable seeds mown for hay .	4½ acres	35½ acres
Arable crops sold . . .	25 acres	49 acres (incl. 14½ acres potatoes)
Average number of cows in milk	20	35
Average number of young and dry stock	49	27
Sales of milk (approx.) . .	15,000 galls.	25,000 galls.
Sales of milk per acre devoted to dairy stock	103 galls.	190 galls.
'Net Output' per acre of farm [1] .	£2 11 2	£7 16 7
Profit or loss per acre of farm .	(Loss) £2 1 6	(Profit) £3 2 0

These figures do not, of course, give a complete insight into management. But they are at any rate suggestive. Labour cost being about equal on the two farms, it will be apparent that both men and horses were used more fully for productive purposes on farm B; but it is also apparent that, at the level of prices ruling in 1925, the more intensive use of both land and stock on farm B was consistent with a much higher level of profit.

Tables III and IV.—The statistical analysis of the use of manual, horse and tractor labour is a rather more laborious task than the compilation of Tables I and II, but it is of some importance, both to the farmer scrutinizing costs with a view to economy, and to the economist in search of comparative data. The figures presented in Tables III and IV were compiled for the same farm as Tables I and II, from weekly labour sheets kept throughout the year. Certain assumptions are involved in compiling the figures in Table IV, the chief being that all the labour on root and forage crops can reasonably be allocated to the stock consuming such crops. This course is justified on the grounds already cited as to the functions of the stock and crops in relation to the maintenance of fertility.[2] The totals of the rows in Table IV, col. 6, brought into relation with the acreage of crops grown and disposed of give, approximately, the average labour per acre absorbed by cereals, forage and grass respectively, and in attention to live stock. The totals of each of the separate columns can be used in estimating the proportional increase in labour hours likely to be involved in extending the activities of the farm in one direction or another.

[1] 'Net output' is here used to comprise rent, plus labour, plus profit (or minus loss).

[2] See pages, 98–100.

	Men and Boys.	*Horses.*	*Tractor.*
Number employed . . .	9 or 10 men 2 boys	10	1
Total hours worked . .	32,389	17,300	1,471
Hours worked per cultivated acre of farm . . .	62	33·2	2·8
Average working week per man, horse or tractor . . .	52½ hours	33½ hours	28·3 hours

SEASONAL DISTRIBUTION OF LABOUR, 1925–6

Month.	*Average man hours per week.*		*Average horse hours per week.*		*Average tractor hours per week.*	
	Total	per 100 acres	Total	per 100 acres	Total	per 100 acres
April . .	561	107	370	71	40	7·7
May . .	576	110	331	63	33·5	6·4
June . .	699	134	432	83	57·5	11·0
July . .	618	118	372	71	35	6·7
August . .	695	133	321	61	26	5·0
September .	607	116	347	66	32·5	6·2
October .	571	109	349	67	27	5·2
November .	572	109	325	62	31	5·9
December .	515	99	250	48	5·5	1·1
January .	531	102	267	51	15	2·9
February .	544	104	334	64	11	2·1
March . .	545	104	327	63	38	7·3

These figures indicate a fairly complete utilization of manual, horse and tractor power. Pressure of work in June–August was met mainly by overtime, casual labour being scarce. Horse-work was below twenty-five hours per horse-week in only six weeks during the year.

TABLE IV

Labour spent on	*Produce sold or used as seed.* Hours (1)	*Sheep.* Hours (2)	*Cattle.* Hours (3)	*Pigs.* Hours (4)	*General.* Hours (5)	*Total.* Hours (6)	*Per cent.* Hours (7)
Cereals	6,999	743	76	202		8,020	24·4
Root and Forage Crops		7,468		17		7,485	23·2
Hay and Grass	164	1,897	140			2,201	6·8
Live stock		8,967	398	80		9,445	29·4
General					5,238	5,238	16·2
TOTAL	7,163	19,075	614	299	5,238	32,389	
PER CENT.	22·1	58·9	1·9	·9	16·2		100·0

Note.—The labour on horses has been distributed in proportion to horse-time worked.

Bringing together Tables I, II, III and IV, the importance of stock and crops in making use of land, capital and labour appears, and the economic basis of the farming is expressed in statistical form which admits of comparisons with other farms and with the financial results obtained.

We are now in a position to approach the financial analysis of the business with some precise knowledge of its structure. Our next concern is with the terms in which the results should be expressed. It has been sufficiently emphasized already that many of the most important products of the farm arise jointly, and that in these cases no comparisons between the costs of each of the joint products can be looked for. On the farm cited in Tables I to IV the interdependence is most clearly marked in the case of corn and sheep, and this joint enterprise occupies practically the whole of the arable land. The cattle and pigs might almost be regarded as distinct enterprises. The corn and sheep are the major activity, cattle and pigs are subsidiary. The methods by which each of these enterprises individually might be scrutinized by the farmer have been discussed in Part I of this chapter. Our present problem is the presentation of the facts in such a way that the results can be made use of comparatively, and used as a basis on which general statements can be made as to the conditions determining success, given reasonably efficient management.

The Basis of Comparisons.—When we are dealing with farms of different sizes it is clear that comparisons must be made in a form which permits of the influence of size upon the total earnings being shown. In manufacturing industry large size connotes multiplication of machines or a large investment of capital; in agriculture it implies, rather, a relatively big area of land. It seems desirable, therefore, that comparisons should be made, whenever possible, in terms of the net returns per acre of land. This may not be entirely satisfactory in all cases, as it may happen that some 'factory' adjunct, such as pig fattening, is a feature of the business. But it would be still more unsatisfactory to attempt to express results merely in terms of the returns from £1 spent in different ways. £1 spent on growing corn may suffice to pay for labour and seed on, say, an extra $\frac{1}{4}$ acre of land, but £1 spent on growing food for cows may mean adding to the area of mangolds not more than, say, $\frac{1}{12}$ acre, and if it is spent on purchased food for pigs no extra land at all is used. But, conversely, if the unit

on the basis of which comparisons of output are made is a given area of land, say 1 acre, it is apparent that the investment of different sums of money will be required in exploiting it in various ways, and for some purposes practically no land is used except as standing room. Some compromise is necessary, and it must be one which is both practical and in accordance with the conditions governing the industry. There seem to be two considerations of importance. In the first place, in farming land is the fundamental factor in production; in the second place, the payment for the use of money is determined largely by conditions external to the industry, whilst the payment for the use of agricultural land is in the main determined by conditions arising within the industry itself. Under these circumstances it seems clear that, whenever the use of land is involved, it is best to make the output of a given unit of area the basis of comparisons, making allowance, if need be, for differences in the amount of capital required for exploiting it by charging interest at current rates. This means that when no additional use is made of land the return to added expenditure is not strictly comparable with returns to expenditure in which the use of more land is involved. An example will make the distinction clear. £1 spent on extra purchased food for pigs, in the hope of getting 30*s*. worth of pork, does not affect the working of the farm in other respects. £1 spent on growing more corn means diverting say $\frac{1}{4}$ acre of land from some other productive use. The two cases are not of the same order, and it is desirable that the difference should be shown in the manner in which the results are presented.

Thus, the object in view is so to classify and arrange the income and expenditure of the farm that there will emerge

(i) the costs and returns per unit of land, devoted to those single or joint enterprises which are based upon the use of any portion of the land which can be distinguished from any other portion separately used, e.g. in Table I, the land devoted to corn and sheep on the one hand, and to cattle on the other.

(ii) where the processes make use of a small area of land merely as standing room, the costs and returns in terms of some convenient unit, e.g. per pig fattened, or per 100 head of laying-birds, or per cow fed entirely on purchased forage, as the case may be.

Since, however, in a large number of cases the whole area of the

farm will be devoted to the production of mutually dependent products, and in nearly all cases some portion of the land will be so used, it is clearly necessary to show how the costs of performing the functions involved in the system of farming practised vary from farm to farm, viz. the costs of the provision of power and equipment, the costs of maintenance of fertility in association with live stock, and the further costs and returns in producing crops or live-stock products for sale after the maintenance of fertility has been provided for. In each case we must have regard to the acreages of land available for use in one way or another under the system practised. It will be essential to know not only what it costs to maintain the fertility of a given area of land by the use of cattle or sheep, but how much of the land remains, after providing for the upkeep of the stock, for producing crops for sale. This is a point of material importance when comparisons between intensive and extensive practice are being made.

It remains now to consider how the farm accounts can be organized to arrive at the data required simply and effectively. Behind the costs and returns in money there lie the hours of manual or horse work, the quantities of seed, manure or food required in production, and the yields obtained. These 'basic' costs and returns are physical equivalents, subject to fluctuations about the 'normal' common to all agricultural data, and these are the fundamental facts for comparison. They underlie the farmer's decision to include or exclude a crop when arranging his rotation, or to use one kind of stock in preference to another: they allow of the influence of prices upon the returns being estimated in advance. But they do not suffice for a complete statement. It is necessary to think in terms of money values, since there are a number of expenses, such as depreciation, repairs, taxes, which permit of statement in no other form. The accounts for elucidation of costs must therefore be kept in terms of money, but the 'basic' costs should appear as the physical equivalents of outlays wherever possible.

The Linkage of Financial and Cost Accounts.—In proceeding to the details of the accounts an accounting principle of some importance should not be overlooked. It is most desirable that it should be possible to establish the connexion between the results of the analysis of costs and the ordinary financial accounts. Very little experience is sufficient to show the danger of basing conclusions

on sections of accounts without first making sure that, when the results of each section are added together, the aggregate will agree with the total arrived at by dealing with the business as a whole.

Now the account which makes the strongest appeal to the farmer, or indeed to any business man, is the statement showing the profit or loss for the year. It is desirable that the cost accounts should be related to, and should as far as possible explain, the Profit and Loss Account. The statement of profit or loss arises from the valuations made at the beginning and end of the financial year, and from the receipts and outgoings of the year as revealed by the cash account and the records of outstanding debts and credits. The distinction between a valuation for the estimation of profit or loss for any period and a statement of the costs of unfinished processes during that period has emerged at different points of the discussion in Chapter I. At best the valuation adopted for the annual financial accounts is an interim approximation in the case of growing and unsold crops, or of stock in process of passing through the farm, for the purpose of assessing the amount which the farmer may safely spend for his own private and household purposes, and on which he may fairly be asked to pay Income Tax. In making that valuation the valuer and farmer will have in mind the trend of prices, the condition of the land and the prospects of the crops. But costing is a process in which approximations have no place at all if they can be avoided; it deals with outlays when they are incurred and returns when they are realized. Through the eyes of the cost accountant the farm is a machine in motion; for the upkeep of the machine certain charges of a general character run on from year to year, into the machine labour and fluid capital in the form of seed, manure and food-stuffs are fed for specific purposes, and there is a constant outflow of products, in producing which different and overlapping periods of time will elapse. Any period of twelve months does not embrace within itself the completion of many of the cycles of operations involved in farming. The growth of a wheat crop may in this country cover a period from September to September, but the crop is rarely threshed and marketed within twelve months from the initial preparation of the land, and the financial accounts may, moreover, run from Lady Day to Lady Day. A flock of ewes may be bought in October to lamb in the spring,

but all the progeny may not be disposed of until the end of the following winter. Farming operations for various crops necessarily overlap any period of twelve months, and the calculations involved in determining the costs and returns per acre from crops and stock will not normally cover the same period as the financial accounts of the farm. A year is, however, a convenient period for the assessment of average overhead charges, and for calculating the expenditure and returns upon live-stock enterprises of a character which depend to any major extent upon purchased foods, e.g. milk production or pig fattening. It follows, therefore, that the process in cost accounting which corresponds to valuation will be merely the bringing forward of expenditure on unfinished processes which will, in due course, be set off against the resulting sales. Hence, if the cost accounting year should correspond with the farm financial year, and it is convenient that it should do so wherever possible, the net results of the two accounts will not necessarily be the same; but the amount by which the two figures will differ will be entirely explained by the excess of the opening and closing valuations over the cost account balances brought forward at the beginning, and carried forward at the end, of the year respectively. A simple Reconciliation Statement in the following form should, if the work has been accurately done, be sufficient to check the clerical accuracy of the apportionments made in the costs analysis:

Profit as shown by Trading or P. and L. A/c	£500
Add excess of opening valuation over Cost A/c balances at beginning of year	250
	750
Less excess of closing Valuation over Cost A/c balances at end of year	300
'Surplus' shown by Cost A/cs	£450

What has been termed the 'Surplus' merely represents what is revealed to have been realized on produce disposed of during the cost accounting year. It is not influenced, as is the 'Profit', by estimates of the value of unsold produce in hand; it may vary much or little from the 'Profit' according to the amount of disposable produce in hand at the opening and closing stock-takings.

It is now necessary to determine on what basis the various expenses of the farm ought to be classified in order to arrive at the information the accounts are required to give.

The Classification of Expenditure.—In estimating the comparative advantage of adopting one of the alternatives open to him at any given time, the farmer need not take into account expenditure which is common to each. But where the system as a whole is under investigation, or comparisons are sought between farms, the whole of the investment, both in the form of capital outlay and current expenses, must be reviewed. The fact that some expenses fluctuate in direct relation to the cropping and stocking of the farm, and other expenditure is related to the system as a whole and is not directly influenced from year to year by minor change, suggests a basis of classification.[1]

Prime Costs and Overhead Expenses.—The distinction between 'prime costs' and 'overhead charges' is common to all cost accounting systems, but the grouping of expenditure under these two headings calls for some discussion.

Prime costs have been indicated to be those expenses which tend to vary in amount from year to year according to the extent of the several enterprises carried out, and which are therefore suitable subjects for apportionment in the accounts. Generally speaking, the costs of cultivation, the seed and artificial manure applied are prime costs of cropping. Similarly, the costs of labour, foods and other direct expenses are prime costs of the live stock. Charges which are more general in character, and which tend to remain unaffected by relatively small changes in farming policy, constitute the 'overhead expenses'. These are not apportionable on any precise basis in the accounts and are most suitably compared in totals.

(A) *Prime Costs.*—These will include labour, horse and tractor work, feeding-stuffs, artificial manures and certain charges for equipment, together with minor expenses incurred in connexion with particular enterprises.

(i) *Labour.*—Labour would appear to be essentially a prime cost of the various operations of the farm, and for practical purposes it may usually be so regarded, though where the supply of labour is comparatively fixed, and no casual labour is available, the wage

[1] See page 83.

bill may tend to show little variation in total from year to year. This is the case where a certain minimum number of men is required by the farming system, whose wages must be paid whether profitable work can be found for them at all seasons or not. Such conditions occur in areas remote from industrial centres, e.g. parts of Dorset, where wages tend to be low but a nucleus of workers must be kept together in order to cope with work at hay harvest. Again, on some dairy farms the number of milkers required may determine the number of men employed. However, even on such farms there is always some flexibility in the number of hours of work available within overtime limits, and it is well worth while to be able to estimate if the time actually spent could have been used more profitably in some other way. There is always, too, the possibility that a machine may reduce the number of hours of manual work at the critical point. Bearing in mind the lower limit of total labour cost in particular instances, labour can usually be treated as a prime cost for purposes of analysis. Family labour, if applied to ordinary manual processes, should be recorded in hours in the labour records together with paid manual work, and for comparative purposes it is convenient to give it a value at so much per hour. This does not introduce any error into the accounts, since the sum debited as a labour expense will be credited in the private account of the farmer as part of his income. It seems essential that this should be done if comparisons between production costs on small holdings and on larger farms are to be made with accuracy. Cottage rents, Health and Employers' Liability Insurance charges, milk and other allowances will enter into the total labour cost.

In view of the necessity for taking average figures over a series of years before any very reliable costs are obtained, and realizing too that time cannot be recorded very accurately on some work, it would seem to be unnecessary to strain after a very exact apportionment of the money wage. It is, however, desirable to group the workers according to their wage rates—keeping men, women, and boys distinct, and to apportion the money cost with reference to these groups separately. Otherwise the economy of employing women and youths on work like potato planting and lifting is lost sight of in the accounts unless, indeed, it is charged as piece-work direct to the accounts concerned.

The farm diary or labour sheets will provide a very necessary

safeguard in the compilation of costs. For making simple comparisons between the outlays on alternative crops, or for determining the amount of manual labour, horse or tractor work on a particular operation, a little care in extracting the time worked may be sufficient. But in allocating costs over the whole year it is very desirable to see that the total labour outlay is allotted to some account. Where investigations are being made continuously over a period, it has been found convenient to summarize the labour and horse work in terms of hours weekly, in crop, stock, and other suitable accounts, leaving the apportionment of the money costs to be made at longer intervals.

(ii) *Horse Labour.*—Horse labour has more frequently an overhead character. It often happens that the number of horses maintained on a farm is dictated by the needs of the farm at busy seasons; at other times the horses are not employed to the limit of their capacity. But it is also the case that horses lightly worked will be fed lightly and will depreciate less rapidly, so that it is reasonable to regard their total cost as varying according to the demands made upon them for work. Hence horse labour will be apportionable as a 'prime cost' of operations. There would, indeed, be little advantage in apportioning the costs of manual work unless the costs of horse-work were similarly divided, since, under present conditions in this country, horses and men are jointly used in most of the major operations on the land. To avoid the theoretical and practical difficulties inherent in an attempt to base the costs of home-grown forage fed to horses upon 'cost of production', and also to hold the scales evenly between those farmers who sell their oats and buy in horse forage as a matter of policy, and those who feed their own home-grown oats, it is proposed to adhere to the principle suggested on pages 90–1, of charging horses with home-grown oats and saleable forage on the basis of the 'farm values' published by the Ministry of Agriculture and Fisheries in its 'Journal' month by month. This practice has no influence upon the net surplus of the farm, since the amount debited to horses is credited to the saleable crops.

(iii) *Tractor Work and Hired Machinery.*—It would be convenient from many standpoints to treat the cost of tractor work as an overhead expense, were it not for the fact that to do so would be inconsistent with apportioning the costs of manual and horse work

in cultivation, the tractor being an alternative means to the same ends. Its apportionment will not prevent the total costs of power being studied comparatively as between farm and farm. The division of the tractor expenses over the work done is probably best made on the basis of the gallonage of paraffin used, but this is, in practice, difficult to ascertain with precision—there is frequently a good deal of paraffin unaccounted for at the end of the year—and apportionment on the basis of hours worked is simpler. Hired machinery will be chargeable to the jobs for which it is used. If it should be considered that the use of horses, tractors, or hired machinery ought not to be allowed to introduce differential costs into the accounts for similar work, it would be quite practicable to determine the total costs of ploughing and other operations, as suggested by Mr. Orwin,[1] and apportion them *pro rata* over the acreage worked. Generally, however, the more direct method of charging the expenses incurred to the jobs will not introduce very much error as between one operation and another, if outlays are averaged over a period of years.

(iv) *Purchased Feeding-stuffs, Artificial Manures, &c.*—Given adequate records of the use made of these materials, their apportionment in the accounts is only a matter of book-keeping, but a check on quantities received and used is necessary if errors are to be avoided.

(v) *Certain Equipment Expenses.*—It will be suggested in the following Section that the costs of use of implements may usually be treated as an overhead expense, but they may nevertheless be considered with advantage in some cases as chargeable to the crops for which they are specifically used. This applies where the introduction of a crop may mean putting in a special and expensive equipment, e.g. the construction of a silo and the purchase of a cutter and blower. Charges of this character are, however, possible without carrying out a complete allocation of the costs of implement use over the whole farm.

The justification for attempting the apportionment of prime costs within the farm is, that otherwise comparisons must be confined to aggregate expenses under each head. It is only by establishing the actual distribution of power and resources within the farm that the physical basis of production appears, and can be

[1] *Farming Costs*, Appendix 1.

made the subject of comparative study. Labour, horses, implements, manures, if they are to be utilized ideally so as to give the maximum employment to each, might severally require a quite different scheme of cropping within the physical limits set by size, soil, and climate. Given a scheme which makes full use of one factor, so that its costs may be regarded as 'prime' costs, the other factors may assume the character of overhead charges, since the total cost of their use will depend upon the employment of a certain minimum quantity of each which may not be fully utilized. The problem of the farmer is to make such combined use of all the productive resources at his disposal as will make the total result the most favourable. The economist must, however, face the labour of apportionment, since otherwise the directions in which waste occurs under unsuitable conditions of production are not revealed.

It is perhaps curious that the classification of costs in farming reverses, in one respect, the usual order of classification in factory industry, where power may frequently be an overhead charge in production. In farming, power, being furnished largely by manual and horse work, is a factor in production which lends itself most easily to apportionment.

(B) *Overhead Expenses.*—Some overhead expenses are common to the farm as a whole. Others are common to a section of the farm, but may not be shared by other activities. These two groups may be distinguished conveniently as 'General Overheads' and 'Sectional Overheads' respectively.

(a) *General Overhead Expenses.*—(i) Establishment expenses. These will vary in character from farm to farm according to the system of management. They may include such expenses as the bailiff's wages, the use of the farmer's car, office expenses, and the costs of general jobs about the farm for hedging, ditching, and sundry work of a general kind. The attempt to apportion these charges between the productive activities of the farm merely introduces uncertainty into comparisons which are otherwise more definite. Some are the subject of separate cash payments, e.g. bailiff's wages, office expenses, &c. Others may have to be picked out from the labour analysis or from tradesmen's bills, and these find their way into 'General Overheads Account' in the process of apportionment of the farm outgoings.

(ii) Bank charges and interest on overdrafts or on borrowed capital should be posted into a separate account. They are the costs of financing the business. They affect the farmer's ultimate income from the farm, but they should not be allowed to influence the estimates of working costs.

(iii) Rent, and any outlays which vary with the rent charge, may, for some purposes, be regarded as overhead expenses, but in cost accounting it may be preferable to arrive at comparisons of costs and returns before bringing the net result into relation with the rent charge, since this will tend to adjust itself, with greater or less rapidity according to the circumstances, to any change in the margin available. The annual letting values of the Northamptonshire grazing pastures reflect the graziers' estimates of returns from the fattening stock, and wide differences in rent may be recorded from year to year: in other cases rentals adjust themselves more slowly to persistent price tendencies. Hence rent, rates, tithe, and land tax should also be recorded separately, together with mortgage interest and costs of upkeep of buildings. These are the costs which arise from the conditions of tenure. Again, they affect the farmer's income as owner-occupier or as tenant, and they afford important comparisons from that standpoint, but they should not be allowed to disturb comparisons relating to the use of the land.

(iv) The depreciation and maintenance of any equipment, buildings, or implements which are used in common by all sections of the farm. The case of implements is discussed under 'Sectional Overheads' below.

Overhead expenses of a general character, reduced to a comparable basis as far as tenure and management are concerned, can be expressed as so much per 100 acres of the farm for the purposes of comparing one farm with another, and for considering the effect of size upon the economy of working.

(b) *Sectional Overheads.*—Under this heading are classified expenses which, whilst peculiar to a section of the farm, are not apportionable on any satisfactory basis between the activities which occur within that section. These may include:

(i) *Supervision.*—That proportion of a foreman's time which is devoted to supervision.

(ii) *Drainage Costs.*—Any annual charges for the amortization of

the costs of drainage or other improvements affecting one section of the farm activities.

(iii) *Implement Charges.*—Certain charges for the repair and depreciation of implements used specifically for some enterprise, including, in the case of arable land, any equipment used by the live stock associated with the arable land for the maintenance of fertility. The use of implements is an expense of the farm which is often treated as a prime cost of crops or stock, but which, on closer analysis, may be found to be, in effect, a general charge. The costs of maintenance and depreciation of implements are, in farm cost accounting, sometimes charged against the work of the farm either in proportion to the number of horse-hours worked on the various jobs, on the principle that the use of horses is generally associated with the use of implements, or, if more exact account is kept of the actual employment of each implement, the apportionment is made having regard to the acreage covered, or to the specific purpose for which the appliance was used during the accounting period.[1] These two methods are not consistent in their results. The cost of upkeep and depreciation of a plough might amount to, say, 2*d.* or 3*d.* per acre ploughed, whilst similar charges on a binder might be 2*s.* or 3*s.* an acre. The amount of horse-work in ploughing an acre would, on the other hand, be more than the amount of horse-work in binding on a similar area. In so far as a certain system of farming may give rise to the need for a minimum equipment of various kinds, and where the number and kind of implements required can only be varied within narrow limits by any alternative in cropping, it would seem reasonable to treat the cost of implement depreciation and repairs as an overhead expense. Wear and tear is determined by the work done by an implement, but depreciation and obsolescence are inevitable, and are not necessarily connected with the number of times the implement is used. It will, however, frequently happen that some implements are used for a particular section of the farm activities which is, in effect, run as a separate unit. This will be the case where the arable land and its associated live stock are organized without reference to the use of some or all of the grass-land, for which a distinct live-stock policy is in force, as in the example in Table I. Here the upkeep of the arable land implements would

[1] *Offices de Comptabilité*, p. 195.

clearly be an 'overhead' charge of the arable land and its associated grass. Similarly, some implements may be used solely for certain classes of stock. Dairy utensils are a case in point. Their costs of upkeep and depreciation would suitably be regarded as a charge against the cows or dairy. It is therefore convenient to classify implements in the inventory into groups which correspond with the main divisions into which the farm activities fall, in order that the charges for upkeep and depreciation may be allotted sectionally.

Although it has been suggested that interest on the capital cost of implements ought not to be overlooked when the advisability of adopting one or other of alternative machines or methods is under consideration, it is not proposed to introduce interest on assets as a charge in the cost accounts. Comparisons of investment, and of the interest which such investment should carry, are more suitably made in total than in detail.

The classification suggested for the overhead expenses is based upon a preliminary dissection of the farm business into its component parts. It will be apparent, however, to all who are familiar with British farming that the farm may not always lend itself to any clean-cut divisions. The dairy enterprise, which in some areas, e.g. in parts of Dorset, exploits a definite and clearly defined group of fields occupying the lower grass and arable land, and which is frequently the subject of distinct arrangements for labour, will, in other districts, be dovetailed into the arable policy as part of what is virtually an indivisible enterprise. The line between general and sectional overhead charges will not, in consequence, be uniformly defined. In the same way, as has been indicated already, the distinction between prime costs and overhead expenses cannot always be drawn with precision. The labour of the smallholder can only be regarded as apportionable for comparative purposes. Each group of farms must, in fact, be considered on its merits, and it will frequently happen in practice that differences of a minor character may have to be ignored if comparisons are to be made at all. The determination of costs in farming must be carried on in the same spirit as that in which the farmer conducts his business. He has to paint his picture on the landscape with a broad brush, taking the risks of the season and looking at the result as an artist looks at his canvas, so as to take in the total effect. His paints are his men, horses, and equipment,

and he must arrange them in combination to economize in the use of each, having regard to the circumstances prevailing at the time. The cost accountant must follow suit and look at the farmer's intentions broadly. He must avoid the danger of missing the real problem by giving undue importance to detail. It would appear to be better to look behind the crops and the stock to the part they play in the farm economy, and deal with their costs accordingly, making such allowances or reservations as the practical man would do when making his decisions on farm policy.

The Grouping of Costs and Returns.—Having decided what expenses should be regarded as prime and overhead charges respectively, the cost accounts may be compiled so as to throw light upon the costs of carrying out the functions essential to the proper and continuous working of the holding. Where the land and climate in the area under investigation are primarily suitable for the production of arable crops for sale, as is the case on the richer and drier arable soils of the Eastern Counties, the costs and returns from the live stock may properly be considered, having in view their function as agents for the maintenance of fertility. In other areas, where live-stock products are the main objective and saleable crops are of secondary importance, the costs of maintenance of fertility may be regarded as incidental to the live-stock enterprise.

Given, then, a group of farms on which the conditions of production are fairly homogeneous over the whole of the farm, or some part of the farm, which is in effect operated as a sectional enterprise, and on which the output of saleable crops is the main feature, the grouping of expenditure for comparisons between farm and farm may proceed on the following lines. The general and sectional overhead accounts having been compiled, the outlays on stock utilized for the maintenance of fertility would be brought into association with all other prime costs incidental to that process, and be set off against the returns from such stock. Similarly, the prime costs of saleable crops would be computed and compared with yields and prices realized on sale. The acreages devoted to crops and stock respectively would be noted. The principles on which the costs of maintenance of fertility should be compiled have been discussed in Section III of Part I of this chapter.[1] The procedure is simply to bring together the prime costs incurred on the root and forage crops fed to the stock and

[1] Pages 96–100.

all other outlays on the stock, and set off against these expenses the sales of animal produce and any increase in valuation of the stock. In addition there must be brought into account the outlays on labour, horse-work, steam or tractor cultivation on bare fallows, weeding operations in the other crops, the cartage, clamping and spreading of farmyard manure whether applied to the roots or to other crops, the costs of purchase and distribution of general fertilizers such as lime, and any similar charges which are related to the upkeep of the land in a state of general fertility. For reasons already adduced,[1] it is proposed to treat the costs of quick-acting manures, applied to corn or potatoes in accordance with the requirements of those crops for giving the best results, as being, for comparative purposes, chargeable to them.

The fact that a considerable aggregate expenditure, and often considerable returns in sales, are involved in the use of stock for the upkeep of fertility, need not deter us from following out the calculation of its cost to a logical conclusion, nor from taking any short cuts that may suggest themselves. Thus, on farms depending upon yard-fed bullocks for manure, all expenses incurred in connexion with the stock, and with the distribution of their dung, might be debited to a 'Fertility Account' without apportioning the labour on manure amongst the several crops to which it is applied; labour on weeding and other cleaning operations might be debited to the same account together with all operations on roots, on fallows and on crops like mustard grown for ploughing in. The costs of the individual processes need not be overlooked and they can be examined for cheaper and better alternatives; but in the end, if comparisons between farms of similar type are to be made, the economy of one or other means of maintaining fertility will be shown by comparing the *total* costs of the process, on a unit of say 100 acres of land, side by side with the returns (after deducting the direct expenses incidental to their production) derived from the saleable crops obtained. If it is clearly realized that the objective is *not* the cost of roots, nor the cost of meat, but the cheapest method of carrying out an essential function efficiently in order to maximize the net returns from the land, any difficulties of classification will readily be overcome.

This procedure in elucidating the costs of farming, where live stock and crops enter jointly into the economy of the farm, avoids

[1] Pages 55–8.

a number of apportionments to which exception was taken in the earlier chapters. Where the costs of keeping land in fertile and clean condition are being compiled, for comparison with similar costs on other farms, no apportionment of those costs between the roots and other crops is necessary. Similarly, no division of the costs of the grain crops between grain and straw need be made: sales of both add to the gross returns from the crops; if grain and straw fed are transferred at 'farm values' the potential earnings of the crop and potential feeding costs of the stock appear; straw used as litter is merely circulating within the farm for the maintenance of fertility and need not be charged. Again, no estimate of the manurial value of foods fed to the stock is involved, and residual values of manures need only be carried forward where fertilizers are applied at irregular intervals of years, as in the case of dressings of lime and slag, for the benefit of the land generally. Even in these cases, if dressings are applied on a rotation basis, each year may well bear its own charges. If any definite improvement, as distinguished from mere maintenance of fertility, is deemed to have arisen, its value would have to be assessed independently of costs, and would at best be the subject of estimate. It would, however, be prudent generally to ignore its value for the purpose in view until its tangible advantage is realized in better crops.

It may be desirable, at this point, to meet an objection, viz. that if the costs on arable land are classified with reference to the function performed by the live stock in connexion with the maintenance of fertility, so many processes are in fact involved that the objects of cost accounting are largely lost, since the aggregate cost of, or surplus upon, the maintenance of the land clean and fertile through the stock may include costs of cultivation, of feeding and of marketing, and will be influenced by many factors, each of which should be the subject of separate study. The answer to this objection is that a study of farm management must have, of necessity, more than one method of approach. For a complete survey of a forest one must look at the lay-out of the trees as a whole and also at each class of trees separately. Whilst the efficient working of the farming system is of primary importance, a study of the whole does not do away with the necessity for examining the constituent parts, with a view to making each as efficient as possible. But the study of separate crops or of different processes is only likely to be of value if, in the first place, the part

each plays in the whole scheme is clearly in mind. It is first necessary to make the general system fit the environment of the farm; the components of the system can then be brought profitably under review.

When the cost of the contribution of the live stock towards the maintenance of fertility is determined in the manner suggested, the further costs of the production of arable crops may be approached. Each crop will require its own particular cultivations, appropriate seeding and manurial treatment, but their respective acreages and positions in the rotation will be arranged having regard to the convenience of each in the scheme as a whole. Thus, the returns from all the saleable crops together would have to be considered. As between the individual crops, the margins between costs and returns are only comparable if the crops are interchangeable. If one of two alternative systems of cropping tends to foul, or to clean, the land more than the other, the effects upon the costs of cleaning or upkeep of fertility should appear in the comparative statements, as well as any advantage derived from the saleable crops themselves. We must therefore aim at bringing together the outlays and returns on a number of farms of similar physical characteristics, in such a way that the combination of activities which is giving the best net returns can be observed. If accounts are presented for each farm in terms of (*a*) overhead expenses, (*b*) surpluses of returns over prime costs on saleable crops, and (*c*) surpluses or deficits arising from the use of live stock or other means for maintaining the fertility of the land, on a unit of say 100 acres of land, the factors determining the net result will emerge. If the farm is, in fact, one indivisible enterprise the unit of 100 acres will cover the activities of the whole of the farm on a proportional scale. But if the farm embraces two or more sectional enterprises, such as arable sheep farming, and also dairying, each of which may be considered on its merits, the calculations would be made per 100 acres devoted to each for comparison with similar enterprises on other farms.

Before giving some illustrations drawn from actual cases it will be necessary to refer to some points of principle in the allocation of costs for the purpose in view, concerning, firstly, the costs of the grass-land used in association with the arable land, and, secondly, the costs of home-grown crops for the feeding of stock.

Grazing Charges.—If the primary function of the live stock is to

keep up the fertility of the arable for the production of saleable crops, the acreage of grass necessary for the proper maintenance of the stock must be included in the arable enterprise. Should the area of grass which, for physical reasons, has to be maintained on the farm be greater than the acreage required to give a proper balance with the arable land, the remaining grass-land should, if possible, be treated as a separate unit on which other, or additional, stock are maintained to exploit the excess grass-land for profit. On the Dorset farms to which reference has already been made the arable-sheep enterprise may involve the use of some grazing land for the sheep, but this will frequently be distinct from the fields occupied by the dairy stock.

But even if the grass be used jointly by the arable and other stock we need not on that account be deterred from classifying the farm activities into the main groups into which they fall. This is one of those cases in which the farmer's intentions as to the primary use of the land must give guidance. Bearing in mind that comparisons can only be made satisfactorily between farms of the same general type, there will be little error if the allocation of the grass area is made on the same principle in all cases. A common case arises in connexion with the grazing for the working horses. On purely arable farms a small acreage of grass is nearly always reserved as a paddock for the horses, and where there is more grass it is often the practice to reserve a field for their use. But where they graze the general pastures in common with other stock, the area chargeable to their use should not be greater than they would require if their needs were the sole consideration; otherwise the inadequate use of the grass for stock would throw a disproportionate charge upon the arable for the costs of horse maintenance, and the failure of grass-land management would not be revealed. The matter is not of great importance so far as actual money costs are concerned. If rent and rates are treated as an overhead expense, the remaining outlays on grass-land for grazing will not be considerable. But if the net return per 100 acres of land is to be used for comparison with other farms, the correct allocation of the acreages of grass used for different purposes becomes more significant.

Should the whole of the grass acreage be utilized, say, for dairy cows, which also consume the roots and forage crops from the arable land, the grass and arable together may have to be regarded

as the farming unit. In that event the returns from using a few sheep to eat up the grazing residues left by the cows are most suitably treated as a by-product of the dairy herd; the sheep do not in that case constitute an independent enterprise on the farm, and no proportion of the grazing need be allotted to them. It may, however, be the practice of the farmer to use certain fields for particular classes of stock. Frequently, for example, the more distant or poorer fields on dairy farms are given up to young or dry stock, the nearer and better grass being reserved for the cows. If such a division of the grass acreage is possible it is desirable to make it, since the proportion of poorer or outlying land on a farm may have some influence upon live-stock management, and its exploitation might, under some circumstances, be considered as a separate enterprise within the farm. Inquiry will frequently reveal that, where the land is of variable quality, the farmer's motives in using the different sections of the farm virtually give rise to sectional enterprises, each of which can be considered on its merits: otherwise it will be necessary to regard the whole of the farm as a single unit in the accounts.

On grass farms carrying two or more classes of stock which graze the land in common, it may happen that any apportionment of the area will necessarily be arbitrary. It is then preferable to treat the costs of the grass as being, in effect, a sectional overhead expense to be carried by the stock as a whole. The form of comparative statement on grass-land enterprises would thus be designed to show, per 100 acres of land, (*a*) the overhead expenses, (*b*) the excess of returns over apportionable costs on each class of stock carried, (*c*) the surplus over prime costs on any saleable crops obtained incidentally in providing the stock with forage.

Home-grown Foods.—It has already been proposed, in the case of roots and forage crops grown in an arable rotation and consumed by stock in the process of maintenance of fertility, that the prime costs of such crops should be the basis on which they are included in the total costs of the process, subject to the overhead charges to be carried by the enterprise as a whole. The chief accounting difficulties are due to the fact that in practice the rationing of home-grown foods is frequently inexact, and measures of quantity are often rather rough approximations. But for many purposes no very exact records of feeding are necessary. The number of acres of roots or hay consumed can, with very little

trouble, be estimated with fair accuracy. Whole fields will often be devoted to folding with sheep. Sometimes one row of roots out of every three will be carted off to cattle and the remaining two rows consumed on the land. The apportionment of the outlays on an acreage basis is then straightforward. A stack of hay can be set aside for horses, and if a stack has to be used for several classes of stock only a very little care is necessary to be able to decide how many acres are used for each purpose. Grain stored in heaps in the barn should be weighed when threshed and can be issued in skipfuls of known content. 'Catch crops' are sometimes taken to utilize the ground during the interval between main crops; land under rotation grass may be mown and then grazed, or mown twice, or grazed entirely. It is clearly impossible, in these cases involving a divided use of the land, to regard the acreage as apportionable between distinct enterprises. All that seems to be necessary, and indeed all that is practicable, is to allocate the prime costs involved to crops or stock as the case may be, and then compare the net return from the land with the net return from land cropped on a different system.

But with cereal crops producing grain and straw, either of which may be sold or fed according to the circumstances prevailing, the apportionment of the prime costs of the crops cannot be made on any basis that is not open to objection. The grain may be sold or part sold and part fed, the straw may be sold, fed to stock, or used for litter or thatching, but policy varies from farm to farm and from season to season. Moreover, where two distinct enterprises are found to exist side by side on the same farm, and grain or straw grown in association with sheep on the arable land is fed to cows or other stock, any system of charging the produce to the stock which ignores the quality and effective value of the crop is clearly unsatisfactory to the arable enterprise, and fatal also to comparisons between dairying or feeding carried on under the conditions described and under conditions involving the purchase of grain or straw. To avoid the objection that the selling prices of produce are not satisfactory measures of their potential values if put on the market in larger bulk, it is proposed to fall back, in the case of foodstuffs, upon 'farm values',[1] which are based upon the prices of alternative food-stuffs, ignoring the value of straw conserved on the farm for manure-making or minor purposes. The

[1] See pp. 90, 91.

same principle may apply to seeds hay produced in excess of the requirements of the stock associated with the arable land for the maintenance of fertility and fed to other classes of stock. As long as the farms under comparison are homogeneous in type, uniformity of principle will give rise to comparable results. The difficulties of comparison arise when farms of distinct types in different areas are being reviewed, and when entirely different methods of use or disposal of crops may be practised.

On farms where the live stock play the predominant part, and where policy is dictated by the requirements of the stock rather than by an attempt to produce arable produce for sale, the grouping of expenses and income would be somewhat different from that adopted on arable farms. In these cases the management of the land, whether it is under arable crops or grass, would be dictated by the needs of the live stock for food. Saleable crops such as potatoes, taken in rotation, would under these circumstances provide a cash income in relief of the costs of providing forage, and they would only be grown if the returns showed some surplus over the prime costs they incur. If there were any choice of saleable crops within the limits set by the convenience of the rotation, that choice would be determined by the selling values of the crops compared with the prime costs involved in their production, that is, by their capacity for making use of the live-stock residues economically. So far no difference of method appears, but with cereal crops grown for their straw or for forage, which may leave some excess of saleable grain or other produce after providing for the needs of the stock, the cash return which they may bring may reasonably be considered as a set-off against the costs of the straw and of consumable produce. If a number of farms of such type were to be compared, the basis of comparison might well be the returns per 100 acres of land arranged so as to show what are the net returns on live-stock produce and saleable surplus grain, less prime costs incurred in connexion with the live stock, including in this case the grain crops, on the one hand, and the net returns over prime costs on other crops such as potatoes, taken as it were in passing, on the other hand.

We may now pass to some illustrations of the method which will perhaps fill in any gaps in the explanations already given.

(i) The two Nottinghamshire farms of identical size and soil type referred to on pages 127–8 will afford the first example. The dairy stock being the

fertilizing agency on both farms, milk and saleable crops are jointly produced and the whole farm is regarded as the unit of account in both cases. Overhead charges, which showed little variation in two consecutive years, were as follows:

	FARM A.						*FARM B.*					
				Per 100 acres.						*Per 100 acres.*		
	£	*s.*	*d.*	£	*s.*	*d.*	£	*s.*	*d.*	£	*s.*	*d.*
Hedging and Ditching	83	19	5	36	4	0	19	13	4	8	8	0
Implement depreciation and repairs	91	5	10	39	6	0	128	10	9	55	0	0
General expenses	137	14	5	59	6	0	50	12	11	21	12	0
Total	312	19	8	134	16	0	198	17	0	85	0	0
Assessed rent and rates	450	9	2	194	0	0	421	0	0	180	0	0
Investment in assets	2,820	0	0	1,215	0	0	2,865	0	0	1,225	0	0
Interest at 5 per cent. on investment				60	15	0				61	6	0

In the following Table sales have been set off against prime costs only of the saleable crops, and against the costs of roots and other expenses of maintenance of fertility in the case of the cattle, to arrive at the surpluses per acre (column 3). The results are stated comparatively per 100 acres of land. The figures given for farm B represent the average of two years' results; for farm A the results have been modified since, in the second year, changes in organization were in progress.

	FARM A.				*FARM B.*			
	Acreage utilized. (1)	*Per 100 acres.* (2)	*Surplus per acre.* (3)	*Surplus per 100 acres of farm.* (4)	*Acreage utilized.* (1)	*Per 100 acres.* (2)	*Surplus per acre.* (3)	*Surplus per 100 acres of farm.* (4)
			£ *s.* *d.*	£			£ *s.* *d.*	£
Wheat sold	18·75	7·5	5 7 0	40	45·75	19·4	8 4 0	159
Barley sold	7·50	3·0	7 5 0	22	—	—	—	—
Oats sold	1·75	0·7	2 0 0	1	8·75	3·7	6 3 0	23
Potatoes sold	3·25	1·3	(deficit) 4 0 0	−5	15·00	6·3	9 5 0	60
Meadow Hay sold	9·50	3·9	2 1 0	8	—	—	—	—
Cattle	168·00	69·0	15 0	52	142·50	60·4	4 4 0	254
Grass Sheep	—	—	—	—			—	25
Pigs	—	—	—	−10	—	—	—	—
Poultry	—	—	—	16	—	—	—	—
Horses	30·75	12·5	—	—	24·0	10·2	—	—
Fallows	5·25	2·1	—	−17	—	—	—	—
Total	244·75	100·0		£107	236·00	100·0		£521
Excess of surplus over overheads, per 100 acres, towards rent, interest and management.			(deficit)	£28			(excess)	£436

The acreage utilized (column 1) will not necessarily be the same as the farm acreage in any year, but will tend to approximate closely to it over a series of years. The acreage utilized by horses includes, in the example, the acreage of oats fed. Farm B disposes of 23·1 per cent. of its acreage as saleable grain, yielding from £6 to £8 surplus over prime costs per acre.

Farm A has only 11·2 per cent. to sell, yielding lower surpluses. In addition, B has 6·3 per cent. in saleable potatoes, yielding a good surplus in the two years, whilst farm A produced only 1·3 per cent., and was unsuccessful on the smaller acreage. The sale of meadow hay on farm A is but little compensation for the loss of saleable arable crops. Even if A's cattle policy had been as satisfactory as B's, the aggregate surplus on B would have been greater on account of the larger acreage cropped. It is apparent that in all respects the farmer's policy on A requires scrutiny and amendment, and this would lead to a close examination of the prime costs and returns on each item in the Table. But the figures tell us more than this. It is apparent that on such land no extension of the cattle enterprise would be desirable, at current values of corn and milk respectively, that would encroach upon the area under saleable crops, and a very considerable fall in corn and potato prices, or rise in the price of milk, would be necessary to make such a change economical. The yield of milk per acre of land devoted to cattle, and the yields of corn and potatoes being known, it would be easy to determine at what price levels the surpluses would tend to greater equality.

(ii) A second example is drawn from the accounts of two arable sheep farms. On both a proportion of the land is devoted to a cattle enterprise, in one case dairying, in the other rearing. Comparisons are, however, confined to the predominant feature of the farming, namely, the arable-sheep enterprise, which is based upon land of similar character overlying the chalk. Farm C exploits a Hampshire Down flock folded on arable crops. On Farm D a flock of Border Leicester ewes mated with a Down ram has recently been substituted for Hampshires, and a considerable proportion of the arable land has been put down to long leys. In both cases a very small proportion of lower grass is involved in the arable-sheep enterprise. The areas exploited are unequal, but comparisons are offered on the basis of 100 acres of land. The results are as follows:

	FARM C.	*FARM D.*
	£ *s* *d.*	£ *s* *d.*
Overhead charges per 100 acres	140 8 8	131 5 0
Rent and Rates per 100 acres	122 8 0	95 8 4
Capital Investment per 100 acres of arable-sheep enterprise	£1,207	£712
Interest on Investment @ 5 per cent.	£60 per annum	£35 10 0 per annum
Ewes per 100 acres	62	37

On the above farms two distinct systems of management are compared. Farm C is intensively, Farm D much more thinly, stocked with sheep. Notwithstanding that fact, only 30·7 acres in 100 of the land are folded on C, but the crops are, in the main, roots, and include only 7½ acres of grass, whereas on D the larger proportion (38 acres in 100) fed to sheep includes 24 acres of rotation grass. The land under saleable crops is 57 per cent. on C and only 44 per cent. on D; in fact 44 per cent. is really higher than is

	FARM C.				FARM D.			
	Total area.	*Per 100 acres.*	*Surplus over prime costs per acre.*	*Surplus per 100 acres.*	*Total area.*	*Per 100 acres.*	*Surplus over prime costs per acre.*	*Surplus per 100 acres.*
			£ s. d.	£			£ s. d.	£
Wheat	39	22	8 8 6	185	57	13	7 1 0	92
Barley	20	11·2	3 17 3	43	28	6½	2 14 4	18
Oats	12½	7	4 5 7	30	75	18	3 4 0	58
Hay sold	30	16·8	3 11 0	60	7	1½	2 12 10	4
Straw sold	—	—	—	80	—	—	—	nil
							(deficit)	
Linseed	—	—	—	—	8	2	7 7	−1
Potatoes	—	—	—	—	8	2	1 13 0	3
Rye	—	—	—	—	5	1	1 2 7	1
			(deficit)					
Sheep consumed	54½	30·7	2 8	−4	161	38	1 0 0	38
Horses	12	6·7	—	—	29	7	—	—
				394				213
Fallow	10	5·6	(deduct)	43	48	11	(deduct)	44
Total	178	100		351	426	100		169
Surplus over overheads and interest per 100 acres towards rent and management				£151				£2

normal on D, as in the year under review the stocks of saleable grain were reduced considerably, and 35 per cent. would be more nearly the average figure. There is some advantage in favour of D in the net returns from sheep, and in this respect the relative results depend in the main upon the selling values of the stock. On a rising market farm C would benefit because of the larger number of lambs for sale; on a falling market farm D would minimize its risk of loss. C's policy gives a surplus of saleable seeds hay; on D more of the grass is given over to the ewe flock. The sale of straw has given some advantage to C in the year under review, and in other seasons D might have reaped a corresponding return on a smaller scale, but the roots on D benefited by some manure from the cattle instead. It is noticeable that the surpluses of returns over prime costs on saleable crops are uniformly higher on C, and in the period under review C produced 5*s.* 10*d.* per acre, after paying rent, as reward of management to the farmer, whilst farm D had nothing left towards rent and profit. At current levels of prices and costs clearly farm C has a considerable advantage over D, in spite of higher overhead and interest charges per 100 acres.

What the changes in relative profits might be in any year clearly turns upon the amount and distribution of the prime costs, and upon the returns received from the saleable produce in each case. The surplus on corn will depend upon the hours of manual and horse labour required and other costs at current levels, upon the quantities and costs of seed and artificial manures applied, and upon the yields and selling values of the crops. With the sheep the prime costs will include purchased foods, the outlays on the forage crops and in attention to the stock, whilst the surplus earned should be considered in relation to the cost of fallows. If one method of stocking and cropping involves higher cleaning and fertility costs than the other, that fact must not be overlooked. The quantitative data should be averaged over a series of years if they are to be considered normal, but the outlays are

found to vary less from year to year than the yields. The following are the relevant data on the farms C and D, expressed *per acre* of cereal crops:

	Wheat.		*Barley.*		*Oats.*	
	C	D	C.	D	C	D
Seed . .	1·45 cwt.	1·4 cwt.	1·43 cwt.	1·34 cwt.	1·45 cwt.	1 cwt.
Manual Labour	52 hrs.	44 hrs.	33 hrs.	36 hrs.	40 hrs.	30 hrs.
Horse Labour	60 hrs.	51 hrs.	48 hrs.	54 hrs.	39 hrs.	36 hrs.
Artificials .	nil	nil	¼cwt. S. Am.	nil	¼ cwt.S. Am.	nil
Sundry Charges	5*s.* 7*d.*	14*s.* 5*d.*	7*s.*	13*s.* 4*d.*	7*s.* 6*d.*	13*s.* 4*d.*
Yields . .	20·8 cwt.	18·4 cwt.	16·7 cwt.	14·2 cwt.	18·7 cwt.	14·6 cwt.

Farm D relies rather more on contract work for threshing, &c., than C, and there is little difference between the total outlays on corn on the two farms, but, on account of the uniformly higher yields on C, a rise or a fall of 1*s.* per cwt. of corn affects the income from the sale of grain on C by about £40, and on D by about £30 per 100 acres of land farmed. The prices on which the surpluses in the preceding Table are calculated are approximately 12*s.* cwt. for wheat, 8*s.* 9*d.* cwt. for barley, and 8*s.* cwt. for oats, though there were some variations on the two farms.

The sheep present a greater contrast. The 'basic' and prime costs on the sheep per 100 acres of arable-sheep enterprise on the two farms are compared below:

	FARM C.				*FARM D.*			
		£	*s.*	*d.*		£	*s.*	*d.*
Bought foods and home-grown concentrates fed	233·7 cwt.	121	15	0	48 cwt.	26	14	0
Labour on Sheep								
Manual	1,755 hrs. @ 7·4*d.*	54	2	3	172 hrs. @ 7·25*d.*	5	4	0
Horse	200 hrs. @ 4·9*d.*	4	1	8	168 hrs. @ 4·8*d.*	3	7	2
Prime costs of crops fed								
Labour—Manual	1,469 hrs. @ 7·4*d.*	45	5	10	430 hrs. @ 7·25*d.*	12	19	9
Horse	1,778 hrs. @ 4·9*d.*	36	6	0	639 hrs. @ 4·8*d.*	12	15	7
Seed		5	12	9		2	1	6
Artificials		5	7	0		4	15	0
Sundry Expenses		5	0	4		3	7	6
Loss on replacement of ewes	40 ewes	54	10	0	16·5 ewes	14	16	0
		332	0	10		86	0	6
Returns on lambs sold	86 @ 72*s.*	309	12	0	46 @ 50*s.*	115	0	0
Returns on wool, &c.		18	8	0		8	14	0
		328	0	0		123	14	0
	Deficit	4	0	10	Surplus	37	13	6

If the sheep could be considered apart from the selling-off crops, a clear case of diminishing returns per unit of capital and labour applied would be shown. For outlays on farm C amounting to nearly four times the outlays on D and an investment in sheep in the ratio of 2:1 the aggregate net return is actually less; but farmer D, who reduced the sheep in order to avoid outlays on roots at current labour costs, appears to have sacrificed yields and types of arable produce for sale to a value which is sufficient to turn the scale completely in favour of the more intensive stocking. The danger of isolating the individual product cost is illustrated by this example. It would seem that the more intensive stocking with heavily-fed sheep is, at the price levels quoted, the better policy on the thin soils overlying the chalk in this area: moreover, that the relative positions of the two farms

would not alter greatly with ordinary changes in the level of costs and of prices of produce. The overhead expenses on D are nearly as heavy per acre as on C, and economic salvation clearly does not lie, on such farms, in reducing the output by spreading sheep of a semi-grazing type over a larger acreage and growing less corn. That policy might pay if carried to a point at which all the arable land disappeared, and with it a large proportion of the overhead expenses, but the farm then becomes merely a sheep run, and returns from land farmed as such would be necessary to indicate the conditions for success and the rentals that could be paid.

But even C, with its superior returns, is only paying 5*s.* 10*d.* per acre on 178 acres as 'labour income' to the farmer himself. The surpluses on corn suggest that the total surplus might be increased somewhat by confining the sheep to a still smaller percentage of the land and growing a few more acres of wheat, though on land of this type there is quickly a reaction towards lower yields if the proportion of roots folded falls below a certain level. The loss of two cwt. per acre of corn at 10*s.* cwt. on forty acres would be as great as the surplus earned on an extra five acres of wheat. Apart from a fall in rent the farmer might retrieve his position by spreading his activities and overheads over a larger area and reducing his prime costs by labour-saving machinery, but to verify this the accounts of one or more of the larger farms in the area would need to be examined.

It would be an almost impossible task to attempt to illustrate, in detail, the wide range of problems that are presented by the varying types of farming in England alone.[1] In cases where the farming depends in the main upon live-stock products, and where saleable arable crops play a very minor part in the farm economy, results will be determined by the policy adopted in the management of the stock. For example, on milk-producing farms the emphasis may be either on summer or on winter milk production, or differences may be observed in the proportions in which home-grown and purchased food enter into the rations of the stock. The problems which may have to be faced will, indeed, be extremely varied in character. But sufficient may have been offered to indicate the principles and methods by which they can be approached. There is no reason why the analysis of costs and returns on the lines suggested should not be made for any farm on which the farmer can find time or facilities for the recording and compilation of the facts of his business. The separate study of overhead expenses is well worth while. Often it will draw attention to excessive expenditure which might be avoided, in particular to labour which is not specifically chargeable to some

[1] The accounts of a mixed arable and dairy farm are analysed in the author's *The Interpretation of Farm Accounts.*

directly productive purpose; and it will frequently reveal unduly heavy expenditure due to depreciation and upkeep of implements in excess of what the farm ought to carry. But the drawback to detailed cost analysis on the single farm is the absence of comparative figures, without which the effects of change can only be determined by trials, of which the results are often marred by inequalities of soil and season. Without a preliminary study of physical conditions, comparisons between farm and farm are dangerous, and general inferences can rarely be drawn with safety from particular cases. The economist is on safer ground if he can select his farms within an area of fairly well-defined characteristics, but even there he must not overlook the limitations to change set by the need for buildings, fencing and other improvements of a permanent kind, the costs of which may not always appear in the tenant farmer's accounts, since they are normally the landlord's charge. In areas where the physical characteristics are transitional in character, the difficulties of comparative costing may not be insuperable, but they are very much greater. Each farm then presents its own problems. Instances are of common occurrence in which the grass-land and the arable may lie on distinct geological formations, and an extension of either grass or arable on the farm would give rise to an entirely different combination of circumstances, with corresponding effects upon productive costs. Sometimes the live-stock policy of a farm has to encompass at one and the same time two distinct ends—viz. how best to maintain the fertility of the arable land, and how best to make use of the grass. The answers to these two questions may be different, and a compromise is the result. The effects of a given change in price levels will be very uncertain in areas where physical conditions are not homogeneous.

Modern teaching in agricultural science stresses the necessity for improvement of breed both of plants and animals. On the plant side the work of improvement is largely in the hands of specialists. But on the live-stock side a great deal of enterprise lies in the hands of the general farmer, who may buy a few good animals as foundation stock but conducts his own breeding with them, aided by the use of milk records, egg records, and the weighing-machine. This work introduces some further complexities into the problems of costing. Where the work of improvement and of production go on simultaneously, it may be difficult to separate the outlays which are really of the nature of 'capital' expenditure

from those which are purely 'revenue' expenditure on production. The difficulty may perhaps be bridged by putting the values accorded to the young home-bred stock on a higher level, at figures arrived at by transferring to them the depreciation written off the values of the pure-bred parent stock. This may be theoretically justifiable, but it is risky, since highly-bred animals frequently prove to be commercially unprofitable. There would seem to be practical wisdom in ignoring any increase in valuation of live stock until it is realized, either in sales of stock or in higher yields of milk or other produce.

The Alternative Use of Financial Accounts.—It remains to inquire if it would not be preferable to approach the main problem of the economy of farm organization by collecting financial accounts from a large number of farms, and comparing their expenditure and returns. As to the value of the information to be obtained by analysing ordinary financial statements relating to farms of uniform type there can be no question. The British farmer may be less amenable to financial cross-examination than the continental peasant, but there can be no doubt that if statistical methods could be applied to a sufficiently large number of cases, conclusions as to the relationship between size of holding, or proportion of saleable products of various kinds, and financial success *at the prevailing level of costs and prices* might be ascertained broadly. But it must be borne in mind that financial accounts present expenditure and income as totals; each item is compounded of two variable factors—quantity and value, and each of these two factors may be influenced by quite different causes, some of which are permanent, others temporary. The costs of management or of equipment will tend to vary according to the size of the farm, but not proportionally; the outlays on labour, manures and feeding-stuffs will depend upon the system of stocking and cropping, the degree of intensiveness of production, the level of prices and the extent to which the farmer undertakes additional processes in preparing or marketing the goods; the output of saleable produce will be determined by its character and yield, by the time of sale, and by the relative values of the products marketed. The profit or loss will thus be influenced, not only by the trend of values, but by the extent to which diminishing returns to expenditure are affecting the output of the more intensively worked holdings, and upon the unequal influence of the season upon the several pro-

ducts for sale. There is, too, the further fact that profit or loss includes items which may vary with the system of management, of tenure, of capitalization, and of labour organization. The value of financial accounts would be greatly enhanced if they were accompanied by statistical data as to the numbers of live stock carried, acreages under various crops, yields and selling prices. If a Trading Account be drawn up in a form which includes the normal quantities, as well as the values, of produce sold, and normal hours of labour, and quantities of foods and artificial manures purchased, as well as their cost in money, the effects of a change in the price of any element in the account upon the income of the farm can be computed with some certainty. A fall in the price of wheat will affect very unequally the fortunes of farmers in different areas; a fall in milk prices will react unequally upon other groups. It would seem to be well worth while to estimate the percentage effect of such changes upon the incomes from farms of different types. But for establishing the precise relationships between costs and physical conditions, and between outlays and returns, the cost accountant seems to have a place which may indeed be indispensable, since it is upon skill in the internal organization of the farm that success ultimately turns.

The Organization of the Accounts.—We may now turn, briefly, to the practical accounting side of the problem of cost accounting for arriving at the overhead and prime costs, and the allocation of the prime costs amongst the crops and activities of the farm. This work will be based upon double-entry principles. The basis of the statement of balances at the opening and closing of the cost accounts annually is suggested as follows:

Horses—at cost less depreciation, or, in the case of reared stock recently broken in, at replacement cost, and younger animals on a standard-valuation basis.

Breeding or milking-stock—on the modified standard-valuation basis suggested on page 36.

Young stock reared on the farm—at standard figures for stock of different ages as suggested on page 36.

Animals drafted out, e.g. draft ewes or fattened cows awaiting sale—with reference to current market values on a conservative basis, less the costs of marketing.

Flying flocks of sheep or other animals temporarily on the farm—at cost plus outlays to date (on labour and purchased

forage at cost, on saleable home-grown produce fed at 'farm values', and on other forage at prime costs). In cases where there is a constant turnover of fattening stock, as in the example of the pigs quoted on page 113, the average cost per animal-week can be used to compute the approximate outlays to date on unfinished animals.

Implements—at cost, less depreciation estimated according to the probable working life of each, subject to re-valuation from time to time if necessary.

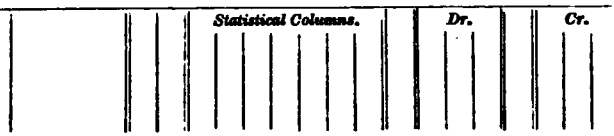
Purchased foods and manures—at cost.

Home-grown produce in stock—at prime costs in terms of outlays on cultivations, harvesting, &c.

Cultivations—at prime costs for labour, seed, manures, &c., to date. The costs of preparing and sowing land for permanent grass may be regarded as Capital Expenditure, and the costs of seed and sowing for temporary pastures spread over the length of the leys.

It will be observed that overhead charges are excluded in the balances of outlays on home-grown produce and cultivations for the purpose of the cost accounts. This is convenient, since it permits of the assessment of overhead charges annually, whilst the prime costs of crops can be computed for the period involved in their production. In the case of live-stock enterprises, a yearly period of accounting for continuous processes such as milk production, stock-raising or pig-fattening is appropriate, the accounts being finished off annually by bringing in the unsold stock at suitable valuations. It must constantly be borne in mind that the objective in view is the compilation of costs in such a manner that the farmer's outlays for specific ends may be computed, for comparison with corresponding costs on similar farms and with the results obtained. The acreages of land involved for each purpose, as well as the outlays, are noted in the accounts.

The Costs Ledger.—No special form of costings ledger is required, but it had been found convenient to use a form of page ruled with a number of columns about $\frac{3}{8}$th inch wide, in addition to a pair of cash columns and the usual spaces for dates and particulars, thus:



The statistical columns are used for recording the hours worked on operations, classified, if necessary, in the wage groups in which the workers are placed, and also for recording the numbers of live stock bought or sold, the gallonage of milk produced and sold, and similar quantitative details. The two money columns may be used for Debits and Credits respectively; this permits of all the entries being made on consecutive lines on one page, the sales being often comparatively few in number as compared with the outlays.

In the Ledger accounts are allotted, according to the circumstances of the farm, to the following groups of accounts:

(i) General and Sectional Overheads Accounts.

(ii) An Implement Account for the subsequent apportionment, according to circumstances, of implement charges.

(iii) The Prime Costs Accounts for collecting the total outlays on manual labour, horse labour, tractor work, implement hire, purchased foods, artificial manures, &c., for subsequent apportionment amongst the live stock and crop accounts.

(iv) The Crop and Stock Accounts for receiving the apportionment of the prime costs other than those transferred to the overhead accounts. It may, for some purposes, be necessary to open intermediate accounts, e. g. for recording outlays on cultivations in anticipation of crops of which the exact nature is not known at the time, or for threshing charges for distribution among the crops. It will, however, usually be possible to make postings direct into crop accounts to avoid a large number of field accounts.

The opening entries in the ledger will, of course, be the balances at the date of stock-taking. All the purchases, expenses and receipts will be posted from the cash-book, or, if personal accounts for Debtors and Creditors are kept, from the Journal, into the overhead, prime costs or other accounts. Before effecting the apportionment of prime costs all necessary transfers within the farm should be made; for example, the Labour Account will be debited with cottage rents, milk and any other perquisites; Horse Labour Account will be debited with home-grown forage; contra entries will be made in the accounts affected. No separate 'working' and 'stock' accounts need be opened for the horses unless foals are reared for sale, or horses are purchased and sold, quite apart from the general horse management policy of the farm. Sales and other receipts having been credited in the crop and

stock accounts, the valuations of live stock, implements, and unused purchased foods or manures are entered, and any transfers of home-grown produce at 'farm values' can be made to the live-stock accounts. The apportionment of the prime costs will be made, in the first instance, to the crop, stock, field or overhead accounts as the case may be. The subsequent grouping or combination of the accounts for arriving at the costs of processes will depend upon the system of farming and the nature of the sectional enterprises into which the farm can be divided. When the overhead expenses have been segregated and the prime costs have been distributed, the accounts are ready for classification as may be required by the circumstances of each particular case. It is important, when posting prime costs to the accounts concerned, to enter hours or quantities as well as the money values attached, and also when transferring home-grown produce at prime costs from crop accounts to live-stock accounts, or when apportioning the grazing charges, to enter the acreage corresponding to the money charge transferred. In this way the basic costs appear in the ledger accounts, and the areas absorbed by the different farm enterprises are clearly shown in relation to the surpluses earned. Some of the stock and crop accounts will show an excess of sales and credits over prime costs: these are designated the 'surpluses'. In the converse case, where the debits exceed the sales or credits, 'deficits' are shown. These are brought together in a 'Surplus and Deficit Account', to which also the totals of the overhead charges are transferred. The net balance of the 'Surplus and Deficit Account' can now be reconciled with the Trading Account or Profit or Loss Account by means of the Reconciliation Statement already described on page 134. It should be emphasized that the Surpluses and Deficits are not profits or losses on the separate crops and stock; they merely represent the excess of sales and returns over the prime costs and other expenses charged, or the reverse. They must be brought together and stated in relation to one another and to the sectional and general overhead charges of the farm. The method of interpretation of these figures, with due regard to the acreage of land from which they arise and to the part they play in the farm organization, has been illustrated in particular cases in the previous pages.

Cost accounts must not be expected to provide more information than they are capable of giving. It would seem that their

special function is the unravelling of the farm business, to show how its working is reflected in outlays and returns, how the amount of the outlays in particular directions is affected by the size of the undertaking, where waste is occurring and how it may be stopped, whether an adequate return, either in convenience or in saleable produce, is being obtained from expenditure in one direction or another, and what differences in outlays and returns are found to result from changes in policy. They are to the farmer and the farm economist what the dissecting knife is to the surgeon, or the microscope to the pathologist. They cannot replace the ordinary financial accounts which show on broad lines how things as a whole are going, nor does their study render unnecessary the observation of those general tendencies of demand and price which, in the long run, determine the profitableness of the industry.

Comparisons between Costs and Returns on Farms in Different Physical and Economic Environments.—It will be a natural corollary to the general argument pursued in the foregoing pages that no comparative costs of producing unit quantity of milk, grain, or other saleable produce under varying conditions of production can be looked for from agricultural cost accounts. Most products of the farm arise as one of several saleable commodities, and any particular product, wheat for example, will sometimes be a primary and sometimes a secondary or by-product according to the circumstances under which the farming is carried on.

But it may be that the classification of the farm expenditure into overhead expenses, rent and prime costs, and the subsequent grouping of the prime costs so as to show the costs of carrying out the processes involved in production in relation to the yields obtained, may throw light also upon the changes in farm organization which are found to occur as the physical conditions of production change. If a general survey of British agriculture be made it is apparent, speaking broadly, that as one passes from East to West the emphasis in farming changes from corn-growing to live-stock raising. If prices of corn rise to any considerable extent, the greatest accretion to the areas under corn crops for sale takes place in the more westerly districts, and, with the falling off of corn prices, these areas most quickly curtail their acreages under corn. Attention was drawn to this fact in the Board of Agriculture Returns for 1891. 'Wheat-growing declines

far more distinctly in the districts where the crop is grown under the least favourable conditions, and where its area has never been extensive. Thus, in Scotland the new decline is 14 per cent., in Wales there is a drop of 10 per cent., and in the group of counties in the south-west of England, formed by Cornwall, Devon, and Somerset, the reduction is nearly 9½ per cent., while in the rest of England, outside the counties named, the diminution barely exceeds 2 per cent. in the past year.' [1]

The reasons underlying this phenomenon are to be found in the combination of climatic and soil conditions which favour tillage and the ripening of corn in the Eastern Counties, and which favour the growth of grass in the west. Natural conditions are reflected in farming costs and returns. In the eastern areas soils, generally speaking, are deeper and more fertile, winter frosts assist in making tillage operations easier, low rainfall favours tillage but means less vegetable growth, summer sunshine reduces the labour of harvesting, and, in a normal year, yields of ripe grain can be expected. In the western districts, on the lower lands, temperature is more even, the soils on the older and harder geological formations are thinner, greater rainfall renders the ripening of corn less certain whilst it favours a more luxuriant growth of grass for hay or pasture for a comparatively long season. On the higher lands in the west corn will hardly ripen at all, and thin soils and low temperatures combine to produce poor pastures. These may only support the hardier breeds of sheep, and serve as rearing grounds for animals which will be brought down to fatten on the lower grass or arable lands. Speaking generally, therefore, in the east the farmer has Nature's aid in corn growing, but would have to overcome natural disabilities in growing good pasture. In the west the conditions are reversed; Nature hinders the ripening of wheat, or of barley for malting, but will produce good grass with little human aid. The more Nature will do for the farmer, the lower are his costs, and the greater his returns per unit of expenditure; hence the differences of emphasis in farming to which the natural conditions prevailing in the two areas give rise.

These broad generalizations are subject to many qualifications. In the arable districts of the Eastern Counties some soils offer greater resistance to cultivation than others, and the costs of

[1] The total decline in 1890–91 was 79,000 acres. See also *Agricultural Statistics*, 1922, Part I, p. 6; 1924, Part I, p. 7.

tillage vary considerably. Higher costs may be compensated for by higher yields, but this is not always so. Again the proximity of a large industrial population may create a local demand for milk, to meet which the arable policy may be adjusted to give as much forage for cows as is possible, and rotation grass may be extended at the expense of corn. Or again, the arable soil may be so light and 'hungry' that an intensive stocking policy may be necessary to keep up fertility, for which purpose sheep may be folded on the arable land at frequent intervals, as on the down-land farms on the chalk formation, or bullocks may be wintered in yards to trample straw into dung.

In all these cases, whether the change be general, in passing from east to west, or local, in passing from one soil to another, or from land of lower to land of higher elevation, the difference of emphasis will be, in the main, between arable produce for sale on the one hand and live stock on the other. The *degree* of emphasis upon the one side of farming or the other will turn upon considerations of relative costs and selling prices.

It would clearly be advantageous, for comparative purposes, if the outlays and returns of the farms could be grouped so as to show the gradual transition in the relative advantages of crops and stock as conditions become more favourable to one or to the other. The fundamental difficulty, however, in making any precise comparative statements is that, as one passes from grass to arable farming, the functions which crops or stock are called upon to fulfil are changing. In the purely arable districts the growth of forage for consumption by stock is not an end in itself, and the stock feeding is not necessarily carried out in a way which would be the most economical if the output of live-stock products were the ultimate aim; hence the live stock cannot be considered simply on their merits, but only as adjuncts to the cropping of the land for corn, potatoes, or other produce. The arable farmers who use bullocks for the production of manure would not carry the process of fattening to the same pitch if the production of cheap meat were the object in view. Similarly a stock farmer, who grows his varieties of oats with an eye to the requirements of the stock for straw, would adopt a different policy if the sale of grain were the objective. Hence, information which arises from the analysis of farming costs under practical conditions, which might appear at first sight to provide comparisons between the

surpluses earned on the production of corn, or meat, or milk in different areas, must be used with care. The overhead expenses on the farms will be those necessitated by the system as a whole, and they are not apportionable between the several products: the surplus of sales over prime costs alone is clearly an imperfect measure of the economic advantage of any single product when separated from the whole system in which it is produced. It is suggested, therefore, that comparisons between costs and returns on farms in different areas should be made in the form of comparative Tables such as those given for farms A, B, C, and D (pp. 151–3), in which the overhead charges and the surpluses or deficits per 100 acres of land cultivated are shown. Such Tables, compiled for representative farms of various types, would indicate, not only the changes in the surplus per acre over prime costs on each of the several crops and kinds of live stock respectively, under the conditions of production prevailing, but also the different proportions in which the several products occupy the land.

A few additional examples have been selected from the accounts of farms, drawn from an area extending from the north-east of Lincolnshire to the west of Dorset. The Tables in the text cover the period of one year only, ending Lady Day, 1926, in each case.

Farm E.—A fen farm devoted almost exclusively to the production of arable crops for sale, cattle being winter-fed for the making of manure.

Farm F.—A mixed farm on the light sandy soil of the Bunter Sandstone formation in North Nottinghamshire, including a considerable proportion of poor grazing exploited by rearing young cattle and by sheep, which also serve to maintain the fertility of the arable land.

Farm G.—This is the same as Farm B (p. 151) but for the year ended Lady Day, 1926—a mixed arable and dairy farm on the Keuper Marl in South Nottinghamshire. The dairy cows function in lieu of other stock for the production of manure, and some sheep consume the grazing residues left by the cattle.

Farm H.—A milk-producing farm on the Kimmeridge Clay in the vale of Aylesbury, exploiting some good grazing and a proportion of indifferent arable, mainly for the sale of fresh milk.

Farm J.—A cheese-making farm in West Dorset on good grass, with a small proportion of arable land for the production of winter forage. The milk is sold fresh in winter, but is converted into cheese in the summer, pigs being fed on the whey.

FARM E, 253 acres (207 arable, 46 grass). Fens, Lincs. Lady Day, 1925–6.

	Acres disposed of.	*Surplus.* £ s. d.	*Surplus per acre.* £ s. d.	*Per cent. of area disposed of.*	*Surplus per 100 acres.*	*Per cent. of total surplus.*
Arable crops:						
Turnip Seed	8·0	48 17 7	6 2 2			
Wheat	35·5	255 13 2	7 4 0			
Oats	16·5	116 1 11	7 0 0			
Barley	26·5	52 18 8	1 19 10			
Beans	21·2	86 13 2	4 1 10	73·5	£ 615	114
Peas	7·0	146 16 4	20 19 6			
Seeds Hay	7·4	63 7 0	8 12 6			
Sugar Beet	14·2	130 3 0	9 3 5			
Potatoes	53·8	687 18 0	12 15 0			
	190·1	1,588 8 10	8 7 0			
Poultry	—	73 14 8	—		29	5
		1,662 3 6 (Deficit)	— (Deficit)	—	644	119
Cattle-feeding	43·6	273 10 10	6 5 5	16·9	—106	—19
Horses	24·5	—	—	9·6	—	—
Total	258·2	1,388 12 8		100·0	538	100

Overhead charges on 253 acres.	£ s. d.
Hedge and ditch	84 3 8
Rates, &c.	208 5 2
Implement charges	255 14 6
Coal	24 0 6
General and Management	235 14 4
	£807 18 2 equals £319 per 100 acres.

Farm assets, £3,695 equals £1,458 per 100 acres = @ 5 per cent. £73 per annum.

Owner in Occupation. Sch. A. Valuation £573 equals £226 per 100 acres.

Note.—In this, and in the following Tables for Farms F, G, H, and J, the live stock have not been charged with costs of cleaning and of distribution of manure, except when such costs were incurred in connexion with forage crops fed. Thus the average surplus on the arable crops covers the remainder of these costs.

FARM F, 322 acres (212 arable, 110 grass). Bunter Sandstone, N. Notts, Mixed. Lady Day, 1925–6.

	Acres disposed of.	*Surplus.* £ s. d.	*Surplus per acre.* £ s. d.	*Per cent. of area disposed of.*	*Surplus per 100 acres.*	*Per cent. of total surplus.*
Arable crops:						
Wheat	34·17	252 12 5	7 7 10			
Barley	43·08	230 8 0	5 6 11			
Oats	6·21	33 19 9	5 9 3		£	
Peas	7·06	62 15 1	8 17 9	33	208	82·5
Potatoes	13·45	49 8 9	3 13 6			
Carrots	2·00	36 8 1	18 4 0			
Sugar Beet	3·00	31 4 7	10 8 2			
	108·97	696 16 8	6 8 0			
Sheep	76·66	216 4 9	2 16 5	23	65	17·5
		913 1 5 (Deficit)	(Deficit)			
Cattle	123·63	69 7 4	11 3	37	—21	
Horses	26·00	—	—	7	—	
	335·26	843 14 1		100	252	100

Overhead charges on 322 acres.	£ s. d.
Hedge and ditch	24 10 6
Rates	40 15 2
Implement charges	121 7 9
General expenses	72 10 1
	259 3 6 equals £80 10*s.* 0*d.* per 100 acres.

Rent, £260 per annum equals £80 10*s.* 0*d.* per 100 acres.

Farm assets, £5,105 equals £1,585 per 100 acres = @ 5 per cent. £79 per annum.

Farm G, 234 acres (123 arable, 106 grass, 5 house, &c.). Mixed dairy and arable. Keuper Marl, S. Notts. Lady Day, 1925–6.

	Acres disposed of.	*Surplus.* £ s. d.	*Surplus per acre.* £ s. d.	*Per cent. of area disposed of.*	*Surplus per 100 acres.* £	*Per cent. of total surplus.*
Arable crops:						
Wheat	46	359 6 9	7 16 10			
Oats	10·2	63 1 2	6 3 0	30	197	46
Potatoes	13·2	41 15 7	3 5 2			
	69·4	464 3 6	6 13 8			
Dairy herd	142·5	433 18 1	3 9 0	60	209	49
Grass sheep		59 16 7				
Pigs	—	51 7 5	—	—	22	5
Horses	24·0	—	—	10	—	—
	235·9	1,009 5 7		100	428	100

Overhead charges on 234 acres (5 house, &c.).

	£ s. d.
Hedge and ditch	19 13 4
Rates, &c.	61 14 11
Implement charges	128 10 9
General expenses	50 12 11
	260 11 11 equals £114 per 100 acres.

Rent, £381 per annum equals £163 per 100 acres.

Farm assets, £2,835 equals £1,210 per 100 acres = @ 5 per cent. £60 10*s.* 0*d.* per annum.

Farm H, 354 acres (arable, 74 on Portland Beds; grass, 274 on Kimmeridge Clay; buildings, &c., 6). Dairy. Bucks. Lady Day, 1925–6.

	Acres disposed of.	*Surplus.* £ s. d.	*Surplus per acre.* £ s. d.	*Per cent. of area disposed of.*	*Surplus per 100 acres.* £	*Per cent. of total surplus.*
Arable crops:						
Wheat	30	68 15 11	2 5 10	8	18	3·6
Dairy herd	299	1,708 5 0	5 14 3	80	456	91
Grass sheep	9	102 14 9	11 8 4	2·4	28	5·4
Horses	36	—	—	9·6	—	—
	374	1,879 15 8		100	502	100

Overhead charges on 354 acres (6 buildings).

	£ s. d.
Hedging and fencing	50 17 5
Rates	125 9 5
Implement charges	61 11 9
General expenses	44 5 8
	282 4 3 equals £113 per 100 acres.

Rent, £741 8*s.* 8*d.* per annum equals £213 per 100 acres.

Farm assets, £4,608 equals £1,325 per 100 acres = £66 @ 5 per cent. per annum.

Farm J, 127 acres (15 arable, 109 grass, 3 buildings). Kimmeridge Clay. Milk, cheese, and pigs. Dorset. Lady Day, 1925–6.

	Acres disposed of.	*Surplus.* £ s. d.	*Surplus per acre.* £ s. d.	*Per cent. of area disposed of.*	*Surplus per 100 acres.* £	*Per cent. of total surplus.*
Arable crops:						
Wheat	3	14 1 7	4 13 10	2·4	11	3
Barley	5	3 17 10	15 7	4·0	3	
	8	17 19 5	2 4 11	6·4	14	
Dairy herd (milk, cheese, pigs)	109	661 11 6	6 1 0	87·2	530	97
Horses	8	—	—	6·4	—	—
	125	679 10 11		100·0	544	100

Overhead charges on 127 acres (3 buildings).

	£	s.	d.
Hedging and general expenses	77	1	11
Rates and tithe	68	12	6
Implement charges	61	17	0
Proportion of upkeep of car	96	4	5
	303	15	10

equals £245 per 100 acres.

Rent (Sch. A), £240 per annum equals £193 per 100 acres.
Farm assets, £2,489 equals £2,000 per 100 acres = @ 5 per cent. £100 per annum per 100 acres.

Note.—On this farm £170 is debited in Cost Accounts for farmer's and family manual work.

The farms are compared with one another, and with the results obtained on the arable-sheep farms C and D (pp. 152–3), in the following summary:

Farm.	*Location.*	*Soil.*	*Percentage of land devoted to* (a) *Crops for sale.*	(b) *Cattle or sheep.*	*Percentage of gross surplus derived from* (a) *Crops.*	(b) *Cattle or sheep.*
E	S. Lincs.	Fen	73·5	16·9	114	−19
C	Bucks.	Lower chalk	57	30·7	101*	−1*
D	Hants	Clay with flints over chalk	44	38	82*	18*
F	N. Notts.	Bunter Sandstone	33	60	82·5	17·5
G	S. Notts.	Keuper Marl	30	60	46	49
H	Bucks.	Kimmeridge Clay	8	82·4	3·6	96·4
J	W. Dorset	Kimmeridge Clay	6·4	87·2	3	97

* Calculated excluding cost of fallows. If fallow expenses are deducted from the surplus on arable crops on C and D the division of the gross surplus derived would be:

	Crops.	*Cattle or sheep.*
C	101 per cent.	−1 per cent.
D	77½ per cent.	22½ per cent.

It will be observed that the farms show a complete reversal of the economic significance of crops and stock as the arable soils and climate of Lincolnshire are replaced by the heavier soils of the Kimmeridge Clay belt. As might be expected, the proportion of land devoted to stock does not show any proportional relationship to the percentage earnings from that source. It is, however, noticeable that, where live stock are associated mainly with arable land for the upkeep of fertility, their direct contribution to the earnings of the farm may often be a negative one. On Farm F the larger proportion of the land utilized by cattle was, in fact, poor grass, whilst in the only two cases in which the stock provide almost the whole of the surplus earned, the land devoted to their use is, in the main, grass of better quality. Bearing in mind the warnings already given as to the variations of function of the stock in the different cases, it may perhaps be suggested that the results are not altogether without significance in relation to the question of the economic possibility of arable stock feeding in the area covered under present conditions.

It might be expected that, in the arable areas, not only would the percentage of land under saleable crops be greater, but the surplus over prime costs per acre on such crops would also be greater than in the live-stock districts; and, conversely, that the percentage of land occupied, and the surplus earned per acre, by live stock would tend to increase as the areas more suitable for stock are approached. This proves to be the case so long as comparisons are made between all the arable crops taken together, and it is also true of the earnings of cattle and sheep.

Farm.	*Average surplus per acre on saleable crops.*	*Surplus (or deficit) per acre on cattle.*	*Surplus (or deficit) per acre on sheep.*
	£ s. d.	£ s. d.	£ s. d.
B	8 7 0	(deficit) 6 5 5	—
C	6 19 6	—	(deficit) 2 8
D	3 19 6	—	(surplus) 1 0 0
F	6 8 0	(deficit) 11 3	(surplus) 2 16 5
G	6 13 8	(surplus) 3 9 0*	—
H	2 5 10	(surplus) 5 14 3*	(surplus) 11 8 4
J	2 14 11	(surplus) 6 1 0*	—

* Dairy Stock.

But any uniform gradations must not be looked for, since crops may be *relatively* more important in one area than in another, whilst the actual returns obtained from crops may be lower. In other words soil and climate may prescribe a different degree of intensiveness of cultivation, accompanied by a change of emphasis in the farming.

Comparative studies of this character, if they are made for representative farms, tend to bring out clearly the economic possibilities of stock and crops in different areas, and they may be suggestive to the farmers who, with their knowledge of the capacity of their land, are able to visualize the limits within which change is practicable. Their value would be enhanced by comparative statistics of the actual prime costs and yields of the several products, similar to the figures given on p. 154, but these should be averaged for a period of years if they are to be reliable. But, at the risk of excessive reiteration, it may be again emphasized that the surplus or deficit on the individual product is no precise indication of its profitableness or otherwise as an isolated enterprise; its prime costs and yields arise under the particular system of farming in which it is included.

There is, however, a limited sense in which the prime costs incurred on some products may be significant in relation to their selling prices, and this may not be without importance.

In so far as conditions may permit of an adjustment within the

farming system in favour of producing more of a particular crop or other product, the prime costs per unit incurred under present conditions of production will represent, very closely, the costs of producing additional units, provided that the extra quantity is small in proportion to the existing output, and that no change arises in overhead charges as a result. Thus we may compare the *marginal prime costs* of any product, and the *marginal surpluses* per acre devoted to its production at current levels of prices, in different districts and under varying conditions of production. The farmer, in practice, makes in his own mind calculations of this kind when deciding whether to substitute one crop for another as far as circumstances will permit. The arable farmer, who is already growing saleable crops to the limit of the capacity of his land, is unable to vary the area under corn crops very appreciably from year to year. It is the farmer who is in doubt whether to grow, on his arable land, corn for sale or food for stock whose policy is most likely to be affected by price changes which appreciably alter the surpluses per acre obtained. Even if his surplus per acre is low compared with the purely arable farms, an upward tendency in corn prices may cause him to replace, by saleable grain, forage crops which, valued at feeding values, produce a smaller surplus per acre than corn. Hence the tendency to greater variation in corn acreages in districts relatively unfavourable for corn production than in the typical corn-growing areas. The farmer's capacity to respond to changes in prices is, however, strictly limited by his environment, and a change which involves more than a small adjustment of cropping may give rise to an entirely new set of conditions on his farm.

Comparisons of 'Labour Income' and Rental Value.—In the Tables for Farms E to J the calculations have not been carried beyond the computation of the gross surplus in excess of overhead expenses. Even these figures must not be taken as representative, either of farms in general in the areas from which they were obtained, or of the results in other years on the same farms. They are quoted merely to show how detailed statements, based on cost records, can be compiled and used comparatively. Estimates of 'Labour Income', i.e. the reward of the farmer for his own work, after making allowance for interest on his capital, can be made in a much more direct way from the financial accounts. Similarly estimates of the rentability of lands may be made by making some

charge against profits for the managerial services of the farmer and interest on his capital, arriving thus at the balance available for the rent charge. But in either case an estimate is involved, particularly where farms are under the active management of their owners, since the amount charged for management will necessarily determine the balance for rent, and vice versa. Indeed no determination of the rental value of land used for agriculture seems to be possible without assuming a certain standard of remuneration for the farmer. When the rental is actually fixed either by agreement, or with reference to the valuation for income-tax or for rating, the determination of labour income is straightforward, although even then the rate of interest to be allowed on agricultural capital is, in the absence of a market for such capital, not precisely determinable. For calculations of this character, however, the detailed processes of costing are not involved, and indeed the total surplus shown in the cost accounts is less satisfactory as a starting-point than the estimated trading profit.

Summary of Chapter III.—The constructive proposals of Chapter III may now be summarized. A study of the dependence of farming upon its natural environment leads to the conclusion that cost accounts are of value to the individual farmer, chiefly as a means of examining critically and in detail the organization of his farm, and of estimating the effects upon his profits of adjustments which do not disturb the general scheme of the farming. Alternative means to the attainment of some end within that scheme may be available to him; power may be provided in different ways, there may be alternative methods of maintaining fertility, crops of which the function within the farming system is the same may replace one another, the grass-land may be made to carry different classes of stock. All that is necessary in such cases is to compute the expenses which are peculiar to each of the alternatives open to the farmer for comparison with the results, and a complete allocation of all the expenses of the farm is not required. Costing for these directly practical ends is relatively simple, and within the powers of the larger number of farmers, requiring only the keeping of such records of cash, labour, food-stuffs and yields as are suggested by business prudence in any event.

But the farming community would be greatly helped in making decisions involving larger changes of policy if comparative results could be made available. Comparisons are required to establish

the relative economy of enterprises of varying size, of different degrees of intensiveness of working, of different combinations of stock and crops. Comparisons are, however, misleading unless they are confined to farms of which the physical and economic environments are similar. The farm economist must therefore select his farms carefully for comparative study, taking as his standard type farms which, in size and in organization, have been found in practice to be the most economical, and which are therefore represented in the largest numbers within their respective areas. He must investigate first of all the characteristic structure of each type of farming, in order to appreciate the extent to which the enterprises it embraces are in fact complementary or independent, and to determine the functional significance of the crops and stock. The accounts of the farm can then be grouped upon a natural basis, and within each main division outlays should be classified according to whether they are related to the enterprise as a whole, or are dependent upon the development of some specific activity within the enterprise. But in finally bringing outlays and returns into relation with one another, the object must be to show the effective cost of carrying out the functions involved in maintaining the farm as a working unit, in order that the returns on crops and stock may be interpreted in a proper relationship to one another. Comparisons between farms will then arise with respect to the amount of the overhead expenses, the surpluses earned on specific products, singly and in combination, and the costs involved in other complementary processes under the conditions prevailing.

Armed with such results the farm economist can make deductions as to the conditions underlying success in any area. His methods must combine those of the statistician and the accountant. He must select his representative farms by analysis of the statistics of the farms in the area; he must analyse their working in terms of quantities of labour, raw material, and produce, in order to isolate the effects of price changes in arriving at 'normal' conditions of production, and he must seek to establish relationships between cause and effect by making due allowance for disturbing factors. In interpreting his results in terms of the material welfare of farmers at any given time he must be guided by the ordinary rules of accounting, but if he is concerned to estimate the character of the changes of organization necessary to maintain

the standards of life of the agricultural community, in the face of new conditions affecting working costs and selling values, he must go behind the computed profit for the current period to the 'basic' costs and yields of processes, and learn from the experience of those farmers who, by foresight or good fortune, have hit upon a means of widening the margin between outlay and return. But in suggesting practical policies the economist must avail himself constantly of the knowledge and experience of the practical agriculturist, in order to avoid the risk that his deductions may trespass beyond what is physically possible, having regard to the mutual needs of crops and stock in rotation farming and to the limitations imposed by natural conditions.

Comparisons between farms in different areas and under widely divergent physical or economic conditions have a different end in view, in that farmers can rarely profit by experience obtained on soils and in climates or circumstances different from their own. But the study seems to be worth while, in that it permits of the structure of farms being laid bare, in such a way that the changing importance of stock and crops becomes clear as the basal conditions of the industry change. It then becomes possible to assess with some confidence the probable influence of price variations upon the character of the output of farms of different types, and to understand the reasons for the adjustments of farm organization in different districts that follow changes in the level of wages or of other important elements of cost.

Cost accounting cannot, for the practical farmer, take the place of well-kept financial accounts, and, whilst it may well repay a farmer who has an aptitude for figures and for analysis to attempt a complete allocation of expenses on the lines suggested, it will more frequently be the case that the farmer's time will be better spent in keeping a close watch on the practical organization of his business, guided by the simpler calculations which have been proposed for his use. For those, however, who are responsible for the guidance of the industry and for taking decisions which affect the fortunes of farmers as a whole, studies of comparative costs and returns seem to be essential, and their co-operation with the farm economist in promoting the collection of suitable data should not be asked in vain.

APPENDIX

The body of rules drawn up by the Agricultural Economics Committee of the Ministry of Agriculture for the guidance of agricultural accountants, to which reference is made in the text, is printed below. The Sections in which the various rules are discussed are indicated by Section or Page references in brackets at the end of each paragraph.

Instructions to Accountants

The following instructions have been drawn up by agreement between research and educational workers engaged in preparing agricultural cost accounts, on methods to be adopted in dealing with disputed questions in cost accounting, in order to secure comparability between different accounts.

1. *Produce Accounts* for arable crops and grass should relate to individual crops and different kinds of grass and, preferably (especially where the previous history of the field is known), to individual fields as well. The advisability of costing on the basis of individual fields is, however, a question which is left to the discretion of the cost accountants, to be considered by them in relation to its applicability and practicability. (Chapter I, also pages 75–7, 82–3, 143–6, 160.)

2. *Overhead Charges.* The rent and rates of cottages should be charged to labour accounts. Where cottages are let with the farm, the rental value of the cottages as estimated by the farmers should be adopted. The rent and rates of farm-houses should be charged in the first instance as a business expense against profits. Any adjustments made by H.M. Inspector of Taxes as regards charging a part to personal account should also be made by the cost accountant. Apart from the above two exceptions rent and rates should be distributed over land alone at a flat rate per acre; but cost accountants are free to adopt differential rates in cases of marked differences in categories of land. (Pages 66–70, 140.)

Where roots are fed on the fields the proportionate share of rent, rates and certain overhead charges allocated in accordance with this paragraph should be charged to the stock eating the roots. In the case of catch crops the proportion of rent and rates should be two-thirds for the main crop and one-third for the catch crop, except in special cases. (Page 149.)

Insurance (except where a direct allocation can be made), upkeep of roads, buildings, hedging, ditching and draining, should be charged in the same way as rent and rates. (Pages 71, 139.)

Bailiff's wages should be distributed between the different produce (including live stock) accounts in the same proportions as the other manual

labour is charged in these accounts. General overhead charges other than the above should be distributed between the various produce accounts in the same way as bailiff's wages. (Pages 71, 139–43.)

3. *Interest on Capital and Management Charges* should not be brought into the accounts (except where cash is actually paid). They should be borne in mind in considering whether the profit is sufficient reward for the capital, management, and labour. In comparing two farms or two systems of farming, the result in each case must be interpreted in the light of capital sunk and labour given without wages. The value of unpaid labour (apart from management) should be estimated and records kept of such charges; such charges must always be kept separate in the accounts. Where cash is paid for Interest or Management (exclusive of bailiff's wages), the charges should not be divided between the accounts for the different farm products but should appear in the Profit and Loss account. In the memorandum accompanying the accounts, reference should be made to the extent of the non-chargeable items. (Pages 53–4, 70–1, 86, 94, 95, 136, 140, 142.)

4. *Produce both grown and used on the farm* (e.g. seed, home-grown foods fed to stock) should be charged in the accounts at the cost of production and not at conventional or market prices (for cost of straw see paragraph 5). (Pages 61–2, 89–91.)

5. *Secondary Products.* The cost of dung should be ascertained so that it can be charged to the crop accounts. To ascertain the cost of the food residues the figures published in recognized tables should be taken as a guide. The cost of straw should be taken as one-seventh of the cost of production (exclusive of marketing) of the Wheat, Oats, or Barley crop. Where the dung made is not used or sold (e.g. in dairies) its cost should be written off in the Dung Account as a loss. (Pages 58–9, 64–6, 98–104, 145, 149–50.)

Wool should be regarded as a by-product. A separate account should be kept for wool solely for the purpose of comparing the cost of shearing and other operations directly debitable to the wool with the price received; and the balance should be carried into the Sheep Account, but shown as a separate item.

6. *The Distribution of the Cost of Manure between Crops and Years.* The cost of artificial manures should be spread over the crops in rotation, the recognized tables being used as a guide for the purpose. (Pages 55–8, 117–18, 145.)

The duration of effect of farmyard manure should be taken as three years; the following proportions of cost are suggested for guidance: first year, 50 per cent.; second year, 30 per cent.; third year, 20 per cent. (Pages 30–31, 58–9.)

7. *Cleaning Crops.* In the case of potatoes carried off, 75 per cent. of the cost of cleaning operations should be debited in the crop account and 25 per cent. should be debited to succeeding crops in the rotation until another cleaning crop is taken. The proportions of the 25 per cent. suggested for guidance are: *three years*, 50 per cent., 30 per cent., 20 per cent.; *four years*, 50 per cent., 25 per cent., 12½ per cent., 12½ per cent.

In the case of *turnips, swedes, and mangolds* carted, one-third of the cost of cleaning operations should be regarded as removed and two-thirds as

remaining to be carried forward to be charged to succeeding crops until the next cleaning crop is taken, in the proportion given above for potatoes.

In the case of roots fed in the field, the stock eating the roots should be charged with the cost of the seed and one-third of the operations; the cost of the manures and two-thirds of the cost of operations should be carried forward and charged to succeeding crops in the manner indicated above. (Pages 30–1, 59–60, 104–6, 145, 148–9.)

8. *Seed Leys.* In deciding what proportion of the cost of a ley to charge each year, the length of ley contemplated should first be ascertained. The initial cost should then be equally divided between each year. If the ley is discontinued before the time contemplated the charges originally allocated to the years by which the ley is shortened should be a general charge. If the length of the ley is beyond the time contemplated no charge need be made for the years by which the ley is extended. (Page 159.)

When the first crop is fed to early lambs, and the second crop mown for seeds hay; or first cut used for hay and second cut used for grazing, the proportions of cost should be two-thirds for the first crop and one-third for the second crop. (Page 149.)

9. *Charges for Grazing.* Four-fifths of the cost should be allocated to the summer grazing, and one-fifth to the winter grazing, the periods of summer and winter grazing to be determined according to locality and season. (Pages 62–4, 90–1, 109–11, 147–8.)

10. *Horse Labour.* No difference should be made in different seasons of the year, but a flat rate should be charged throughout the year. Where horses are fed on home-grown produce grown during the same season as that for which it is desired to calculate the cost of horse labour, it will be necessary, in order to enable the cost of home-grown foods to be arrived at, to estimate the cost of the horse labour—such estimate, after the first year, should be based on the preceding year's cost subject to such modifications as may be justified by altered circumstances.[1] (Pages 88–92, 137.)

11. *Valuations.* As a general rule the term 'stock in hand' should be employed in preference to 'valuation'. Stock in hand should as a general rule be valued at cost.

In the case of breeding-stock, however, the 'Standard Valuation' method should be adopted, i.e. the stock should be valued at a fixed amount per head, unvarying from year to year, unless the change in market values requires the adoption of a different fixed amount. The advantages of this method in agricultural costing are so great that it should be adopted even although another method has to be adopted for Income Tax purposes.

Working horses should be brought into the accounts at cost. For depreciation purposes a decision should be made as to the number of years of life and the value written down by the yearly amount so obtained every year. In the case of working horses bred on the farm the cost at which they

[1] This difficulty can be surmounted, without using any estimated cost of horse labour on produce fed to horses, by ignoring, for the computation of the cost of horse work, both the number of horse-hours worked for the benefit of the horses and its value. See 'A note on the Determination of the Cost of Horse Labour' by the Author, *Incorporated Accountants' Journal*, June, 1925.

are brought in (i.e. the cost up to the time of working) should be estimated. (Pages 31–7, 89.)

12. *Discount.* The net amounts paid or received for goods or services rendered should be entered in the accounts.

On the memoranda referred to in clause 3 a note should be made of the total amounts of discounts paid or received.

13. *Draining.* In the event of mole or tiling draining operations being carried out a Drainage and Improvement Account should be opened, and the estimated depreciation written off each year over the whole farm. (Pages 140–1.)

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Printed in England at the Oxford University Press
By John Johnson, Printer to the University