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ORGANIC FARMING SYSTEMS IN ENGLAND AND WALES: PRACTICE, PERFORMANCE AND IMPLICATIONS

ANNE VINE and DAVID BATEMAN

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by

Anne Vine and David Bateman

Department of Agricultural Economics
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CHAPTER 1

Introduction

The purpose of this Report is to examine whether the farming practices currently associated primarily with organic farmers have anything to offer which may be of general significance to the agricultural industry.

This raises immediately the questions: what is an organic farmer?; and what is it about his practices that we think may be of interest?

Organic Farming is carried out with the belief that all forms of life have a role to play in the farming system. In general, people who call themselves organic farmers consider that materials which - either in kind, or in amount - do not normally occur in nature, are potentially harmful and should be avoided as far as possible. They believe that these materials create unsuitable conditions for the survival of some components of intrinsic importance to the system, with undesirable repercussions. These beliefs lie behind the two main characteristics usually associated with organic farming practice, viz.,

(i) The farmer actively seeks to foster biological cycles and natural disease resistance mechanisms.

(ii) The farmer restricts his use of certain inputs, notably highly soluble mineral fertilisers and synthetic pesticides. The degree of restriction ranges from people who use none at all - "pure organic farmers" - to those who use substantially less than that which is generally believed to be the economically optimum amount - "semi-organic farmers". Instead, organic farmers rely to a major extent on the fertility-building value of the grass ley, on rotations, on recycling waste products, and on biological nitrogen fixation.

We do not claim that Organic Farming can be satisfactorily defined in terms of these characteristics (and, indeed, we discuss the definitional problem further in Chapter 3). What we are suggesting is that these characteristics, which are central to the beliefs of organic farmers, are the ones that may be of interest to farmers in general - to "conventional farmers" as we shall call them.

The significance of these characteristics is this. Current farm practice in industrialised countries has developed in response to rather different resource availabilities than those which may obtain in the future: nitrogen fertiliser is cheap in relation to the output that can be gained from it; potash and phosphate have so far been easy to obtain and worth paying for. The prices of cereals, pulses, and formerly fishmeal have been such that we have been able to afford to convert large quantities of them into animal products at the expense of losing a high proportion of their energy in the process. The use of high inputs has been supported by plant and animal breeding for more productive varieties that can make use of high nutritional levels. Herbicides, pesticides and other technical chemicals are used to control the transfer of energy and nutrients as much as possible into the chosen agricultural products, such as wheat-grain or lean meat, instead of allowing them to be distributed, as in the natural state, among other forms of life within the usual food web.

Expensive labour has been displaced by herbicides, and by capital investment in mechanisation requiring a source of support energy. Intertwined with all these developments has been economic pressure to specialise, simplify rotations, simplify the countryside. As a result of all this, in the West, food shortages have, at least for some products, given way to food surpluses.

There are, however, criticisms of and perhaps threats to this streamlined, currently oil-based, system of agriculture, and it is in connection with these criticisms that Organic Farming becomes relevant. The criticisms are these:

1. Economic. Farming in the West produces surpluses that cannot be sold, but in order to do so uses resources that are in scarce supply and may become more scarce. In particular:

    (a) Energy, including the use of energy to produce nitrogen fertiliser from atmospheric nitrogen and water.

    (b) Other plant nutrient supplies, particularly - in Britain - phosphate. Most of our phosphate comes from abroad.

    (c) Animal feedstuffs. If incomes per head can be raised in developing countries (and if distribution channels improve) demand for food for humans will expand and compete with the amount available for livestock production.

2. Technical. Development of resistance to pesticides, to fungicides, and to antibiotics, together with a tendency for increased susceptibility to disease and stress in some of the modern high-yielding varieties and intensive animal production systems.

3. Social. Public concern for (a) human health both of farm workers and of food consumers (b) environmental quality and (c) amenity, may put constraints on some farm practices (particularly the use of pesticides and herbicides) or increase the size of special markets. Furthermore, the decline in rural employment and consequently of rural areas generally causes some people to question the welfare effects of current farm practices.

4. Animal welfare. Not everyone is happy with the treatment of animals in some conventional farming systems.

There is of course no one single solution to these criticisms of Conventional Farming. Amongst the many possible ways of alleviating the problems, an alternative system of agricultural technology is sometimes proposed using:

1. Renewable inputs, deriving the energy for their formation from the sun	e.g. Nitrogen fixation; fuel production from digestion or burning of waste products such as slurry and straw; fuel production from fermentation of

			crops specifically grown for the purpose, as with sugar-cane in Brazil ; solar, wind, and animal power.
2.	Extensive nutrient recycling and conservation.	e.g.	Recycling wastes for crop and animal feed; extending the depth of soil from which minerals are brought into circulation by some use of deep-rooting plants; using animals as scavengers, as soil fertility improvers, and as management tools on arable farms.
3.	Biological and cultural control of nutrient flow down the most productive channels.	e.g.	Diversification to encourage a complex stable web of potential pests and other organisms keeping one another in check; rotations to prevent the build-up of weeds and disease.
4.	Structural changes.	e.g.	A reduction in farm size and an increase in labour usage.

Organic farms rely on some or all of these techniques, and semi-organic farms use them in conjunction with restricted quantities of conventional inputs. It is not, of course, suggested that large numbers of conventional farmers in Britain are ever likely to adopt the full organic philosophy: a more plausible possibility would be what we might call Low Input Farming, i.e., a system in which conventional farmers, in response to changing economic incentives, find it profitable to use lower levels of chemical inputs than they currently find profitable.

It was in order to find just how plausible such a possibility might be that we looked to Organic Farming. We found that the effects of the techniques being used are hardly known, at least outside the circle of organic farmers themselves*. Our study therefore took the form of a survey of organic farmers in Britain, and an analysis of the results with the objective of answering the following specific questions:

(i) what are the main elements of Organic Farming systems, how do such farms operate and what, in detail, are the practices they adopt?

(ii) how successful is Organic Farming judged in purely business terms and how far can the causes of its strengths and weaknesses be identified?

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* Studies of Organic Farming have been undertaken in other countries, e.g. Dessau and Le Pape (1975), COBL (1977), USDA (1980).

(iii) what are the factors which might hinder the expansion of Organic (or Low Input) Farming and how far might the competitive position of these systems be altered by foreseeable changes in the economic situation (particularly in fuel prices)?

These three questions are discussed in Chapters 4,5 and 6. As a preliminary to this central part of the Report, Chapter 2 outlines the methodology of the survey, and Chapter 3 discusses the objectives of organic farmers and the associated definitional problem. Chapter 7 summarises the major conclusions and discusses briefly a further question: how far does Organic Farming offer benefits to society not reflected in its profitability?; the chapter concludes with some recommendations.

CHAPTER 2

Methodology

2.1 Selection of Sample

The intention was to contact as many organic farmers as possible and select from them a representative sample of 50 farmers from whom to seek further information. In practice this approach had to be revised to a more subjective one.

The addresses of farmers likely to be organic were nearly all supplied by two of the main organisations representing the organic movement in Britain: the Soil Association, and Organic Farmers and Growers Cooperative Limited. All past and present farmer members of one organisation were written to (over 200), while the other maintained initial confidentiality by passing on our enquiries to those members who they thought would both cooperate and be useful. A few addresses were suggested by ADAS representatives in Wales, and by the local NFU officers in two counties. These two sources - ADAS and NFU branches - were not pursued to other regions of the country as the pilot run yielded few contacts compared to the other sources. Newspaper and magazine notices yielded two useful contacts plus a handful of interested enquiries. Finally, some contacts were made through other organic farmers when they were visited.

Approximately 250 letters were sent out to the contacts suggested to ask if they were in fact using organic methods, the nature of their farms, and whether they would mind being visited to obtain further information. About 175 replies were received, of which 50 were from fully organic farmers, 18 were from farms in the process of becoming organic, and 14 were semi-organic (organic in approach but making regular supplementary use of low quantities of artificial fertilisers during critical periods of growth). Seventy of these farms were visited together with a further 40 which would more accurately be described as conventional.

In Appendix A, Tables are presented showing the number of farms contacted, the number visited, how many were fully organic, and for how long. Their location, size and ownership is also indicated. Nutrient inputs, where known, are tabulated for individual farms, as is their use of herbicides.

Four problems arose in trying to set up a representative or random sample from the contacts made, however. One was that the population was both unknown and difficult to define anyway; the second was that the extent to which the farm was being run seriously was unknown; the third was that the amount of confidential information a farmer would be prepared or able to give could not be foreseen. Fourthly, it was felt that, ideally, performance should only be recorded from farms that had been running organically for more than five years. In practice, considerably fewer than 30 seemed likely to fulfil this ideal, and even fewer to provide full economic data.

In our revised approach, therefore, the total identifiable population was taken as the potential sample, and visited, - excluding a very few who had either had to give up temporarily or sounded unsuitable for other reasons. We collected information by personal visits rather than by postal questionnaires because this both established a better rapport and enabled a more flexible approach to the nature and detail of information sought.

2.2 Information Collected

About 110 holdings were visited, ranging from those which were clearly organic to some which were more conventional than organic The seventy farmers who could be described as organic, becoming organic, or semi-organic were questioned on their reasons for farming the way they did, and on the way in which they managed their farm. About thirty of them provided full financial and physical records for one accounting year, while a few more farmers provided partial records in varying detail.

2.2.1 Objectives and motivations of the farmer

Farmers were asked about their farming background and what were the reasons leading up to their farming organically or changing to organic farming. They were also asked what sort and level of returns they were seeking. The replies are presented in Chapter 3.

2.2.2 Management of the farm

Farmers were questioned on the following:

Process by which the farm was made organic

Materials used on the land, crops, and for the livestock

Enterprises, acreages and stock numbers

Crop rotation

Grassland management

Weed control

Occurrence of pests and disease

Outputs and marketing

Consequences observed from farming methods

Main difficulties encountered.

This information is documented in Chapter 4, supplemented by some detailed reports of individual farms in the Appendices.

2.2.3 Economic and physical performance during one accounting year

As far as possible we tried to collect the same records as those collected by the Farm Management Survey Units so that the organic farms could be compared with the averages published by these Units. Thus, records were collected of all farm income and expenditure during one accounting year, livestock numbers and valuation, crop yields, quantities of produce sold, quantities of materials bought, and valuations of machinery and stores.

This full economic data was sought from farms which had been organic for three or more years, and which appeared to be being farmed commercially. The obviously subjective selection of farms to be recorded for farm business analyses was inevitable given the need to include as many farms as possible, since numbers were fairly low and not all farmers felt happy about releasing private financial information. However, subjective selection was also felt to be appropriate since the purpose of the study was to evaluate the potential of a method of farming rather than to find average statistics for the whole population.

The completeness of the information collected on farm accounts was very variable. Time did not allow for the usual FMS procedure of placing of an accounts book at the beginning of the farmer's accounting year and collecting it at the end, because it was necessary to visit a farm first so that its suitability for farm business analysis could be judged and the farmer's cooperation be obtained. Instead, farm accounts were collected in retrospect for a previous year. It varied from farm to farm which year's accounts were available - sometimes the most recent year was still with the accountant. The quality of the information obtained was also very variable: many farmers made all their invoices, receipts and bank statements available while others preferred to hand over the accountant's balance sheets only. Accountants' balance sheets were useful in some respects but insufficiently detailed in others; for instance fertilisers, sprays and seeds might be lumped together under one heading; fuel, machinery, power, tractor and vehicle running expenses lumped in various combinations with one another, and searching for all these details elsewhere was not always very successful. Some people were only prepared to give estimates of the variable costs and yields for each particular crop while others provided as much detail as possible. One or two farms were recorded on the basis of 'this is what happens in a typical year'.

It took a great deal of time and patience on the part of the farmers, and also a certain amount of guess-work, to provide the detailed information sought in the course of one visit, and it was difficult to press hard for more precision. However, many farmers were also very helpful in their replies to subsequent enquiries in the post.

In all, records from about thirty farms were sufficiently detailed to compare against standards published by the Farm Management Survey. Some were not so complete but still gave a useful indication of the productivity of the farm. Economic and physical performance is presented in Chapter 5.

2.3 Conventional Standards Used for Comparison

Stocking rates, crop yields and measures of economic performance were compared with figures published by the Farm Management Survey for the appropriate region, year, type of farming, and farm size group.

The figures published by the Farm Management Survey are based on a random sample and therefore reflect average performance. They also present figures for the top 50%, top third, or top ten farmers, differing from Survey Unit to Survey Unit. It might be argued that the potential of a farming system is indicated by the performance of the best farms but that the success in implementing a system is indicated by the average performance.

CHAPTER 3

Definitions and Goals of Organic Farming

"Organic farming is both an agricultural philosophy and a system of farm management"

Robert Oelhaf

"Organic farming is an attitude of mind, it is not a technique"

Lady Eve Balfour

3.1 Defining Organic Farming

Organic Farming can be defined in terms of the practices rejected by organic farmers, in terms of the positive practices they adopt, in terms of their objectives or in terms of their underlying philosophy of life. In this chapter we discuss all of these approaches in turn - an essential preliminary to our discussion, in Chapter 6, of the possible future extent of Organic Farming. This first section is concerned primarily with definition in terms of organic farm practice.

One of the problems of defining organic farms is that many words - "chemical", "biological", "natural", "artificial", as well as "organic" itself - are used with strong emotive connotations rather than as descriptions. Another problem is that there is, in any case, no sharp distinction between 'organic' and 'conventional' farming, but rather there are two poles between which there is a continuous gradation of practice and belief. Even at these polar extremes, conventional and organic farmers have many objectives and practices in common. What divides one type of farmer from another is often the <u>way</u> that they believe their objectives can be achieved and the practical ability and opportunity of the individual farmer to put his beliefs into practice. Thus the individual farmer, classified on this continuum between organic and conventional farmers, occupies a position that is both perceptually and economically determined.

Organic Farming is often defined in negative terms as farming without fertilisers, pesticides or animal feed additives. The national organic farming organisation themselves use negative criteria when defining marketing standards (see Chapter 4.6), presumably because this is the only way they can define boundaries that are clear enough to justify special recognition or a premium.

Though these negative characteristics may be the simplest way of uniquely identifying an organic farm, most organic farmers themselves would define their systems positively. As far as practices are concerned, a formal definition is difficult because there is room for considerable diversity.*

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*A definition might be produced on the lines proposed by Wittgenstein for defining a game (for discussion of a similar problem see Bateman, Edwards and LeVay , (1979).

The central idea, however, is that an organic farm is one which actively seeks to foster biological cycles and natural disease resistance mechanisms*. It is in implementing this approach that the belief is held - to varying degrees with different people - that highly soluble simple fertilisers ("artificials") and synthetically produced chemicals not normally occurring in nature ("other chemicals") should not be used in complex biological systems, therefore not on a farm. It is argued that the introduction of these materials must upset the balance of interacting processes, cycles and feed-back within the system, leading both to imbalanced nutrition of individual organisms and therefore a loss in their vigour, and to a breakdown in the sustainability of the system.

The definition of Organic Farming thus needs to include both a negative statement on the materials it tries not to use, and a positive statement on the practices that it actively adopts. The USDA report on Organic Farming (USDA, 1980) also came to this conclusion and put forward a definition that fulfils these requirements well:

> "Organic farming is a production system which avoids or largely excludes the use of synthetically compounded fertilisers, pesticides, growth regulators, and livestock feed additives. To the maximum extent feasible, organic farming systems rely upon crop rotations, crop residues, animal manures, legumes, green manures, off-farm organic wastes, mechanical cultivation, mineral-bearing rocks, and aspects of biological pest control to maintain soil productivity and tilth, to supply plant nutrients, and to control insects, weeds and other pests."

As they go on to say, "the concept of the soil as a living system which must be 'fed' in a way that does not restrict the activities of beneficial organisms necessary for recycling nutrients and producing humus is central to this definition".

All farming simplifies the local ecosystem. Organic Farming makes a point of nurturing all trophic levels** within a simplified system so that by their interaction they are believed to form a basis both for self-regulation of the whole and for balanced nutrition of the individual. Conventional Farming, by contrast, may be said to concentrate on nurturing only those trophic levels which are directly convertible into cash.

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*The most important cycle is the reconversion of dead organic matter into a form which will be taken up by the crop for its own growth. The natural disease resistance mechanisms are those of induced and inherited immunity, and of well-nourished vigour that can tolerate or outgrow a certain degree of foreign invasion.

**Trophic levels, i.e., primary producers (plants), primary consumers (herbivores), secondary consumers (carnivores) and detritus processors (consumers of dead matter).

Ideally, Organic Farming seeks to maximise the opportunities for balance (i.e. interaction and feed-back) in a way that is both sustainable and profitable. The more dependence that can be put on living self-perpetuating organisms to do the work of channelling nutrients and energy into the required end-product, and the lower the necessity for unassured outside resources, the more self-sustainable the system.

In addition to organic farms, we also refer in this report to semi-organic farms, low input-farms and biodynamic farms. Semi-organic farms seek to maintain a profitable level of agricultural production by similar means to those of organic farms but supplemented by a low input of soluble inorganic fertilisers, herbicides and pesticides where necessary to achieve a desired level of profitability. Low-input farms are taken here to mean farms where the amounts of materials brought onto the farm from outside are substantially lower than those generally used and required to maximise net agricultural output per hectare, on that type of land. Organic farms are not necessarily low-input (for instance some bring in large quantities of slurry). Low input farms are not necessarily organic (they may just be farms with run-down management). Biodynamic farming includes all the practices of organic farmers but also takes into account cosmic influences and man's spiritual development.

3.2 Organic Farming in Practice

In section 3.1 we have tried to outline the ideals of organic farm practice. Amongst the farmers we interviewed, we classified 68 who regarded themselves as organic or becoming organic or semi-organic, according to their usage of herbicides and fertilisers. Of these, 18% used inorganic fertilisers regularly in low to (occasionally) moderate quantities, and a further 15% used them occasionally and at a low rate. Semi-organic manures (Humber or Palmer) were used on a regular basis by 16% (including some of those also using artificial fertilisers) and a further 7% made use of them occasionally. In most cases it was the farmers using inorganic fertilisers that we classified as semi-organic or becoming organic (Appendix A).

Herbicides were not used for weed control in grassland except for the occasional spot-treatment of docks or wholesale blitzes on taking over a dock-infested farm. On arable land, about 20% of farmers used herbicides fairly regularly (about once in a season), 40% occasionally, and 40% never did.

Table A2 gives individual information, for a selected sample, and also shows what nutrients they did use: in conjunction with Chapter 4 and Appendix B, this Table brings out the positive characteristics of organic farm practice.

3.3 Reasons for Farming Organically

We asked farmers why they preferred organic methods, and responses for 58 farms are given in Table 3.1. For each farmer, up to three main reasons were listed, and the table shows the percentage of farms giving each reason.

By far the most common reason (76%) was one that we classified simply as "good husbandry" though the actual words used varied: minimise biological stress, nature's way, stewardship of the land, etc. For many of these farmers, the view that the land should be left "in good heart" through Organic Farming was at least as much an ethical view as a reflection of economic objectives. Other reasons that we have classified under the general heading of Husbandry were less commonly given and were, for the most part, fairly practical in nature: the existence of an organic husbandry clause in the tenancy agreement, the ready availability of organic fertilisers, etc.

The second most important group of reasons had to do with health - animal or human. We distinguished two categories here, the nutritional quality of food and the specific dangers of agrochemicals: both reasons were commonly given.

Economic reasons were also important, with as many as 28% giving independence from debts, lower costs, lower capital involvement or lower risk as reasons for farming organically. Independence was the underlying theme to all these objectives. Although only one farmer was met who initially embarked upon Organic Farming partly because he was attracted by the business opportunities implied by a special market, several of the (younger) farmers were just as keen to make a good living as some conventional farmers. A good income not only provided the usual benefits in terms of standards of living and consumption, it also acted as a defiant symbol that the farming approach they believed in, worked.

Environmental and social considerations were main reasons for only fairly small numbers. These reasons covered concern for the environment (i.e., benefiting wildlife and avoiding pollution) and the maintenance of community life (the provision of rural employment generally and in particular of providing varied and satisfying work). The maintenance of traditional skills was mentioned by one farmer.

We also enquired about the main stimuli that had led farmers into Organic Farming in the first place. Table 3.2 summarises the responses.

The attempt made in this section to analyse objectives shows a good deal of overlap and for many farmers this was clearly an artificial exercise: their objectives formed part of a wider philosophical view - an attitude to life - and in the next section we discuss some of the issues involved.

Table 3.1

Main Reasons (up to 3 maximum) for farming with an organic-type system

(58 farmers)

	% for whom this was a main reason
HUSBANDRY REASONS	
Good husbandry, (minimise biol. stress, balance, nature's way, long-term, stewardship of the land)	76
Improve difficult soil structure	3
Encourage clover as major part of system	2
Free or cheap outside manure supply	3
Organic husbandry tenancy clause	3
HEALTH REASONS	
Food quality for humans and livestock	38
Danger of agrochemicals, particularly sprays	24
ECONOMIC REASONS	
Reduce debts, costs, monetary risk, (including low-input, self-sufficiency and independence as reasons)	28
Preparing for future shortages	5
Special market with premium	2
ENVIRONMENTAL & SOCIAL RESPONSIBILITY	
Active concern for environment*	7
Develop an agricultural system for the future	3
Community life	2
TRADITIONAL SKILLS	2

* For half of these, it was an extension of their religious convictions.

Table 3.2

Main Stimuli (up to 2 maximum) for farming with an organic-type system

	% for whom this was a main stimulus
PERSONAL INFLUENCES	
Reading, talks, travel, education	32
Own convictions	12
Upbringing	11
Friends and acquaintances	9
Organic adviser	2
PERSONAL CONCERNS	
Own health problems	9
Danger of certain chemicals to health	9
Desire to eat health-promoting food	4
Religious convictions	4
Trust policy to develop farm and life systems for the future	4
Animal nutrition	2
Wild-life conservation and estate management	2
TECHNICAL PROBLEMS	
Difficult soils	3
Animal health problems	3
ECONOMIC	
More profitable	5
Cheap supply of manure available	4
Cut costs in general	4
Self-sufficiency	4
Cut fertiliser cost	4
Cut labour cost by being less intensive	2

3.4 Schools of Thought Underpinning the Current Interest in Organic Farming

Organic Farming draws support not just from one but from several different influences or schools of thought. We have distinguished six such influences, as follows:

(1) The connection between health and nutrition

The organic movement in Britain was founded by Sir Albert Howard, Lady Eve Balfour and other people in the 1930's and 40's who were concerned that wrong nutrition is the source of much ill-health. The founders of the movement were interested initially in the nutritional implications of the new agrochemical technology. They suspected that it might produce food with a composition to which the human and animal body was not adapted, never having been exposed to it before in the course of evolution. These people questioned the wisdom of applying the major plant nutrients (N,P and K) alone, and in a simple soluble form. Such applications would swamp the normal ratios of available nutrients released by natural processes, thus distorting the conditions under which the regulation of nutrient uptake had evolved. They were disturbed that previously unknown, perhaps toxic, chemical agents were being released into the environment of food production. Furthermore they rejected techniques of nutrient provision and pest control which ignored what they regarded as the vital intricate balance between a multitude of life forms normally functioning in a sustainable ecosystem. Many of their arguments are still the main ones given today for farming organically.

(2) The extension of holistic thinking to cosmic and spiritual influences on nutrition and growth

Organic Farming as developed by such people as Sir Albert Howard and Lady Eve Balfour, argues that all the forms of life on a farm are of importance to its long-term health and productivity, and should therefore be taken into consideration. Biodynamic farming, developed from the ideas of Rudolf Steiner on the Continent, argues that far wider forces than those in the local ecosystem affect the growth of plants, and that they too should be treated as part of the farm management system. Thus the holistic concept of Organic Farming is taken still further to include, for example, lunar and planetary influences on the one hand, and the personal development of the farmer on the other.

Several of the farmers met, particularly in the south of England, follow some biodynamic practices particularly with compost making. There was not time to follow up contacts with some of the main exponents of that movement, an omission to be regretted since some of them stand out as very able agriculturalists.

(3) Ecological awareness

It is rather more recently that the principles of ecology have become popularly articulated. At the same time some of the practices of modern conventional farming have been seen to augment pest and disease problems, and to cause environmental damage both by pollution and by simplifying or reducing natural habitats.

"Ecological farming" (developing for example, in America) is not synonymous with organic farming. It seems to have the same outlook but it is not necessarily wholly organic in methodology. If the terms come to be used interchangeably, it could lead to some mis-misconception. There are a number of "semi-organic farmers" in this country, and also conventional farmers, who would be better described as "ecological farmers".

(4) Politico-economic interest: management of finite resources and the supply of energy

In the very recent past, it has been the probability of increasing oil prices that has started to bring some of the practices of conventional agriculture into question rather than nutritional, or ecological considerations.

(5) Socio-political criticism of society

Another reason for a developing interest in Organic Farming has been the growth of protest movements generally advocating greater independence of the individual. "Small is beautiful" expresses a whole set of ideas which have become well-known and which provide a strong supportive framework for Organic Farming. This aspect is discussed at length by Dessau and Le Pape (1975).

(6) Ethical and spiritual

Moral and spiritual values are an important influence on many organic farmers and on their supporters. Some of them would call this "the giving, not the taking, way of life" or would regard stewardship of the land as an expression of reverence for God's gift. Others, though they might explain themselves in very different words, appear to be influenced by rather similar ideals.

In a later chapter we discuss the likely future extent of Organic Farming, referring in particular to possible changes in economic influences. In making any such assessment it is important to remember that, of the organic farmers currently working in Britain, economic considerations are generally a significant but no means a sole motivating force.

CHAPTER 4

The Practice of Organic Farming

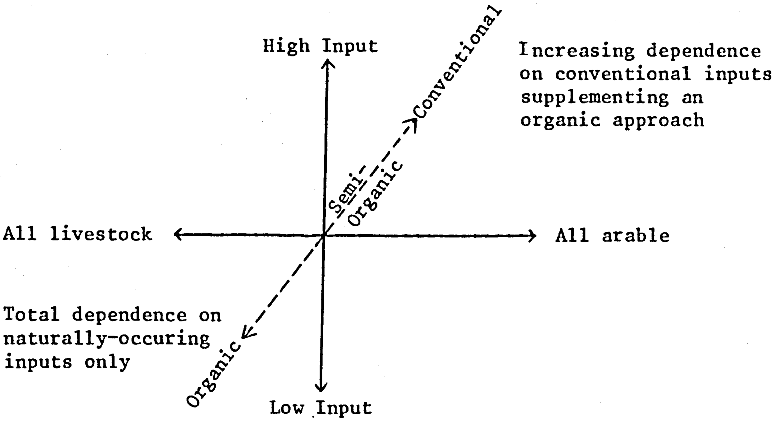
4.1 Introduction

Chapter 4 describes the practices of Organic Farming as encountered in England and Wales. Biodynamic farming is omitted as we collected little information on it. There are three main types of system used by organic farmers in this country; the principles behind these are described together with the methods that organic farmers make use of in Sections 4.2 - 4.5; marketing and standards are discussed in Section 4.6. More detailed descriptions of actual farms are given in the Appendices.

Organic agriculture on a farm-scale in this country is derived from traditional rotational and ley farming as practised before herbicides and abundant simple fertilisers came into common usage. Hence the systems used by organic farmers have a lot in common with those on conventional farms, both having had the same historical background and the same forebears only one or two generations back.

Organic farms in Britain range widely from entirely grassland to entirely arable systems; from farms which bring large quantities of nutrients onto the farm (high input) to those which are relatively self-contained and low in input; and from farms which are purely organic to those which use some conventional materials.

Diagramatically the range of organic farms can be illustrated by a multi-dimensional series of axes. Here we take three:



Organically-orientated farms can be almost anywhere within this three-dimensional space, the more purely "organic" ones coming out of the paper towards the reader, and the increasingly "conventional" farms going into it.

There are three main systems of Organic Farming:

1. All pasture
2. Alternate husbandry (3-4 year leys alternating with 2,3 or 4 years of tillage)
3. Arable rotation (continual tillage including short 1-2 year leys)

The all-pasture farms tend to be in the wetter western and central parts of the country, from sea-level to 1,000 ft. Alternate husbandry is practised right across the country, and the largely arable farms encountered are in the east to north-east of England as one would expect.

The basic components of the three systems are as follows:

	Pasture (including that on mixed farms)	Alternate Husbandry Rotation	Arable Rotation with Short-term Ley
Principle management tool	Grazing control	Crop rotation	Crop rotation
Provision of fertility	Clover plus, often, some import of nutrients including animal concentrates.	Fertility building value of the medium-term ley plus, to a varying degree, those sources used on Arable Rotation farms.	Importation of substantial quantities of nutrients in an organically acceptable form, legumes, green manures, recycling of all residues.
Output	Dairy, beef, sheep	Dairy, beef, sheep, occasionally poultry. Cereals, (fed on the farm or sold). Some potatoes, beans. Occasionally fruit and vegetables.	Beef, sheep. Cereals, some beans, potatoes, sugar-beet, hay.

On all but permanent pasture farms, rotations provide the framework of organic farming. The level of external nutrient input to these systems varies widely within each: organic farms are not necessarily low-input. The more nutrients sold off the farm - progressing from beef and sheep to cash crops - the greater the necessity of high inputs.

In determining the success of organic farms it should be borne in mind that the most significant input to an organic farm is the design of the system. System design should in particular take account of the following:

(1) The sequence of events in organic farming is very important: it goes a long way to assuring a productive level of soil fertility, a controllable weed population, and healthy crops and stock.

(2) The balance between crops and stock, or crops, green manures and legumes, will determine the extent to which the system can be self-sustaining. On almost all organic farms, livestock are vital to the system or - if not - green manures, legumes and imported wastes.

Whatever the method of recycling and fertility building, it must be planned on a scale which will balance nutrient loss from the farm. This straightforward requirement is not as easy to plan for as it sounds. A common problem is that green manures, root crops for the stock and for cleaning the ground, sometimes even animal production off poor leys, may yield too little monetary return to pay for the running costs of the field. There are different methods for solving this problem. For some farmers it might be possible, and acceptable, to intensify animal production by buying in more concentrates, hay and straw, or by investing in winter housing; some outside source of acceptable manure or fertiliser may be available as a means of improving crops and pasture. But all these methods cost money, petrol and time, maybe more than is available. Is the farmer then prepared to buy some semi-organic or inorganic fertiliser on a regular basis?

If it is not feasible or acceptable to balance the system by bringing in more nutrients from off the farm, then the mix of enterprises must be reconsidered. It might be possible to include more of an enterprise with higher returns. (Like conventional farms, many of the older organic farms have had to become less diversified, contrary to their concept of good husbandry). Or the proportions of the enterprises might be adjusted to render the farm more self-contained in nutrient and cash flow; or it might be possible to find time and equipment to process some of the produce before selling, thus reducing the yields and nutrient inputs needed to support the business.

The capital investment needed for each of the alternatives is often a constraint. Adequate buildings and equipment are important in Organic Farming where physical methods of husbandry, and efficient recycling of all wastes, are relied upon almost exclusively - compared with conventional systems which have access to chemical aids. The farmer needs to plan to have equipment and buildings which enable him to fit into the seasonal rhythm of growth at precisely the right moments (e.g. seed bed preparation and sowing; the making of quality hay; the resting of grass over winter).

The design of organic farming systems is rendered doubly difficult in that it involves both the planning difficulties associated with mixed farming, and the use of nutrient supplies that are less readily available or quantifiable than straight fertilisers. There is a need for experience and guidance in this area that is costly, risky and which takes time for an individual farmer to acquire for himself.

4.2 Principles and Methods: PASTURE-ONLY FARMS

The management of organic pasture farms is very much like that of conventional except that, generally, no highly soluble mineral fertilisers are used and no herbicides. Usually clover plays a central role in the productivity of these farms. The promotion of its growth is thus a very important aspect of management.

The basic tool that an organic farmer has is *grazing control*, i.e. dictating where the stock should be, in what numbers per unit area, when, and for how long. He may enhance the effects of the controlled grazing by *reseeding* with more productive or more palatable varieties, by *bringing in nutrients* to boost production and by applying *"sweeteners"* to improve palatability (see later). He may also supplement the grass with a small area of *fodder crops* to extend the grazing season at either end, or to provide bulk for conservation.

Methods used on organic pasture farms to increase output can be described under five headings; most of these methods are the same as those used on conventional farms with perhaps more emphasis on clover and deep-rooting plants. They are:

(1) increasing herbage production

(2) increasing herbage utilisation

(3) improving herbage quality

(4) promoting the health of the stock

(5) processing and marketing the output to gain a higher return per unit.

4.2.1 Increasing herbage production

(a) *Species composition of the sward*

Most of the pasture farms are down to permanent pasture or, if reseeded, to long-term leys. Seeds mixtures always contain white clover and some of the more productive grasses suitable for the area. Species are chosen to complement one another in their seasonality, rooting depth and ability to fix nitrogen. There is little emphasis on the classic deep-rooting herbal ley found on rotational farms, partly because invasion of indigenous 'weeds' or herbs is inevitable anyway, and partly perhaps because the cost of these more complex mixtures is less justified than on a higher-output rotational farm. When a field is reseeded, another crop e.g. roots or arable silage, can be interjected (a) to work the weeds and (b) as a nurse crop for the reseed.

(b) *Resting the grass over the winter*

Some grass is rested over the whole winter, ideally, for an early spring bite, and at least over late winter if it is to be cut for conservation.

Cattle housing, even sheep housing, is a great boon to the organic system - as to any other - in that not only does it rest the grassland but it also necessitates bringing straw (or bracken) onto the farm for bedding and production of FYM. The manure can then go out on the conservation area, support more stock again over the winter, and hence step up the whole cycle. Though the technique is there, scarcity of the initial capital outlay can be a problem, or even the cost of transporting straw in some parts of the country.

A few acres of fodder crops can also be grown to increase the length of time that the stock can be kept off the grassland when the soil moisture content is at field capacity and the ground more liable to poaching. Thus rape, kale, cabbages and turnips may be grown for autumn and winter use while rye gives a very early spring bite.

(c) *Bringing in nutrients*

Lime and slag, or rock phosphate (depending on soil type and on availability) are taken over the whole farm about once every eight years.

Raising the pH helps produce soil conditions which favour more vigorous growth of more productive grasses and clover. These conditions also promote decomposition and turnover of organic matter by encouraging earthworm activity.

Clover responds well to phosphate, and basic slag in particular has been of tremendous value in promoting clover growth. It is now difficult to obtain, with changes in steel-making processes, so only a low grade 14% basic slag sold by Fisons, rock phosphate, and a TIMAC product seem to remain as wholly organically acceptable. Rock phosphate is not useful on high pH soils above 6.5 or 7 because it becomes highly insoluble. TIMAC market a blend of phosphate, potash and calcified seaweed, an expensive form of P and K but valued by one or two farmers met in improving palatability and utilisation of old grassland. Some farmers will use superphosphate, although it is in a processed, more soluble form: the phosphate soon becomes bound in a fairly insoluble state and so does not lead to the high imbalanced concentrations of one or two plant nutrients that organic farmers so much object to.

Other manures and fertilisers tend to be concentrated primarily on the conservation areas. Farm-yard manure (7-15 tons/acre), slurries (2000 gals/acre), poultry manure (two tons/acre per application), sewage sludge (used by very few organic farmers) and calcified seaweed (five cwt/acre) are used. Most people regard Humber's and Palmers' fishmeal-based manures as too expensive for grassland use, or immoral, but two of our sample used them on their conservation areas. A few farmers, some of whom are otherwise completely organic, use compound fertiliser such as 20:10:10 at the rate of 1½ to 2 cwt/acre in early spring to boost the conservation crop, or to get an early bite.

Manures and slurries are taken round the rest of the farm as often as quantities permit, which may be only once every five years or so.

Some people bring a lot of nutrients onto the farm (high-input) and some almost none (low-input). On dairy farms the high fixed costs of the enterprise require that a certain level of production be achieved to service them. Furthermore, there is a continual outflow of nutrients in the form of milk. All organic dairy farms growing pasture only (except for one small part-time tenanted farm) had a substantial import of nutrients, largely in the indirect form of animal feeding-stuffs and straw (see Farm B 1.1.1). Indeed this has been one way in which the fertility of farms has been built up in the past, when cereals were relatively cheap (Farm B 1.2.3.). The large import of concentrated feeding-stuffs is, of course, no different on conventional farms growing pasture only, except that the conventional farms have the still relatively cheap option of depending on nitrogen fertiliser to boost production of a highly digestible grass product which may reduce the need for concentrates.

On beef and sheep farms, input of nutrients can be, and generally is, much lower both for technical reasons (a smaller quantity of nutrients is being sold off the farm) and economic ones (overheads are lower so a relatively smaller margin over variable costs is required to service fixed costs). Farms B 1.2.1 and B 1.2.2 are examples of such farms.

Where large quantities of organic waste are available locally, however, these can be worth making use of if the (considerable) extra physical labour and perhaps transport costs are justified. Thus one of our sample brought in a lot of swill to feed through pigs, producing manure; another carted in a lot of poultry manure from four miles away. The former has not being going long, but the latter ranks as one of the highest performers in his local MLC sheep-recording scheme.

It is often argued that organic farming surviving on such a basis is not of interest, because there is not enough waste to make it of widespread use. In effect, however, it may be that these farmers are putting themselves in a very favourable position for the future. Having built up a high level of biological activity and turnover in the soil, it may be that a system with a substantial pasture component will subsequently only need topping up with low inputs of nutrients from outside to keep up the momentum. Many organic farms have been, or are, going through this process of building up a high level of organic matter and biological activity, before becoming comparatively low-input subsequently (e.g. Farms B 1.2.3, B 1.1.1 and B 2.1.1).

One so-far non-organic dairy farm visited also had this approach. A much greater quantity of organic matter is now passing through the pastures and soil as a result of using a lot of fertiliser, bought-in animal feedstuffs, a high stocking rate, and all slurry recycled after digesting for methane. It is hoped to restore and build up the inherent fertility of the formerly worn-out farm to a point where the old props can be removed and the system revolve around recycling, use of clover, long-term deep-rooting seeds mixtures, and a higher proportion of home-grown feed. Thus, in the long term, the farm hopes to become sustainable organically.

4.2.2 Increasing herbage utilisation

Good utilisation may be encouraged as one way of compensating to some extent for lower yields. There are two senses in which utilisation can improve: firstly, by an increase in the proportion of herbage tissue grown that is harvested before it becomes old, relatively unacceptable, less nutritious, and/or lost by decay back into the soil; secondly, by more complete digestion and absorption of the material eaten by the animal. Organic farmers can promote high utilisation by the species composition of their swards, by grazing control measures, and by additives to improve palatability:

(a) *Sward composition*

Clover improves utilisation both in being palatable and therefore sought after and also, in a physiological sense by its synergistic action on the feed value of the diet. Organic farmers have little difficulty in retaining a high percentage of clover in their swards.

Cocksfoot, on the other hand, although much advocated for its deep-rooting properties by organic farmers, is quite often avoided by them because it has to be carefully managed. Once it has grown away from the stock it becomes coarse and unpalatable and a spiral of underutilisation takes place. The difficulties with cocksfoot can be overoome by following selective grazers (dairy cows) with less choosy ones such as bullocks, and by topping. However, there is a new variety of cocksfoot called Cambria which is softer and much more acceptable to stock even when it is old, though it has at least one drawback of not being winter-hardy. Such development of varieties may prove of much help to the classic deep-rooting herbal ley of the organic farmer.

(b) *Grazing control measures* need to match the rate of grazing with the rate of growth of the pasture so that the herbage presented to the animals tends to be young and highly digestible, and yet enough time allowed for full regrowth to take place. For these reasons - among others - some farmers think paddock-grazing, on-and-off with a high-density stock, in a short space of time, essential. Moreover, it may help to promote clover regrowth in competition with grass for light if the sward is periodically grazed right down. Paddock grazing also, of course, helps control the build-up of parasitical worms. Experiences and circumstances differ, however, and some of our sample reported set-stocking, combined with topping or shutting up part of a field, encourages desirable species including clover and provides just as good a livestock output per hectare.

A widely advocated, though not always adopted, measure for increasing utilisation (as well as controlling worms) is mixed grazing or rotational grazing with two, preferably three types of livestock complementing one another in their grazing habits. The better farms tend to be those with a combination of stock. Generally this is cattle and sheep, though horses too are sometimes involved and poultry folded behind cattle. Competition with dairy cows for grass in spring, inadequate fencing for sheep control, lack of sheep handling facilities, or empathy with only one form of stock are all factors which lead some people not to meet the mixed grazing ideal.

(c) *Herbage "sweeteners"*

Lime and seaweed, particularly calcified seaweed, but also Maxicrop and SM3 (liquidised seaweed products) are found by some farmers to encourage more complete grazing (e.g. Farm B 1.2.3).

4.2.3 Improving herbage quality

Most of these methods have already been referred to:

(a) *Reseeding* if the more digestible grasses and clovers are not present.

(b) *Good utilisation,* so that a lot of old, less nutritious material does not build up and get ingested unavoidably.

(c) *Making high-quality hay or silage.*
On some farms, the production of high-quality barn-dried hay (cut young, and brought in after only two to four days to beat the weather) is crucial to their otherwise low-cost feeding policies. Arable silage (some combination of peas, beans, cereal and vetches) may be grown where a pasture is broken up for reseeding. Not only does it provide a high-quality bulky conservation crop, but it can act as a nurse crop for the next grass ley. It was the experience of two

farmers, however, that cattle prefer grass silage to arable silage.

4.2.4 Livestock management and promoting stock health

Ethically, the health and comfort of their own stock is one of the most important motivations of organic farmers. Economically, thriving animals show a better return to the herbage put into them. In Organic Farming, therefore, one might say that emphasis is put firstly on increasing, within the bounds of comfort, performance per animal, and secondly on performance per hectare. Quality is aimed for.

In general, the management of livestock on organic farms is little different from that on conventional with the important exception that *as much as possible of the feed is organically grown*. It is considered that organically-grown unforced food is more likely to provide the natural composition for which the animals' digestive systems were evolved. Inherent trace-element deficiencies in the soil, however, have to be made good for instance by feeding dried seaweed, and magnesium and phosphate are often augmented by high-magnesium or high-phosphate minerals.

On the high-input dairy pasture farms in our sample, and some others, a significant proportion of the animals' food was not organically grown. For some reason or another, either to do with the nature of the land, or the climate, or the adaptability of the farmer, or just plain economics, it was not possible to justify growing the concentrate feed required and a compromise had to be made. The forage was grown organically, but conventionally-grown feed was brought in from outside, and it was hoped that the organically-grown forage would counterbalance any deficiencies.

In addition to providing as much organically-grown food as possible, considerable thought is put into *reducing stress* i.e. making the animals comfortable. This is, of course, not an attribute exclusive to organic farmers, but it is one which all bona-fide organic farmers have.

Husbandry measures taken on organic pasture farms to improve the health of the stock are:

(i) Rotational and mixed grazing to reduce parasites.

(ii) Deep-rooting herbs - chicory, ribgrass, sheep's parsley and burnet - are included in seeds mixtures for their high mineral-accumulating properties.

(iii) Stock are home-bred where possible to foster immunity to local pathogens, adaptation to local climatic stresses, and development of a rumen microflora able to cope with a high percentage of clover in the diet.

Bloat can be a particular and serious problem if cattle are brought in from outside. In general, those farms with home-bred stock have no trouble. But someone who wishes to buy in stores and fatten them on clover-rich pastures has to find some way of checking bloat, for instance by restricting the amount they can graze, providing long hay or straw at the same time, or perhaps giving access to an adjacent root crop. Chicory and docks are thought to have some anti-bloat properties, and the inclusion of sainfoin in the seeds mixture, for its anti-bloat constituents, was being considered by one farmer.

(iv) Various measures to avoid stressful living conditions and deficiencies, part of the skill of any good husbandry person, are adopted. For instance: ample, dry, well-bedded winter quarters, exercise even in winter, provision of some sort of green fodder every day throughout the year, feeding of seaweed for its mineral content, or free choice minerals, and an intimate knowledge of the stock.

(v) On almost all farms the normal veterinary measures are taken if something goes wrong but the cause, ideally, is always sought and put right, as sickness is regarded as an indication that something is wrong with the system. On the whole, the usual preventative dosing, injections and dressings are used though possibly more restrainedly or selectively. Some farmers know and use old-fashioned remedies with success, and a very few use homeopathic preparations.

4.2.5 Premiums on output

Monetary returns per unit of output can be higher by virtue of some nutritional quality or some rarity value e.g. high butter-fat milk, sales of pedigree breeding or milking stock. Many organic farmers tend to go for quality stock and produce anyway (Channel Island milk, pedigree stock, some of the less common but hardy breeds) in their pursuit of excellence, craftsmanship or traditional values. Any associated premium gives some small compensation for what is generally a lower output in quantity compared with conventional farms. However, we found that virtually no premiums were being obtained for meat and milk by virtue of their organic method of production.

Monetary returns per unit of output can also be raised by processing the basic commodity on the farm. Thus on three organic dairy farms, bottling, processing and retailing of Channel Island or goats' milk into yoghurt, cream, cheese and cheesecake, was essential to survival. Three more of the larger farms also processed, or had processed, some of their milk.

4.2.6 Weed control

On the whole, most of the undesirable weeds (e.g. nettles, thistles, bracken) can be kept down by repeated topping using a tractor, Mayfield or back-pack flail cutter, depending on the area and steepness of the fields. A heavy dock problem is a source of concern, and given the pressures of time and economics, some of our sample had decided the best thing was to spray them right out and thereafter keep numbers low by grazing management (e.g. putting sheep on in early spring) and manual pulling. One farmer told of how he dealt with a dock problem by putting ringed sows on to the land, in particular in winter and early spring. They ate the crown out of all the young docks and kept them starved out. It seems that creeping thistles can also be as difficult to control as docks.

Buttercups and daisies tend to indicate drainage or lime problems, as indeed do docks on poached land. It is then the organic approach to tackle the underlying cause rather than spray the weed itself.

Most other herbaceous 'weeds' in grassland are regarded by organic farmers as beneficial on account of their higher mineral content and sometimes greater rooting depth.

4.3 Principles and Methods: ALTERNATE LEY-ARABLE ROTATIONAL FARMS

Alternate husbandry means the alternation of arable crops with grassland. A medium-term ley, three, four of five years long, is used to build up the structure and fertility of the soil, to suppress arable weeds, and to support one or more livestock enterprises. The accumulated reservoir of nutrients in the roots, the turf, and the dung of the animals is cashed in by a sequence of arable crops before the land is again returned to grass for 'replenishing'. The specific characteristics of alternate husbandry are discussed in this section, but those characteristics which are common with predominantly arable rotational farming are postponed to section 4.5.

4.3.1 Crop rotation

Ideally, the sequence of arable crops is chosen such that:

(1) the most valuable or most hungry crops (e.g. wheat or kale) are grown when fertility is at its highest;

(2) crops with different cultivation requirements are grown in order to suppress weeds at different stages and clean the ground for one another;

(3) the ground is kept covered as much of the time as possible to keep more soluble or labile nutrients cycling through living tissue rather than leached away.

Economic or climatic and soil conditions particular to the farm tend to limit the feasibility of putting (2) and (3) wholly into practice.

Rotations followed in Britain are generally 3-4 years of grass followed by 2-3 years arable. The proportions of grass, cereals and fodder crops vary according to the climate (more grass and fodder in the wetter west), the livestock (fodder as a main crop may be more economically justified with dairy cows than with other livestock), the practicability of a one year legume crop of beans or red clover, and the amount of nutrients brought onto the farm.

Many farmers grow two years of cereals, some straight after grass, others after a year of arable silage, field beans, well-dunged kale or potatoes. Most people visited grew either one or two years of cereals, with a fodder crop either at the beginning or at the end. A few managed three or four years of cereals where there was a large input of animal feed or of imported manures and semi-organic fertilisers. A few would use low rates of compound fertilisers.

The inclusion of a fodder, root or potato crop in the rotation has certain well-known technical and risk-avoidance advantages:

(1) cleaning crop for arable weeds

(2) break-crop against cereal pests and diseases

(3) perhaps increased scope for catch cropping between main crops

(4) more likelihood of offsetting one poor enterprise year against other enterprises

(5) sometimes an additional source of food for the stock.

It is a central principle of organic farming to aim for a diversity and multiplicity of enterprises for the above sorts of reasons. However, a root break increases the capital outlay on equipment, may need extra labour, and in the case of potatoes risks a lot of invested capital. Thus the technical ideal of a root-break is, under present circumstances, severely restricted in practice. With fodder crops there is the problem that the value of the material for feeding may not cover the fixed costs of the field. On one of the best farms visited, the year of roots and kale formerly included for the sheep can no longer be afforded.

4.3.2 The arable sequence

Cereals

Yields of cereals are shown in Table 4.1. Part of the variation is due to the greater nutrient input to some farms than others.

Table 4.1

Cereal yields on organic and semi-organic farms

(number of farms given in brackets)

	ORGANIC FARMS			SEMI-ORGANIC FARMS		
	(No. of estimates)	Range T/ha	Average T/ha	(No. of estimates)	Range T/ha	Average T/ha
winter wheat (out of grass)	(12)	3.0 to 5.8	4.1	(4) 4 farmers using 40 to 80 units N/ac or 1½ cwt Humbers 12:6:6	4.7 to 5.3	4.9
spring wheat	(6)	2.5 to 4.9	3.5			
winter barley				(1) 1 farmer using 1½ cwt Humbers 12:6:6 or 4:12:12	4.9	
spring barley	(8)	3.1 to 4.3	3.7	(5) 5 farmers using 34 to 55 units N/ac	3.4 to 4.9	4.1
winter oats	(3)	3.7 to 4.8	4.2	(1) 1 farmer using 1½ cwt Humbers	4.9	
spring oats	(4)	3.4 to 5.6	4.5			

Winter wheat is normally grown immediately after the grass break, when fertility is at its highest. Most of the farmers grow a milling variety rather than a feeding wheat. Yields range from 3.0 to 5.8 T/ha (24 to 47 cwt/ac) out of grass with an average for 12 farmers of about 4.1 T/ha (33 cwt/acre). The 5.8 figure was out of permanent pasture. (Three farmers using a lot of bought-in manures on largely arable farms yielded 3.7 to 6.2 T/ha (30 to 50 cwt/ac) the highest yields coming from the farmer whose compost included chicken manure; the other two were using pig slurry at 2,000 to 4,000 gal/acre). Four alternate-husbandry farms putting on 40-80 units of nitrogen, or 1½ cwt Humbers 12:6:6 had yields of 4.7-5.3 T/ha (38-43 cwt/ac), with 4.9 T/ha (40 cwt/ac) as the average.

The fertility of the soil is unlikely to be high enough to support a second wheat crop out of grass so, in an organic system, barley or oats are grown instead for a second and sometimes a third year. Ideally a winter cereal is followed by a spring cereal in order to avoid a build-up of particular weeds. However, some farmers have reasons for following the first winter cereal with a second which, for them, outweigh the husbandry argument for a spring variety. For instance: a higher financial return from a higher yield may be obtained providing the crop can be kept clean without too much extra expense; the earlier harvesting date of winter barley enables a catch-crop of stubble turnips to be put in for strip grazing and dunging the land for the next crop; and some farmers found that, on their soils, weed-control was easier in a winter-sown crop than a spring one. The third cereal crop is generally a spring one so that the next ley can be undersown into it.

To some extent, the lower-value cereal crops (barley and oats) that must be grown instead of repeating wheat, can be increased in value by feeding them through stock instead of selling direct. A mutually-improving cycle can then be encouraged: the higher-value cash crop of wheat can be grown cheaply out of grass, while the lower-value subsequent cereal crops can be fed to stock. Supplementary cereal feeding enables higher stock numbers to be supported on the grassland which, in turn, increases nutrient recycling and pasture production. This then favours the next crop of wheat. In this way, nutrients are sold off the farm either (a) direct for human consumption - thus commanding a higher price than that sold for animal feed - or (b) in value-added form as animal products which, at the same time, take less nutrients off the farm. On the other hand, however, selling cereals direct requires lower investment and yields a more immediate return.

Fodder Crops

(Kale, rape, rye, Typhon, cabbages, arable silage, mangolds, fodder beet, swedes and turnips)

In the more predominantly livestock areas, a forage crop may replace one of the cereals. If the forage crop is to be carted off the land, then a more valuable cereal crop will be grown first to cash in on the built-up fertility of the ley. If it is to be eaten in situ, however, then it can be grown straight after the grass, dunged (e.g. Farm B 2.1.3) and the ground will still yield a reasonable crop of spring barley or oats the following year.

The advantage of following grass with rape or kale is that the ley need not be ploughed up until a conservation crop has been taken off it, so relieving pressure on the other grassland. Furthermore, as has already been mentioned, kale is a hungry crop, like wheat.

A few farms grow mangolds, fodder beet and swedes, sometimes in strips with kale. Again the labour involved restricts the acreage to a fairly minor part of the rotation. As with potatoes, manuring is necessary beforehand, from which a following cereal crop can also benefit. Turnips and Typhon are grown rather more frequently. If grazed in situ, they too can be followed with another cereal crop to reap the benefits of dunging.

Potatoes

Potatoes need a good dressing of manure beforehand (15-25 cwt/acre is used) but the residual may again be cashed in with a cereal crop afterwards.

Several organic farmers grow half-a-hectare or more of potatoes to meet their own needs with some to spare. The surplus is sold through local outlets, generally obtaining a slightly higher price and a regular clientele for their quality and keeping ability.

A few farmers were growing 4 to 10 acres of potatoes for sale as a component of their rotation. Most were using really heavy rates of manure or slurry. One grew 6 acres straight after grass on a farm to which chicken manure and other nutrients were imported in fairly substantial quantities. Weed control was straightforward using a ridger on a tractor. He reported 49 tonnes/ha (20 T/ac) in 1978.

Two of these farmers, however, using lower rates of dung or unsuitable soil, were finding it such an expensive crop to grow for relatively low yields (amount 20 tonnes/ha normally but down to 11 in a poor year), and a risky market, that they were probably going to stop. Not only is the initial investment high, but weed control becomes very expensive if a lot of manual labour has to be brought in.

Catch crops

Catch-cropping where possible is a useful practice for increasing the output of an organic farm. It is used:

(a) to provide an extra bite for stock at low cost (rape, stubble turnips)

(b) to keep the ground covered (rape, mustard, trefoil) or

(c) as a green manure (mustard, trefoil).

However, the fuel and labour involved need to be considered in deciding whether inclusion in the rotation is worthwhile (see Farm B 2.1.1)

Green manuring is much more widely practised on the continent than here, and is discussed in section 4.5.2.

4.3.3 The grass ley

In organic alternate husbandry, where the grass plays a major role as fertility builder, the ley must be down for at least three, preferably four years. In that time there will have been an extensive production of roots and a good bottom of turf developed for ploughing in.

In Britain the deep-rooting herbal ley has become a cornerstone of organic farming, derived originally from the work of such people as Sir Robert Eliot at the end of last century with his "Clifton Park System of Farming" (Eliot, 1943). The composition of the ley - varied in different parts of the country - consists basically of four or five perennial grasses suited to the area and complementary to one another in their seasonality; one or two varieties of white clover; very occasionally red clover but this dies out; and two, three or four of the herbs Chicory, Ribgrass, Sheep's Parsley, Yarrow and Burnet.

The seeds mixture is rather more expensive than the usual medium term leys because of the herbs, but it is generally considered worth paying extra for. The herbs are included for a number of reasons:

(a) they accumulate minerals of benefit to the stock

(b) Some of them root deeply, particularly the Chicory, and hence increase the depth of the soil profile that is being tapped for nutrients. When their leaves die, or dung is returned, the nutrients are added to those near the surface of the soil, thus benefiting the shallow rooters.

(c) The roots leave drainage and aeration channels deep into the soil when they die.

Cocksfoot is another deep-rooting plant sometimes included in the ley. Its merits and difficulties have already been discussed in section 4.2.2.

One further advantage of deep-rooting is that plants withstand drought better. There are experimental observations to suggest (Stewart, 1980) that roots will be less confined to the top few centimetres of soil under organic management than under conventional, where soluble fertilisers tend to be concentrated near the surface. All organic farmers without exception reported that, in dry years, their pastures remained greener longer and recovered from drought sooner than their neighbours'.

While the grass ley plays such an essential role in alternate husbandry organic systems, enabling reasonable cereal crops to be grown without conventional inputs, the grass itself can be an economic weak point of the system.

Monetary returns on it can be low both compared with the arable crops it is displacing, and with grass production using fertilisers. This is important to note because the overhead machinery costs of the arable sector, and the foregone continuing arable profit of conventional farms (reflected in rents expected) have to be met. These pressures are reduced if the land is owned outright and perhaps run by family labour, particularly if skilled at second-hand machinery maintenance.

On nearly half of the alternate husbandry organic farms for which estimates could be made, stocking rates were about 60-75% of the standard for conventional farms, pulling down the overall farm income in spite of reasonable cereal returns. However, low production off grassland is not an inevitable concomitant of organic alternate husbandry: grassland and animal nutrients can be brought onto the farm in a form other than artificial fertilisers, to boost grassland productivity per hectare, (including, for instance, Farms B 2.1.1, B 2.2.1 and B 2.2.2 where grassland stocking rates were as high as the average for other farms in their area).

The management of grassland and stock on organic farms has also already been outlined in section 4.2. Some of the measures taken to counter-balance lower quantities of grass have been put forward in sections 4.2.1 to 4.2.3.

4.4 Principles and Methods: PREDOMINANTLY ARABLE ROTATIONAL FARMING

On the Continent, and in parts of Britain where summer growth of grass may be held up by low rainfall and a shallow soil, a medium-term ley may not be sufficiently productive to justify having it down for so long. Under these drier conditions a more wholly arable rotation may be adopted with grass and clover down for one or two years only, or none at all. The short ley then acts more as a break-crop, providing some nitrogen and root matter, but not the improvement of soil structure and fertility restoration derived from longer-term leys.

The rotations people use, or are proposing to use, generally involve sequences of either:

1 year cereal
1 year fodder, root and/or nitrogen-fixing crop

or: 2 years of cereal
1 year fodder and/or nitrogen-fixing crop.

e.g. 1 yr cereal, 1 yr fodder or potatoes (6 yr rotation)

Year 1 : Spring barley
" 2 : Complex ley
" 3 : Spring oats
" 4 : Stubble turnips
" 5 : Wheat
" 6 : Potatoes and kale

+ SHEEP
grazed and folded on
the ley
+ CATTLE
yarded and fed some grain
FYM returned.
Most grain sold.

e.g. 2 yrs cereal, 1 yr nitrogen-fixing crop (6 yr rotation)

Year 1 : Winter wheat
" 2 : Oats
" 3 : Beans
" 4 : Winter oats
" 5 : Spring barley
" 6 : Red clover/Italian ryegrass/trefoil ley, cut for hay

grain, beans and hay
fed to CATTLE on
permanent pasture or
in winter housing.
Surplus crops sold.
FYM returned to
arable section.

Nearly all arable-rotational farmers have a one or two year ley of Red Clover together with varying proportions of Italian Ryegrass and sometimes Trefoil. If the farm has no stock, the ley is cut for hay which is sold, and the aftermath ploughed in. If the farm does carry stock, or rents out the aftermath for sheep keep, then the ley gets grazed and dunged as well.

Spring beans are also used as a nitrogen-fixing break between cereal crops.

Fodder turnips, potatoes, kale and mustard with intervening fallow cultivations are other break crops which benefit the cereals in the rotation: they allow for thorough weed cleaning cultivations, or for heavy dunging *in situ* by the folding of animals over fodder crops and turnips.

On five out of eight of the arable-rotational farms visited, an area of permanent pasture or long-term ley provided an important complement to the arable section. The pasture permitted flexible movement of stock out onto the break crops, stubble, and aftermaths when needed. The stock then return to base. The pasture and fodder break crops are used to feed stock, while the stock process straw into FYM for redistribution on the land. Some of the lower-value cereal crops (i.e. barley, oats) could be fed through the stock as well.

On the whole, substantial quantities of nutrients are sold off the arable-rotational farms, and need to be replaced by large importation of other people's wastes, rock phosphate or Europhos, or - in some cases - by semi-organic fertilisers or conventional supplementation.

As an exception, one farm fed much of its arable produce and hay through stock, so had a lower need of imported nutrients: Europhos and Alginor (a seaweed product) only were brought in.

A more interesting exception to high brought-in nutrient input was the following five year rotation system practised on heavy clay in East Anglia without stock:

2 winter cereals (wheat), each undersown in May with trefoil which was subsequently ploughed in as a green manure;

1 spring beans;

1 oats;

1 yr fallow (for weed control).

The system is still at a fairly experimental stage, the farmer backed by other income as well, and information on production from the rotation as a whole was not available.

Finally, there was one farmer in the fens whose rotation consisted of cash crops only with no leys, no green manures and no stock on the land itself. The rotation followed is:

Year	1	Sugar beet
"	2	Winter wheat
"	3	Winter wheat
"	4	Spring barley
"	5	Spring wheat (used to be ½ beans, ½ oats).

The farmer imports 1000 tons of straw, poultry waste and sewage per year to make about 350 tons of rotted compost spread at 7 cwt/ac and supplemented with up to 4 cwt Humber manures (10 cwt on sugar beet). Some of his own straw is converted to FYM by fattening store cattle in a half-covered, straw-bedded "crew yard" over the winter. It is not a system to be entered into lightly however, without assessing fuel and time, and being able to market some produce through OFG Grade 2 (see section 4.6).

All these farmers chopped surplus straw (i.e. that not destined for feeding or bedding) behind the combine, and some dressed it with rock phosphate or slurry.

Section 4.5 will deal with Cultivations, Sources of Nutrients, Weed Control and Pests and Diseases, where the practices are common to both alternate ley-arable systems and predominantly arable systems.

4.5 Rotational Organic Farming: Some Practices Common to Both Types

4.5.1 Cultivations

In their cultivations, organic farmers try to preserve the structure of the soil profile as far as possible in its natural state. The purposes of this are, firstly, to keep organic residues near the surface of the soil since their decomposition requires a supply of oxygen to the organisms involved and, secondly, by maintaining cracks, worm passages and old deeply-penetrating root channels, the drainage and aeration of the soil is assisted. Thus it is that organic farmers plough shallowly where possible, 4" or so deep; they try to spread manures on the surface rather than plough them in; they advocate the chisel plough rather than the inverting action of the mold-board plough; and many of them sub-soil regularly to improve drainage and break up any pans. However, deep ploughing is also necessary sometimes - for instance, to break up a ley where surface cultivations would take too long to get the next crop in or to pull up couch. The energy-saving and soil structure-preserving practice of direct drilling from a grass ley is not open to organic farmers because of the concomitant use of herbicides.

Compromise is sometimes necessary when it comes to the ideal of keeping the ground covered. For instance some soils are too wet in spring to prepare for a crop then, so cultivations must be done the previous autumn.

Contrary to some popular belief, organic farming on a commercial scale in this country is, with one or two rare exceptions, just as highly mechanised as conventional farming. Quite a few organic farmers report a greater ease of seed-bed preparation as the years go by, and there may possibly be grounds for postulating reduced energy consumption due to an emphasis on shallow-ploughing. However, such observations or assertions can only be recorded here, not examined.

Adequate machinery and equipment (including building) is an important factor in making the organic farming system competitive, because timeliness of operations is so important without herbicides and fertilisers to get crops off to a good start.

4.5.2 Sources of Nutrients for Crop Growth

On both types of farms, nutrients can be classified as either internally or externally provided:

Internal Sources

1. Medium-term Grass-Clover-Herbal Leys
   using solar energy to accumulate plant nutrients in reservoirs of organic matter. These then become available to subsequent crops as decomposition proceeds.

2. Short-term leys, green manures and dunging of fodder crops grazed in situ.

3. Recycling farm wastes and by-products

   - FYM
   - Slurry
   - Compost
   - Straw and haulm chopped behind the combine

External Sources

1. Biological sources

   - Animal feeding stuffs
   - Seaweed and seaweed products
   - Fishmeal-based manures

2. Waste materials from processors, other farms and consumers

   - FYM
   - Slurry
   - Sewage in dried or liquid form
   - Straw
   - Spent mushroom compost
   - Hoof, horn and dried blood from abattoirs
   - Spent 'Lime' from sugar-beet factories
   - Basic slag

3. Mined, unrefined sources of nutrients

   - Lime
   - Rock phosphate, "Gafsa"
   - Chilean nitrate and Chilean potash nitrate

4. Refined or manufactured sources of nutrients

   - Europhos
   - Kayphos
   - Kainit
   - Phosac
   - Humber, Palmers and Timac semi-organic manures
   - supplementary, relatively low, quantities of nitrochalk, nitram, superphosphate and compound fertilisers on some farms.

Nutrient provision common to all alternate husbandry farms is:

(a) (by definition) the Medium-term ley

(b) some form of Internal recycling and redistribution

(c) occasional Lime where necessary

(d) some form of Phosphate if not supplied by other brought-in sources such as feeding stuffs and manures. There were just one or two exceptions to this.

In addition to these basics, many of the alternate husbandry farms bring in other nutrients from outside.

Almost all the predominantly arable rotational farms, i.e. farms without a medium-term ley, bring in substantial quantities of nutrients from off the farm. They get a certain amount of green manuring and nitrogen fixation benefit from 1-2 year leys of red clover, Italian ryegrass and sometimes trefoil, or from legume cash crops. Almost all these farms carry stock as well. Their presence, together with almost universal chopping of straw behind the combine, help maintain recycling on the farm.

A summary of rotational farms using external sources of nutrients is shown in Table 4.2.

Table 4.2 Number of farmers (out of 35) bringing in external sources of nutrients

Animal feedingstuffs	12 + several a little
Calcified seaweed	5
Liquid seaweed products	12
Bought-in bulky manures and sewage	20
Purchased straw	8
Spent mushroom compost	1
Hoof and horn	1
Spent sugar-beet lime	2
Phosphate rock, slag or superphosphate	22
Potash (Chilean potash nitrate, Kainit)	2
Chilean nitrate	3 + 1 occasional
Semi-organic fertilisers	9 + 2 occasional
Inorganic simple or compound fertilisers	15

Low Input - Low Output Farms

Comparatively few of the rotational farms visited tended to be self-contained in nutrient input i.e. low input farms (6 out of the 25 Organic and 10 semi-organic farms). These farms used lime if necessary, some sort of slow-release phosphate occasionally, and bought in relatively small quantities of animal feedingstuffs. They were almost all over 200 acres.

In spite of low input, three of these farms sold their arable produce rather than feeding it through stock. One was poor in performance ; one unknown; and the third had been getting average yields of 3.7 T/ha (30 cwt/ac) in two cereal crops out of every three grown for ten years now. The value of the output is increased by selling it as flour. The three farms selling only livestock produce were in a comfortable financial position. They all sold beef and, or, sheep and one was dairying as well.

It seems that a 3-4 year ley will support one or two cereal crops without any further additions, but a longer run of cash crops requires some other recycled or bought-in nutrients.

Moderate to High Input and Output Farms

(a) Animal Feedingstuffs

About one-third of the rotational farmers visited supplemented their internal resources with a significant quantity of bought-in animal feed. Almost all of these people were the dairy-producers who do not differ from conventional farmers in this respect. There were just two largish dairy farms which managed to grow most of their own feed requirements.

Money spent on purchased feeds was generally no more than on conventional farms in the area, and quite often less if a lower stocking-rate was carried. Thus it would seem that, on the whole, bought-in concentrates are not being substituted for soluble fertilisers to obtain reasonable production - although feedingstuffs may, in the past, have helped to build up the fertility of a few of the farms.

It is other cheaper forms of nutrients that are used on some of the organic farms to match the role of fertilisers in raising output. Some farmers bring in substantial quantities, particularly those who sell crops as well as stock off the farm.

(b) Bulky Organic Residues

Twenty out of 25 organic and 10 semi-organic farms brought in manure, slurry or sewage from outside the farm:

FYM	- Pig	3
	- Poultry	7
	- Cattle	1 occasionally
Slurry	- Pig	6
	- Duck	1 occasionally
Sewage	- Sludge	5 (including two only occasionally)
	- Dried heat-treated sludge	2 (including one only occasionally)

Transport costs and time are two important draw-backs in bringing in bulky manures and three of those listed above gave up on this account. The acceptable radius for transport seems to be very small indeed, 3-8 miles or so, and generally nearer three than eight. The dried heat-treated sewage sludge, marketed from Yorkshire (Dewmus), was imported over longer distances, but only reluctantly when more local resources had failed.

Seven farmers said that the availability of outside organic residues was essential to their way of farming, and on a further six farms it would appear to be very important.

Several farmers brought in extra straw to supplement their own for bedding stock and producing FYM. Liberal purchase of straw, if it could be afforded, was regarded as an investment in fertility.

Only one farmer made regular use of spent mushroom compost: he used it to soak up and store slurry from the dairy.

(c) Phosphate

Most of the sample bought in Phosphate in some form or another. It was put onto grass, or before roots, or spread over chopped straw in the field to assist its breakdown.

(d) Semi-organic Fertilisers

These were being used on cereals on some high-output farms (3 farms); as a supplement while the farm was changing over to organic (4); as a stop-gap when other manure supplies were inadequate (2); and in spring if growth was late (1).

(e) Inorganic Fertilisers

Inorganic fertilisers were used mainly by people in transition from conventional to organic farming (5) or on cereals by people who had decided to use low quantities of them regularly (6). Two more people occasionally used 1-2 cwt Nitram or Nitrochalk on grassland in spring while four dressed their cereals with 30-50 units of N after a bad winter or poor spring.

If nitrogen usage was kept below 50 units per acre, the crop could still qualify for the Organic Farmers and Growers Grade 2 premium as it then was. Use of certain herbicides was also permitted under this, so, where their use was necessary, farmers would sometimes add the extra nitrogen allowed for by this grade. This Grade has now become much more liberal (see section 4.6) and maximum quantities are no longer specified although the type of fertiliser permitted is. The types of herbicide that can be used are also specified.

Handling of Organic Inputs

Farm Yard Manure: Out of 16 people giving estimates of usage, a few (4) spread 6-10 t/ac, most (8) spread 10-15, three or four used 20-25, and one, exceptionally, put on up to 50 t/ac. The heaviest dressings go on before wheat and potato crops, and on land that is being reclaimed. Very roughly, it would appear that there is the equivalent of 1-6 tons of FYM available per acre per year from the farm itself, according to the amount of winter housing.

There is no general consensus of opinion as to when it should be spread. In practice it generally just has to fit in with other farm operations.

Slurry: Most slurry goes on to the grassland at 2,000 gal/ac. There is usually only one application, less commonly two. One farmer uses 12,000 gal/ac/year on potatoes with no ill-effect and no fall-off in response; his land is very sandy.

One farmer visited "composted" poultry slurry in a straw-bale lagoon built onto the ground and filled with more straw as more slurry was delivered. The digest could then be spread in solid form when needed.

Compost Making: Only six people regularly took the trouble to compost and turn FYM and/or bought-in residues. Two had prepared concrete pads on which to do so while others did it on a soil, or at a time of year, when machinery did not get bogged down. The material was either tipped out into long rows from the back of a cart, or deposited more loosely from a power-take-off spreader. The long heaps were built up to about five feet high and the width of one, or perhaps two adjacent, spreaders. Some people formed vertical ventilation shafts every three feet or so using a stake. The heaps were left two or more weeks to heat, then turned by lifting the sides to the middle with a fore-loader, or by turning the heap over sideways.

One or two farmers added biodynamic preparations to the heap.

There were one or two old "traditional" practices still being carried out or only recently dropped. Thus one person floored his yard with 12 tons of sawdust (£300 in 1979) to soak up all urine and dung, and put it on the land. This was called an "Irish Pad". Three other people lined the floors of their cubicles or cow sheds with rough chalk, partly to absorb urine and put lime into the FYM. One of these people also used to block off all drainage channels with sawdust to soak up effluent.

Green Manures: Very few people grow mustard or trefoil specifically as a green manure for direct ploughing in, but two farmers are experimenting with direct undersowing of trefoil into cereal crops in about early May. After harvest, the trefoil is allowed to grow on over the winter before spring ploughing. Mustard was grown as a "catch-crop" green manure by one person.

On the whole, however, most people who plough in a crop as a green manure have already taken some cash value out of that crop by grazing it with stock or cutting it for hay. It is the regrowth of the aftermath that is ploughed in. Wheat generally follows the aftermaths of both arable silage (some combination of peas, beans, oats and vetches; or dredge corn) and 1-2 years Red Clover/Italian ryegrass/trefoil leys ploughed in as green manures.

As mentioned earlier, green manures are much more widely used on the Continent as a means of fertility building than they are in Britain. There is much experimentation and experience to be gained from over there. One experimental organic research farm in this country intends to develop their use under British conditions.

Straw-chopping: Straw is chopped into short lengths either behind the combine or as soon after combining as possible. For instance, one (conventional) farmer chops all straw the following morning whilst waiting for the dew to clear, before harvesting the next section. The point is to get the straw small and in contact with the ground (perhaps very shallowly rotovated in) under damp conditions so that microbial growth is promoted. Some people dress the straw with slag, rock phosphate (3-5 cwt/ac) or slurry to assist breakdown.

Only one farmer (a fairly conventional one on heavy clay) reported any difficulty with inhibited germination of the winter-sown cereal crop. Another farmer found it necessary to roll the ground before sowing the next crop so that the seedlings did not grow down into air pockets held open by incompletely-rotted straw.

Straw-chopping is a technique being experimented with at experimental husbandry farms, as it is of interest to conventional farmers. Competition for available soil nitrogen by the decomposers has raised questions as to how to cater for this on an organic farm - but from the people met, it does not seem to be showing itself as a problem in practice.

Seaweed and Fishmeal products: Unlike wastes, the seaweed and fishmeal products are expensive.

Seaweed products are used, and quite widely, more as an article of good husbandry than simply in order to obtain an increase in monetary return. They tend to be used where quality or palatability of crops and grass, long-term investment in improved swards, or simply being organic, are much valued by the farmer for their own sake. Some farmers doubt their effectiveness but there are others who are well pleased with positive effects on keeping quality, palatability, disease-resistance and drought resistance.

Most people who have used calcified seaweed on grassland consider it has much improved sward utilisation and clover growth. There are one or two who did not find it worthwhile, but its advocates would say they have not used it for long enough.

The semi-organic manures produced by Palmers, Humbers, and now Timac are generally very highly regarded, apart from their expense. Humbers and Palmers used to be based on fishmeal but now that this is expensive, the organic base is thought to be other processing wastes. Timac markets a product based on calcified seaweed with rock phosphate. The non-organic content of plant nutrients in semi-organic fertilisers is immediately available at lower concentrations than in straight fertilisers. It is said that this has a comparatively less inhibiting effect on seed germination. (Hull University experiments quoted by Humbers). The organically-bound content of plant nutrients is released more slowly and then in increasing quantities as the crops grow. It is claimed that a larger percentage of the nutrients provided are taken up by the crop compared with the usual soluble fertilisers and - concomitantly - that less of what is purchased is lost through leaching. Improved grain-filling, and sugar-content in sugar beet, are reported by the manufacturers.

Some organic and semi-organic farmers dismiss them as "neither one thing nor the other" and would prefer to use organic manures plus straight fertilisers more cheaply.

4.5.3 Weed Control

Weed control was cited as the biggest problem on several, though not all, organic rotational farms.

The framework for weed control on organic farms is crop rotation as it provides opportunities for performing different cultivations at different times of the year. This goes some way to preventing the build-up of weed populations in the soil. Weed control in a particular crop is then tackled (a) by increasing the relative competitiveness of the crop at the seedling stage (b) by physical removal, and (c) on some farms by a restricted use of herbicides.

Rotation and Cultivations

In the first cereal crop after ploughing up grass, usually a winter cereal, there is little weed problem. The general advice is then to follow a winter cereal by a spring cereal so that any weeds that do begin to multiply under a winter cereal routine are not encouraged by a repeat of those conditions. Instead they are disturbed by autumn and spring cultivations. However, yield considerations, the availability of improved winter barleys to follow winter wheats and - on some farms - wet soils in spring, mean that the weed control tenet of avoiding two winter cereal crops in succession is not always followed.

Beans and roots are regarded as cleaning crops in the rotation in that row cultivations are done. However, with root crops, the economics of the labour required and the low (fodder roots) or risky (potato) returns involved mean that their inclusion as a cleaning crop does have drawbacks.

Some farmers managed a "bastard fallow", i.e. two, three or four months of frequent cultivation. The ground is harrowed or disced every time it greens over, perhaps once every two or three weeks in the summer. The trouble with frequent cultivations on light land is that the humus gets oxidised quickly. The gain in weed control is thus counterbalanced by a loss in soil organic matter.

Summer bastard fallows are possible between an early-ripening crop such as winter barley and the next autumn sowing; or if a grass field is broken up early immediately after conservation. Summer rotovating and discing of old grassland is found by one farmer to be effective in the control of docks. The field is then ploughed properly in autumn.

Winter or early spring fallow cultivations can be done on dry well-drained land before putting in a spring crop. Few people have dry enough land to do this. One man who does, leaves stubble untouched until the New Year so that birds and frost can get at any wild oats and other seed.

Only one farmer was met who still included a full fallow, but he was experimenting and had the support of an additional income. His view was that you could not start to farm organically, particularly on the heavy clay land he had, until it had been cleaned by a year's fallow.

Competition

Organic farmers need to take much care over seedbed preparation so that the seedlings get off to a quick start and smother the weeds. A few farmers had time to interpose a "false" seedbed i.e. the fine tilth is prepared two weeks or so before sowing the crop. Weed seeds are thus encouraged to germinate and get harrowed in during the sowing of the crop itself. One farmer, on light chalky soil in the south, delays his sowing into a false seedbed until late October, otherwise he still tends to get a weed problem. Other farmers would advocate much earlier sowing to procure good establishment before winter, and perhaps higher yields.

Some farmers drill crops in two directions diagonal to one another in order to smother the bare ground more quickly. One person doing this found that a small increase in sowing rate in otherwise identical conditions made all the difference in smothering weeds completely by producing a fuller stand.

The decision as to when to sow was several times mentioned as a particularly important and difficult one for the organic farmer, who has no recourse to herbicides and soluble fertilisers to get crops off to a good start. The farmer has to catch the optimum conditions for establishment and yet get the seed in early enough (with spring crops), or late enough (with autumn crops), to avoid weed competition. To some extent this is an advantage of winter cereals. Most people find weed control in winter crops easier than in spring, presumably because weeds are less competitive at the time of germination and establishment of ground cover.

The purpose of all these husbandry methods is thus to ensure vigorous competition by the crop which will smother weeds out. The undersowing of leys into cereal crops, the use of long-strawed wheat varieties, catch crops of broadcast rape, and the very early start of spring beans were all mentioned as further instances of this principle.

Physical removal

There are four main forms of mechanical or manual weed control practised: vigorous harrowing and rolling of young cereal crops in spring; mechanical hoeing of precision-drilled cereal crops; the growing of fodder and root crops on ridges which can be hoed and scuffled; and some hand-roguing.

Mechanical hoeing of cereal crops requires that the crop be carefully drilled at seven or more inches spacing. The hoes may be front-mounted and guided by the tractor driver, followed by a weeder attached behind the tractor to drag the weeds about. Or the hoes can be rear-mounted and guided between the rows by a second man. Cereal weeders and hoes are not so suitable for stony soils. Several organic farmers are interested in the production of a less expensive version of a German weeder which is being initiated by Organic Farmers and Growers.

One person had a secondary cleaner on his Laverda combine which collects and bags weed seeds rather than returning them to the land.

Cleaning of harvested material can contribute an additional expense to the organic farmer, which, together with transport costs, can eat into any premium he obtains for the crop. One farmer puts the harvest through a rotary cleaner as it comes off the field, before drying, so that the moisture in the weed seeds does not have to be removed as well. The harvest is cleaned again in an ordinary cleaner after drying.

A different physical method of preventing weed spread was practised by a non-organic farmer visited: he rotovated a strip one yard wide around the edge of all his cereal fields except the last one undersown to grass. This bare, clean, strip prevents incursion of creeping perennials from field edge into crop.

Herbicides

Herbicides were not used during the ley part of the rotation apart from the occasional spot-treatment of docks. Other methods (section 4.2.6) were adequate.

On the arable section no herbicides were used at all by about 40% of the organic farmers visited, about 40% used them occasionally, and 20% used them fairly regularly about once in a season. Weeds were generally reported as being of not much problem after ploughing up a medium or long-term ley. It was subsequent crops and direct sown leys which presented the problems.

Some farmers who never use herbicides do tolerate a higher weed population and to some extent regard them as contributing to the feeding value of the straw. Farmers who use no, or only occasional, herbicide must pay a lot of attention to cultivations, seed-bed preparation, and mechanical weeding.

Those people who occasionally resorted to herbicides did so when they thought a weed population liable to get out of hand, and then they generally sprayed only once. The sprays were used more to suppress than to achieve total kill. MCPA on broad-leaved weeds such as charlock and chickweed was particularly mentioned. Several farmers used MCPA at half-strength, three or four of them diluting the spray with liquid seaweed extract. They found it gave comparable results to full-strength MCPA.

The new Grade 2 of Organic Farmers and Growers, attracting only a 5% premium, allows for the use of MCPA, MCPB, CMPP, Asulam and Glyphosphate (the latter not pre-harvest).

One farmer who had a black-grass problem expected that it would eventually be kept in check by the ley-arable rotation he was establishing after several years of continuous cereals. Until then he was using the appropriate herbicide. Wild oats were mentioned by three people and, although they hand-rogued and rotated the crops, they still found it necessary on their farms to spray sometimes. One in particular had a neighbour growing seed corn.

"Organic farmers" who were using some herbicides fairly regularly were mostly in the process of becoming more organic and they were generally still making use of small quantities of fertiliser as well. There was one farmer whose system was fully established, using a lot of bought-in slurry, who found herbicides essential on his 56 hectares of light sandy to peaty soil. Another growing bulbs could find no alternative to herbicides on the bulb part of the rotation because weeds left around the bulbs bunged up the harvesting equipment.

Thus, although about 25 organic farmers were met who never used herbicides (including 12 rotational and 13 grass-only farmers), there were a larger number of other people, including very committed organic farmers, who found it necessary to spray on occasion to suppress (e.g. broadleaves) or remove (e.g. winter oats) a weed problem.

4.5.4 Pests and Diseases

Pests and diseases do not present much of a problem on organic farm crops, apart from blight on some potatoes. They occur, but not, it seems, in threatening quantities. Some fungal disease may go unrecognised.

Aphids, flea beetle, cabbage white butterfly, turnip root fly, wireworm and leather jackets were all mentioned. Many people with aphids on cereals, beans or swedes, or infestations on surrounding conventionally-grown crops, reported that ladybirds came in within a week or so. The aphids never reached pest proportions although the neighbouring farmers had felt it necessary to spray. One farmer in the Fens, however, with a purely arable rotation, occasionally used "Excel" nicotine and Aphox on sugar beet aphids about once every two years.

One farmer had leather jackets one year for which he put down poison on slates so that it could be cleared up afterwards. Another made sure he avoided leather jacket trouble by growing spring barley first.

There was one farmer, converting from conventional to organic, who had a known wireworm problem in some fields. He avoided winter crops on that land, rolled it, and sowed spring crops. He also found that ploughing in white mustard helped.

A farmer with very large fields on thin chalkland left grass rides into these fields to provide "highways" out from the hedgerows. In this way he hoped to bring indigenous fauna out into the fields to facilitate biological control.

The only fungal disease mentioned as an occasional real problem by a few farmers was blight on potatoes. The problem was to find an acceptable organic control measure. One person used Bordeaux mixture, another (a biodynamic farmer) used silica, while a third grew Désirée as being fairly resistant.

All organic farmers tried to choose disease-resistant varieties, and one at least was putting in a blend of three or four varieties of barley.

A few farmers advocate foliar feeds for quality promotion, increased resistance to disease and recovery from stress: nettle juice, Chase SM3 (liquid seaweed extract), Siapton (peptide and amino acid extract from slaughterhouse wastes).

Quite a lot of organic farmers used undressed seed. Between one half and three-quarters tried to use undressed seed, including about half of these who saved their own seed whenever possible. Some of these people used a higher seeding rate to allow for that eaten by birds.

The other people, who used dressed seed, did so because: they found undressed seed difficult to obtain; they felt it did no lasting damage; they actually preferred it, to stop losses from rooks and crows; they had a wireworm problem (newly converting to organic farm); or they were introducing a new variety to their farm.

4.6 Marketing and Standards

4.6.1 Markets

There is an organised market for organically-grown cereals and beans but no special marketing channel for livestock as yet, nor for milk. Processed products and the more-horticultural crops are sold at the farm gate, in local markets, or in specialised shops sometimes some distance away.

Livestock and Livestock Products

The very great majority of the stock and milk produced is sold through ordinary channels, obtaining normal market prices. An organic premium is only obtained, if at all, by the very few people who process and retail their own produce to special shops, farm-gate, and personal customers.

A serious attempt is being made by the Organic Farmers and Growers Cooperative to establish a marketing system for meat through one of the nationwide butcher chains. This chain is prepared to market organically-grown produce through one of its shops once a steady guaranteed supply has been established. To this end, producers belonging to the Organic Farmers and Growers Cooperative are being encouraged to sell their stock to this particular firm at normal prices to start with. If the firm is satisfied with the flow and quality of the meat, it will start paying a small premium. The Cooperative may also be able to link up organic farmers each dealing with different parts of the production cycle (for instance rearing to stores, or fattening bought-in stores) so that the animal is entirely reared on organic farms.

Horticultural-type Produce

Farmers and growers must make their own arrangements with special shops, farm-gate and local customers if they are to market their produce as organically grown. More widespread use of the organic marketing symbol of the Soil Association is being encouraged as a marketing device; this symbol is explained in more detail in section 4.6.2.

Arable Produce

There is an organised marketing channel for cereals and beans, and one or two farmers sell potatoes and carrots through it as well. It is run by the Organic Farmers and Growers Cooperative but not all organic farmers market their cereals through it. One or two prefer to use their local market because of transport costs, or their local co-op through loyalty. A few mill and retail their own grain. They thus get a substantially greater return per tonne.

Processing

Three people sold wheat straw cut with a binder and threshed for thatching.

Four farms processed some or all of their milk into yoghurt, cream cheese and a little cheesecake. They sold it direct from the farm-gate, or to health-food shops and restaurants.

Five farmers milled all their own wheat and sold it as flour. One farmer is hoping to pearl his own barley.

Table 4.3 summarises the usage made of different marketing channels by the organic farmers visited; some used more than one outlet for the same product:

Table 4.3 Marketing Channels for Organic Produce

	No. of Farms	Usual Channels	Marketing Cooperative	Special Shops	Farmgate and Personal Customers
			Percentage of Total		
Arable crops	(24)	4	79	12	21
Beef, Sheep and Dairy Stock	(54)	96	0	2	6
Milk and Dairy Products	(17)	88	0	12 (processed)	18 (processed and milk)
Potatoes and a few vegetables	(9)	11	11	22	78

Very small quantities, and eggs, have not been included in the above table. They were sold at the farm gate. A certain amount of grass keep or hay was also sold by some people to neighbours (in one case, for racing horses). Semi-organic farmers marketed through conventional channels except for those crops they had grown to OFG1 or OFG2 specifications.

4.6.2 Standards

Both Organic Farmers and Growers, and the Soil Association, have drawn up standards for the marketing of produce. Organic Farmers and Growers is a marketing cooperative for arable crops which also acts as agent for obtaining members' requirements if asked, and provides some advice. The cooperative may eventually handle livestock marketing as well, as explained in section 4.6.1. Farmers pay a membership subscription and 4% commission on the price they receive for Grade 1, no commission for Grade 2. The cooperative sells to wholefood businesses and processors both in this country and in Europe. There are two grades of produce sold, summarised here but listed in more detail at the end of the Chapter:

OFG1 : Use of farm wastes and other organic manures, rock minerals, seaweed products, combined with careful rotations and 'considerate', preferably shallow, cultivations and subsoiling.

No soluble processed mineral fertilisers, herbicides, insecticides or other agrochemicals are permissible, though under special circumstances, such as a cold late spring, Chilean Nitrate of Soda can be used to a maximum of 30lbs of nitrogen per acre.

The non-residual insecticides such as Pyrethrum, Derris, Nicotine or Rotenone are allowed but discouraged because they are non-selective. The premium for OFG1 is, at the moment, 25% less 4% commission.

Old OFG2 : As for OFG1 but a maximum of 50 units of nitrogen, 30 of phosphate and 30 of potash could be used, as could the herbicides MCPA, MCPB and Azulam. No seed dressings were allowed except against flea beetle on brassicas and roots. Rotations were essential.

The premium for OFG2 was between 10% and 15% less 4% commission.

New OFG2 (from September 1981) : Specified commercial fertilisers can be used: ammonium nitrate with a base, nitrate with a base and single superphosphate. Certain herbicides can also be used (MCPA, MCPB, CMPP, Azulam and Glyphosphate, the latter not preharvest). There appears to be no written restriction on quantities. The premium for the new OFG2 grade is 5% with no deduction for commission.

The old OFG2 standard, for which a market existed: (a) allowed committed organic farmers to save a very poor crop from failure (e.g. due to weeds, or a very late spring) and still obtain some premium and some recognition for their organic approach; (b) may have helped people make a gradual transition to organic farming by avoiding the complete cut-off in fertiliser and generally poor crops obtained in the first two years or so; (c) possibly, by providing a small premium, encouraged some people to go some way towards organic farming which, to those with environmental interests, may be better than achieving no cut-back in pesticide and fertiliser use at all.

However, there are some people who think that the existence of a second, somewhat arbitrarily defined grade associating itself with organic farming is false, or the thin end of a wedge into their principles. There was a market specifically for this low-artificial input produce but it seems that it was more difficult or limited than the rather different one which the new OFG2 grade has been designed to serve. A feasibility study in London showed that there was a small potential for pesticide-free food in several major supermarkets and, providing negotiations are successful, it is likely to go ahead. It is intended that the standards in this grade will allow yields of 2-3 tons per acre but at the same time will not allow any chemicals that are residual and could be passed on to humans.

The Soil Association also has a certified marketing standard. This consists of one grade only, similar to OFG1 but somewhat stricter in its attitude to Chilean Nitrate, whose use is under debate. The Association administers the standard by granting people permission to use a certified trade symbol if their husbandry practice is within the limits prescribed. Two part-time inspectors are appointed to examine the farms in detail when they apply for the symbol; there is an annual re-inspection thereafter. The grower takes on legal responsibility, in using the symbol, that the products have been grown within its specifications.

By permission of the Soil Association and of Organic Farmers and Growers, their specifications are reproduced at the end of this chapter.

The need for clear specifications in marketing organic produce seems to lead to a conflict of interest between the producer on the one hand, and the retailer and consumer on the other. Thus if the consumer is to pay more, he wants to be assured of exactly what he is getting. If the farmer is to obtain the premium, either financially or psychologically, he must grow that crop wholly within the organic black-and-white specifications or lose the premium entirely.

In marketing a defined product, no lea-way can be allowed for a poor year needing remedial treatment, nor in a normal year for differences in interpretation of what is good husbandry. But without an intermediary grade, there is no financial incentive, unless costs are lower, to effect a compromise if pure organic farming cannot be achieved. There is also no outside kudos or psychological reward to those who are trying to become fairly organic in a world geared to conventional agriculture. Several organic farmers were met who felt guilty for not always wholly succeeding in meeting the standards idealised by the organic movement. The censorious attitude implied by the standards of the non-farming consumer seem to overlook the very real risks and difficulties that would-be organic farmers sometimes have to contend with.

Thus although the introduction of less-than-pure organic grades of produce may seem to some to be a betrayal of organic farming and to leave room for abuse, the existence of (a) a market for this produce (though not now apparently big enough) and (b) farmers wishing to be more organic but not entirely succeeding, would seem to justify the concept of a second "organic" grade. Furthermore, it leaves room to develop rather than fossilise the contribution that the organic attitude to farming can make. Too many grades, on the other hand, cannot be workable in a small market.

The new OFG2 grade is no longer an organic grade fitting into the above line of reasoning. Its justification rests more on the avoidance of pesticides alone, though this may necessitate only low-to-moderate fertiliser use anyway because higher rates of fertiliser seem to make crops become more prone to pests which then need spraying.

SOIL ASSOCIATION ORGANIC HUSBANDRY : QUALIFYING STANDARDS

I PERMITTED LIST

This is the permitted list of products that may be used with the Soil Association Organic Husbandry Qualifying Standards. New products, resistant varieties and new applications appear and the list will be revised periodically.

The numbers apply to the attached notes.

A MANURES

1) Farmyard manure
2) Pig manure
3) Sheep manure
4) Horse manure
5) Goat manure
6) Poultry manure
7) Slurry
8) Homeopathic preparations.

B COMPOSTS

13) Composted organic animal and vegetable residues.

14) Mushroom compost
15) Deep litter compost
16) Municipal compost
17) Sewage sludge
18) Spent hops

C ANIMAL BY-PRODUCTS

25) Shoddy
26) Dried blood
27) Blood and bone
28) Bonemeal
29) Tannery wastes
30) Fishmeal
31) Hoof and horn
32) Dried animal manures
33) Guano

D MINERALS

37) Basic slag
38) Phosphate rock
39) Dolomite rock
40) Felspar rock
41) Ground chalk
42) Ground limestone
43) Ground basalt rock

E SEA PRODUCTS

49) Ground calareous seaweeds
50) Seaweed meal
51) Seaweed foliar feeds

F HOMEOPATHIC SPRAYS & PREPARATIONS

60) Biocides

G INSECT CONTROL

73) Pyrethrum, Rotenone
74) Derris
75) Garlic, herbal sprays and preparations
76) Quassia
77) Ryania
78) Nicotine
79) Homeopathic sprays and preparations
80) Diatomaceous earth

H FUNGUS CONTROL

96) Homeopathic sprays and preparations
97) Herbal sprays and preparations
98) Formaldehyde
99) Lime sulphur
100) Dispersable sulphur
101) Copper fungicide

J HERBICIDES

108) See notes

GENERAL

Compost/Manures

To be acceptable these must be produced from material grown or cultivated following Soil Association principles, or from material which is composted for at least three months and subject to these notes.

Organic fertilizers are effective not so much by what they contain but by what they do to the soil and its micro-biological life. Organic humus matter is highly important, together with the mechanical conditions of the soil. To increase the earthworm and biological content are priority aims, as is the judicious use of the subsoiler/mole plough allowing aeration and so producing an increasing soil life.

Composting of materials is preferable to returning them neat to the soil. A carbon/nitrogen ratio of 30-35:1 (1 ton straw to 2-3 tons fresh manure) should be aimed for. A minimum of 140°F (60°C) for several days with a maximum of 170°F (77°C) should be reached in the compost heap. A small amount of lime may be added to help decomposition and retain phosphate.

See also Soil Association booklet, 'Farming Organically'.

Sewage Sludge and Heavy Metals

Pathogens are present in sewage sludge especially raw untreated material. Most pathogens are destroyed by anaerobic sludge digestive processes and digested sludge only should be used. Risk of transmission of disease to animals and man is very low. Animals should not graze land treated with sewage sludge until at least five weeks have elapsed.

Sewage sludge is best composted and included with other materials in the heap. If it is used directly on land it must not be used on crops for direct human consumption. Application should be some time before sowing; at least one season's growth (harvest) before a crop intended for human consumption.

Most sludge contains heavy metals. These should be avoided as they are stable in the soil. The accumulation of toxic metals is likely to be less serious in soils with a high degree of humus content. Rural area sewage from small treatment works is less likely to have a high metal content. Accurate analysis of sludges is essential, and it is recommended that nitrogen from sewage sludge should not be greater than 150kg per hectare when applied to the soil.

The toxic effects of copper, nickel and zinc are cumulative and can be worked out with the help of ADAS Advisory Paper 10 (Permissible Levels of Toxic Metals in Sewage used on Agricultural Land) available from local Ministry of Agriculture.

Where no previous contamination with toxic metals, zinc equivalent maximum 250 p.p.m. (250mg per kg) in dry matter topsoil, and boron 4.4kg/ha.

Note that 250 p.p.m. = 500lbs (227kg) per acre in soil.

Further information will be added to the permitted list when it becomes available.

The other metals causing human toxicity - cadmium, mercury and lead - are a serious problem in sludge, especially cadmium because of its ability to translocate from the soil to the edible portion of plants. The level of cadmium in the soil should not exceed 1.5mg/kg, lead 200mg/kg and mercury 0.9mg/kg (p.p.m.)

Our present protection lies in maintaining a high soil pH (6.0 - 6.5) to reduce cadmium availability and to err on the side of caution. A lowering of the pH of soils increases the risk of toxic effects from sewage sludges.

Lead is insoluble especially on alkaline soils, and when it is taken up by the plants it is retained in the roots; root crops therefore tend to be at greatest risk.

Mercury is absorbed from the soil into the root systems, but is not readily translocated to the edible portions of plants.

NOTES ON PERMITTED LIST

A MANURES

1-6) These will be of more value if composted before being spread. Steroid hormones and the so-called chemical hormones are NOT destroyed with composting. Antibiotics should be destroyed with composting, if satisfactory heating up to 170°F takes place and heaps are turned to make sure contents are all thoroughly composted for three months.

2) Copper and zinc are incorporated in manufactured pig food and will be in pig manure from this source. Copper is highly toxic especially to sheep. See note on Sewage Sludge and Heavy Metals.

6) Growth hormones are incorporated in some manufactured poultry food and may be found in poultry manure from broiler units. Flash dried deep litter and poultry house muck is useful but frequently contains high proportions of NH_3 - toxic unless material weathered before direct application to plant. Better procedure is to compost. Not to be used on crops for direct human comsumption unless previously cleared by O.S.C.

7) Slurry

Carbon nitrogen ratio of 6:1 is too small and therefore use straw heaps sprayed with slurry.

If this is impossible and slurry remains in lagoons, periodic aeration is recommended.

Spread thinly and only in dry weather so that fresh manure is not immediately led towards roots. Spread on grassland immediately it has been cut or grazed. It should not be added in such quantities that it forms a cap and prevents aeration of top layers of the soil.

8) Homeopathic Preparations

These preparations require considerable expertise and understanding of them is best sought from someone familiar with their use.

B COMPOSTS

13) Proprietary composts, e.g. John Innes, Jack Temple Compost and Levingtons contain added soluble fertilizers. Source of supply should be cleared with Soil Association first.

14) Beware of Gamma B.H.C. (persistent organo-chlorines). Source must be cleared.

15) See note 6, and note on Sewage Sludge and Heavy Metals.

16-17) Heavy metals are found in samples of sewage. Before using any product with sewage as an ingredient an analysis of heavy metal content should be obtained.

Digested sewage sludge contains approximately 6% nitrogen, 4% phosphate ($P_2 O_5$), 0.3% potassium ($K_2 0$) and is obtainable in semi-solid or pelleted (cake) form.

C ANIMAL BY-PRODUCTS

25) 3% - 12% N shoddy from the woollen industry sometimes has glass/metal waste and Australian/New Zealand seeds in it.

Seeds in the main produce large thistles.

26) 12% - 13% N.

27)
28)
30)
31) Best applied before planting/sowing.

28) Source of phosphate 20% - 24%. Steamed bonemeal is quicker acting.

29) Little value.

30) 7% - 14% N. 9% - 16% $P_2 0_5$ (phosphate).

32) These should be watched for any additives, e.g. chemical hormones and steroids.

33) Source of potash.

D MINERALS

37) 9% - 22% phosphate and about 25% - 33% lime + trace elements. Sometimes contains added rock phosphate (Europhos). 6 - 10 cwt per acre applied every three years. Small dressings yearly (2 cwts.) give better results and/or may be alternated with calcified seaweed and Basalt Rock dust. Apply autumn, winter or early spring.
*Kainite and K Slag too highly soluble.

38) Finely ground produces 26% - 33% insoluble phosphate. Gasfa 301 only. Up to 7 cwt. per acre every 4th/5th year. Gasfa contains high proportion of calcium which might produce problems on high pH soils.
(Superphosphate and triple superphosphate prohibited).

39) Source of magnesium.

40) Potash source.

42) Apply according to pH. A pH of 6.00 for grassland and 6.5 for cereals should be aimed for. Overliming locks up trace elements and is to be avoided. Slaked or burnt limestone not recommended.

E SEA PRODUCTS

49) Up to 5 cwt. per acre every 3 or 4 years. See also note 37. Not recommended on calcareous land.

50) Seaweed itself (Laminaria) most valuable up to 5 - 6 tons per acre on grassland and potatoes. Kelp 12% - 16% K.

51) Contains trace elements and growth factors. These products must be checked for addition of soluble chemical fertilizers.

F HOMEOPATHIC SPRAYS AND PREPARATIONS

60) Applications of permitted biocides should be made when beneficial day-flying insects (e.g. bees) are not working.

G INSECT CONTROL

73) Pyrethrum from the flower; Rotenone from the root of Pyrethrum. Photo-chemical - best applied in dull light/in the evening.

74) Must be kept clear of water as it will kill fish. Recommended for use as warble dressing - apply late spring.

75)
78) Beware of taint.

80) Diatomaceous Earth.
Active ingredients are 80% SiO_2 used as an insecticide in the form of a wettable powder for grain and seed storage. Trade name of Perma-Guard D.10 for prevention of damage by weevils and sawtoothed grain beetle; 7 lbs. of powder per ton of grain.

Perma-Guard D.20 Household insecticide.
Perma-Guard D.21 Plant insecticide.
Perma-Guard D.30 Livestock insecticide.
Possibility of use as antihelmintic, e.g. parasites. Fed at rate of 1% - 2% of total ration.

H FUNGUS CONTROL

98) Seed dressing and general fungicide wash, e.g. on seed boxes.

99) Is non-selective. It kills predators. Fruit crops.

100)
101) These chemicals are only temporarily allowed and are mainly to combat potato, tomato and vine blight. They will be replaced if and when organic alternatives or resistant crop varieties are found. They do not leave a residue on the produce. Copper fungicide at leaf stage only. No other fungicides.

J HERBICIDES

108) No herbicides on crops for direct human consumption, and for other crops reference must be made to O.S.C.
No growth inhibitors.

No growth regulators + inhibitors, e.g. for standing corn, e.g. Cycocel.
No potato sprout inhibitors, e.g. Fusarex.

II LIVESTOCK PRODUCTION STANDARDS

To be eligible for the Soil Association trademark, livestock produce should be the produce associated with an organic farm, and in the main fed from produce of such a farm, home grown or purchased. The producer must agree to abide by the following rules. "Chemical" refers to substances obtained by chemical treatment of minerals, chemical treatment of natural products - vegetable or animal, total or partial. The following standards are under continuous consideration by the Organic Standards Committee and changes will be sent to those authorized to use the Symbol.

	RECOMMENDED	ALLOWED	PROHIBITED
HOUSING	Buildings giving maximum fresh air, daylight, and freedom of movement. Natural light. Period of free range during life cycle of all breeding stock.	Farrowing crates (up to seven days). Airy deeplitter houses with fresh green food provided.	Batteries; Sweat boxes; overcrowding, lack of free movement (sow stalls, flat decks) broiler houses. Permanently on completely slatted floors. Permanently tied up. Continuous artificial light. De-beaking of poultry.
FEEDING (i) Herbage	Quality of herbage necessary for good health and cultivated organically according to O.S.C. standards.	Up to 3 years changeover to organic methods	Chemically fertilized or herbicide treated herbage.
(ii) Feeding Stuffs	Forage, fesh, ensiled or dried. Untreated with chemical herbicides, pesticides and fungicides. Crops grown to O.S.C. standards. Buying in of concentrated foodstuffs of unknown origin permitted up to 10% by weight. 90% by weight self sufficient in roughages (hay and feeding straw) and succulents. Where eggs sold as 'free range' hens must have access to good quality herbage. Cereals, pulses, other seeds and vegetables ground crushed or whole (produced on the holding as far as possible). Natural whole milk (suckling).	Buying in of concentrated foodstuffs of unknown origin permitted up to 30% by weight. Buying in of roughages (hay, feeding straw) and succulents permitted up to 25% by weight. The rest of the foodstuffs grown to O.S.C. standards. Natural dried milk, skim milk. Soyabean extract.	Total dependence upon purchased feeds. Meals, nuts, supplemented with products of synthetic origin: Hormones/implants growth promoters. Antibiotics. Milk substitute powder.
	Pure fishmeal 'Expeller' pulses and oil cakes.	'Extracted' pulses and oil cakes.	
(iii) Mineral Additives	Salt. Calcified seaweed. Natural rock phosphate Seaweed powder. Steamed bone flour and other natural minerals.	Mg Cl, Calcined magnesite	Minerals of chemical origin other than those used remedially.

	RECOMMENDED	ALLOWED	PROHIBITED
(iv) Vitamins	Products containing natural vitamins, e.g. Cod liver oil, yeast.		Synthetic vitamins other than those used remedially.
(v) Others			Urea, non protein nitrogen. Antioxidants, anticoccidiostats, emulsifants, chemical colourants. Cattle food containing dried poultry manure.
DISEASE TREATMENT			
(Suckling is the basis for health and disease resistance).	Homeopathic treatments Herbal remedies Fasting Cider vinegar Control of internal parasites by grazing rotations.	Minimal ~~Mineral~~ usage of antibiotics and drugs in cases of emergency. Normal milk fever and grass staggers injections. Cu SO_4 Stockholm tar. Dictol. (Liability to a particular disease to be declared).	Routine use of drugs and antibiotics used as prophylactics.
(i) Sheep Dips			
Scab	Lime and sulphur. Carbolic acid and soft soap tobacco and sulphur, used as a double dipping type (8 day interval).	See permitted list.	
Fly-Strike	Make a mixture of five parts (by volume) lysol, four parts (by volume) carbon tetrachloride and eleven parts (by volume) household paraffin. The above should be diluted by adding one part of the mixture to four parts of water.		
(ii) Warble	Derris		Systemic compounds.

Antihelmintics for fluke, lung and gutworm infestation: vaccines for livestock and other veterinary procedures must be declared.

In all cases of doubt or difficulty or emergency, such as problems caused by disease or crop failure leading to the need to purchase foodstuffs, reference should be made to O.S.C.

III FOOD STANDARDS

MILK & MILK PRODUCTS

Defined as products derived from milk of the cow, goat or ewe reared, managed and fed according to the Soil Association Livestock Standards.

PRODUCT	ALLOWED	DISALLOWED
Natural or Plain Yoghurt	Whole milk, skim milk.	Additives other than yoghurt bacillus.
Fruit Yoghurt	Fresh fruit grown to Symbol standard. Honey.	Sugar, canned fruits, colourants.
Hard Cheese	Whole milk, skim milk. Plant or animal rennet and starter. Sea salt. Dendritic salt. Natural spices, aromatic plants. Herbs of Symbol quality.	Synthetic rennets, colourants, chemical additives, processed cheese. Equipment must not be greased with liquid paraffin.
Butter	Cream from whole milk. Sea salt. Dendritic salt.	Chemical colourants or additives. Containers or utensils made of aluminium alloy.
Buttermilk	By-product of Symbol quality butter manufacture. Also product produced by G.M.L.	
Liquid Milk and Cream	Whole milk from healthy attested accredited herds with stringent hygiene procedure.	
EGGS	Hens housed and fed as recommended in the Soil Association livestock standards.	Routine washing.
JAMS	Undenatured beet syrup. Unrefined cane sugars, e.g. Original Demerara (not London Demerara) and Barbados. Fresh fruit grown to Symbol standards. Honey.	Refined sugars. Non-stick or aluminium cooking ware.
FLOUR	Plain: cereals grown to Soil Association organic standards. 100% Wholemeal. Minimum extraction 85%.	
	Self raising: cereals grown to Soil Association organic standards. 100% Wholemeal. Minimum extraction 85%. Soda - bicarbonate. Cream of tartar.	All other products are disallowed.
BREAD	Wholemeal flour, 85% minimum extraction. Yeast. Natural leaven. Sea or rock salt. Vegetable oil, preferably cold pressed. Pure lard. Butter to Symbol standard.	Non stick or aluminium cooking ware. Mineral oils, e.g. liquid paraffin.
FRUIT JUICES	Fresh fruit grown to Symbol standards only.	Colourants, canned fruits, sugar, sulphur dioxide and carbonation.

CYDER	Fresh apples grown to Symbol standards and fermented using natural yeasts.	Colourants. Sugar, dried or pulped apples treated with sulphur dioxide. Carbonation of final product.
VINEGAR	Fresh apples grown to Symbol standards and fermented using natural fermentation products.	Colourants, sugar, dried or pulped apples treated with sulphur dioxide. Unnaturally produced or added acetic acid.

ORGANIC FARMERS AND GROWERS LIMITED
STANDARDS FOR 100% ORGANIC PRODUCE
OFG.1 GRADE

Members of Organic Farmers & Growers Ltd. consider that agriculture is primarily a biological science and is most likely to prosper when it is practised in harmony with biological principles. Accordingly Members consider that biological husbandry is not just the non-use of agrochemicals. It is also the use of sound, traditional farming practices which are brought up to date when necessary. We move ahead with the times with the aim of producing larger yields and more varied crops.

SUMMARY OF OFG.1 STANDARDS - No soluble mineral salts - no herbicides, pesticides, insecticides or other agrochemicals - use of farm wastes and other organic manures - use of rock minerals - use of seaweed products - careful rotations - considerate cultivations - farming in harmony with nature to produce optimum crops.

ROTATIONS - We use rotations to keep soil-borne diseases under control, to build up fertility, to control weeds and to keep insect problems minimal.
Some points are that wheat and barley should not follow each other, as their root systems are similar.
Legumes should be in a rotation to provide nitrogen.
Deep-rooting crops should be in a rotation to bring up trace-elements from the subsoil.
Grass and clover leys from 1-year upwards should be included if possible.
It is useful to include a rowcrop such as beans, potatoes, etc., as a cleaning crop.
Of great value is a green crop for working into the soil if a time can be found for it.
Rotations can be simple 4-year programmes or up to more complicated 10-year ones. It depends on farm enterprises, soil types and other important factors.

FERTILISERS - Biological methods rely on the interdependent relationship between the plant and soil life. This relationship ensures that food for the plant is made available to it by the soil life. The season and bacterial activity around the live roots of the plant play their part. The object of the organic farmer is to follow methods that seek to provide for his crops adequate plant food and minerals, minor-elements and trace-elements for optimum plant growth. These are provided not in immediately available form but in forms which become available to the plant as required. In this way crops should grow within their ability and with strong and correct cell formation.
Rock minerals are used for phosphate, potash and calcium. Seaweed products are used for calcium, magnesium, trace-elements and in the case of foliar feeds for their cytokinin hormones. Animal by-products such as bonemeal, dried blood and hoof and horn are useful if not too expensive.

Under special circumstances such as a cold late Spring, Chilean Nitrate of Soda can be used to a maximum of 30 lbs. of nitrogen per acre.

MANURES - All animal manures are allowed. They are greatly improved if turned at least once. Poultry manure can be used preferably if composted for three months. Sewage sludge is a good product if free from heavy metal contamination.

CULTIVATIONS - Ploughing, if it has to be done at all, should be shallow. 4" to 6" is ideal depending on soil type. Otherwise cultivators and subsoilers should be used. Contour working is useful if a slope is involved.

WEED CONTROL - Some people regard weeds as wild plants that are out of place. To the farmer, with the responsibility for providing as much food as possible for a hungry world, weeds are in the way and have to be kept under control. Herbicides are the usual method of removing weeds nowadays. In their various forms,however,herbicides leave residues in the soil and, when their use is stopped,weeds proliferate again. Organic farmers use cultivations with various implements, crop rotations, fallows and green manures to control their weeds.

INSECTS - We do not allow the use of insecticides except the non-residuals such as Pyrethrum, Derris,Nicotine or Rotenone. Even these are discouraged because they are non-selective. Biological control is used where applicable. But in general insects are not a problem. Predator insects, such as ladybirds, combined with the effects of growing crops organically, seem to be sufficient.

CONCLUSION - The aim of the above methods is to keep the soil open and friable as possible to allow penetration of oxygen and nitrogen from the atmosphere, to keep a constant build up of bacteria, fungi and other soil life, to build up and then maintain the appropriate organic matter level, and to produce crops that are growing well within their capability so as to encourage them to produce maximum disease resistance and proper cell formation.

ORGANIC FARMERS AND GROWERS LIMITED

OLD OFG.2 GRADE

There are many and varied reasons why a farmer or market gardener may not be able to keep to OFG.1 Standards at any particular time, but still wish to farm with absolute safety to his soil and the environment. OFG.2 Standards are designed for these farmers. Due to continual advances in machinery design, plant breeding, chemical development and our own researches within our movement, OFG.2 will be subject to continual review and modifications.
The Standards of OFG.2 at the moment are:- 50 units Nitrogen, 30 units Phosphate, 30 units Potash and M.C.P.A. can be used, as also Azulam for docks. NO MORE AGROCHEMICALS can be applied in that year.

Management Principal: This is firmly biological. Soil organic matter should be built up and maintained. Rotations are essential and permitted agrochemicals are only to be used if felt necessary.
Manures: Farmyard manure, other stock manures and slurries should be applied if available. Solid manures should be part-composted if possible and slurries aerated to encourage aerobic activity. If the farm has limited stock or no stock, then unwanted local supplies of manure or slurry should be taken advantage of if economically possible.
Sewage Sludge: There are a few good digested sewage sludges and liquids available and they should be used if wanted. Provided heavy mdetals are at a safe level they provide a useful source of N and other minerals and also some organic matter.
Mineral Rock: Products such as basic slag, rock phosphate, felspar, etc. are usually adequate for providing the main requirements of phosphate, potash, magnesium and trace-elements. The pH of the soil needs to be at a suitable level for these products.
Seaweed: Maerl, often known as calcified seaweed, is encouraged as it supplies calcium, aids palatibility of grass, the workability of soil, and encourages bacterial activity. Seaweed foliar feeds are also very valuable for the action of the cytokinin hormones. These encourage extra root growth, increase bacterial activity and lessen moisture content of the crop. Seaweed meals are also encouraged.
Soluble Fertilisers: It has been shown that with good biological management small doses of artificial fertilisers give as good results as much larger doses under chemical management. Our use of artificial fertilisers is mainly to assist in a good crop establishment so that the crop gets off to a good start, or as nitrogen to give a necessary boost in a cold Spring. Experience has so far shown that, if the soil has been farmed biologically, then 50 units of N per acre are adequate. Quite often about 30 units of N per acre will give the required results. This is the total N per crop including any that might be in a compound used in the seedbed, but does not include any N in organic matter.
In OFG.2, soluble mineral salts are to be used solely as a topping up measure, and are not to be relied on for basic fertility. We encourage the use of Chilean Nitrate or Nitro-chalk being balanced products rather than the use of very refined nitrates especially if they include chlorides.
Seed Dressing: Under biological systems seed dressings have been found unnecessary, and are banned under OFG.2 Standards. The exception is for flea beetle on brassicas and roots.
Herbicides: Weeds need to be under control, and there are various ways such as rotations, grass breaks, cultivations and fallows to achieve this. But sometimes the weather or some other factor intervenes, and a crop is at risk. MCPA or MCPB can then be used. A half dose is very effective if used with a seaweed foliar feed. Azulam for dock control is allowed.

OFG.2 GRADE (OLD VERSION) Sheet 2

Insecticides: At the moment, with the exception of Derris, Pyrethrum, garlic, Nicotine and Rotenone, all insecticides are banned. However, it might be that some highly selective and safe insecticides could be beneficial, and will be allowed if they stand up to our investigations. The best prevention against insects is a really healthy properly grown plant.

Mildicides: Not permitted at this stage. Seaweed foliar feeds are useful at aiding prevention of mildew and help the crop to grow away from trouble.

Rotations: For farmers with stock a suitable rotation is relatively simple with a permutation of grass and corn with beans, roots or brassicas if favoured. In order to prevent a build-up of soil borne diseases barley should not, if practical, follow wheat. Those farmers with no grazing stock may wish to concentrate on white straw crops but they should try to include a legume or green manure crop somewhere in the rotation. If fallowing or even bastard fallowing is being used, weeds should be allowed to grow as large as possible and incorporated before seeding, to supply useful minerals and also organic matter. If the farm has sheep there are many useful ways of using green crops and catch crops to build up fertility for following straw crops. We like to treat each farm as an individual farm and develop a rotation with the farmer to fit in with his particular circumstances.

Green Manures: These are mentioned above as being useful in a rotation, and can include trefoil, mustard, clover, etc. If the soil is in need of building up it could pay to use some fertilisers within our permitted amounts on a green manure crop to ensure a good bulk to turn in, followed by a grain crop grown to OFG.1 Standards.

Summary: The above Standards are to encourage farming that uses biological systems and management for its main base, with chemicals to top up when necessary.

We wish to encourage farming that is safe to the environment and that achieves a steady increase in fertility.

No agrochemical is used that lasts longer than 6 months in the soil.

OFG.2 Standards are continually reviewed and additions or alterations made if necessary.

OFG.2 has now become a recognised standard both in this country and on the Continent, and provides a viable system of farming for those farmers who do not wish to be totally organic, or who are gradually altering their farms to OFG.1 Standards.

STANDARDS FOR NEW OFG.2 GRADE - Starting September 1981

1. Land on which the new OFG.2 crops and livestock are produced is to be treated according to the following standards to ensure that such produce will be of high nutritional quality and as free as possible from all pesticide residues.

2. Production should be based upon knowledge and to this end regular and comprehensive soil analyses must be carried out on the lines laid down by C.F. & G. to determine nutrient availability, organic content and pH. O.F. & G. shall have access to holdings to inspect production methods and take samples of produce for analysis.

3. Production to OFG.2 Standards implies that the Producer carries out a balanced rotation of crops efficiently recycling waste products of the holding, and utilising green manures if appropriate. It is recognised, however, that some crops are suited to monoculture (e.g. certain fruits).

4. The use of soil additives such as natural ground rock products, organic manures, seaweed products and bacterial cultures are encouraged as they aid soil fertility.

5. The use of commercial fertilisers is limited to the following at present, as where used as advised they offer the most effective aid to optimising production compatible with maintaining soil fertility and crop health.

<u>NITROGEN</u>

1. Ammonium Nitrate with base e.g. Nitro Chalk 26%
   C.A.N.
2. Nitrate Nitrogen with base e.g. Chilean Nitrate of Soda
   Chilean Potash Nitrate
3. All organic sources e.g. Slurry, Digested liquid sewage, guano Oil Seed Rape cake, Dried Blood, Hoof & Horn, Fishmeal, etc.
4. Bacterial Additives e.g. Azotobacter derivitives.

<u>PHOSPHATE</u>

1. Single Superphosphate
2. Rock Phosphates
3. Basic Slag
4. All organic sources e.g. Digested liquid sewage, Sterilised Bone Meal, Fishmeal, poultry manures.

<u>POTASH</u>

1. Adularian Shale.
2. Organic sources e.g. Slurry, Wood Ash.
3. (Certain sources of Sulphate of Potash are under consideration)

<u>LIME & TRACE ELEMENTS</u>

1. For Calcium: Ground Limestone, Chalk, Calcified Seaweed, etc.
2. For Magnesium: Ground Dolomitic Limestone, Calcified seaweed, Kieserite.
3. For Trace Elements: The use of the products recommended will add sufficient trace elements under most circumstances. Specific trace element deficiencies may be corrected by the addition of suitable nutrient sprays, etc.

6. Weeds may be controlled by the use of the following at present. Consideration is being given to the use of a general broad leaved weed herbicide and a specific wild oat herbicide compatible with the aims of OFG.2 Standards.
   1. Mechanical Hoes and weeders
   2. Flame weeders
   3. MCPA
   4. MCPB
   5. CMPP
   6. Asulam
   7. Glyphosate (not pre-harvest)

7. The use of the above products should minimise fungal diseases. Certain cropping situations, however, call for the use of fungicides and the following can be used.
   1. Sulphur
   2. Lime
   3. Copper
   4. Zineb

8. The occurence of pest species in crops does not always mean loss for the producer as predators and natural checks can keep pests within bounds. However, if serious damage is imminent the following can be used.
   1. Bacterial additives
   2. Biological methods e.g. introducing predators or sterilised males
   3. Pirimicarb
   4. Rotenone
   5 Pyrethrum
   6. Ryannia
   7. Sabadilla

   Where routine disinfection of grain stores is necessary good hygiene and the use of Diatomaceous Earth are the only methods allowed.

9. Experience has shown that seed dressings are not usually necessary at the present time. An exception is made in the case of early sown brassicas where Gamma BHC is permitted for the time being.

10. Livestock production should be conducted on humane principles.
    1. Forage crops for ruminant livestock should where possible be grown on the holding to the above standards.
    2. Under intensive livestock systems batteries, unreasonable restriction of freedom of movement and totally controlled environment housing are prohibited.
    3. Hormonal implants, growth stimulants and antibiotics are prohibited except that antibiotics may be used to combat disease in individual animals if appropriate. Consideration is being given to a suitable limit for the use of copper sulphate in pig rations.

CHAPTER 5

Organic Farming as a Business

5.1 Criteria for Assessing the Efficiency of a Farm

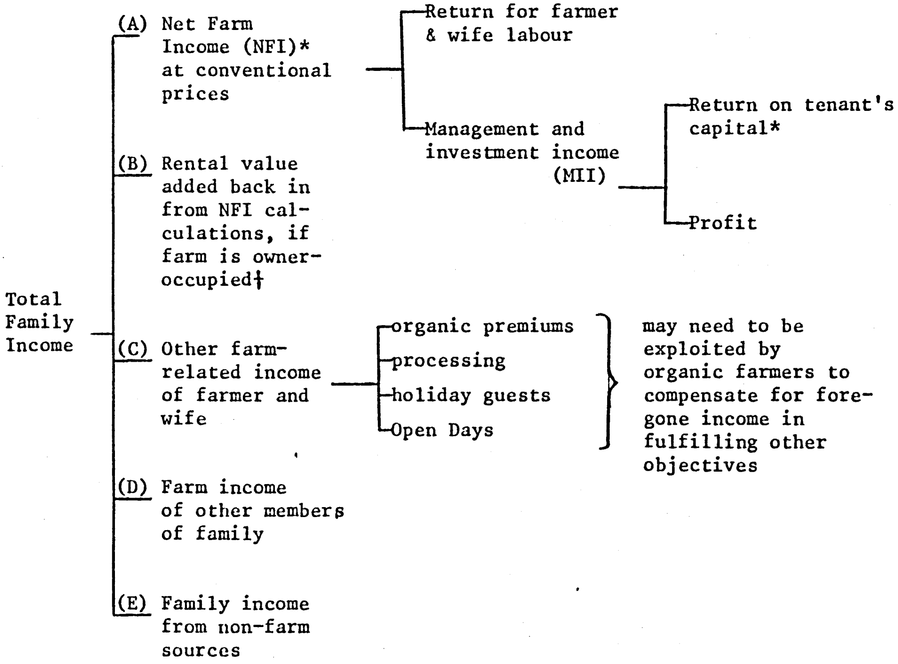
The efficiency of Organic Farming from the viewpoint of society will be discussed in Chapter 7. Taking the viewpoint of the farmer himself, efficiency has to be judged in terms of the ability of the farmer to meet his objectives, whatever they may be. Objectives of farmers have been discussed in Chapter 3 where it was argued that organic farmers may differ from conventional farmers in that the weight they give to certain non-pecuniary objectives is likely to be higher. This is, however, a matter of degree only, since very few farmers of any kind are either motivated solely by pecuniary objectives or are able to ignore such objectives completely; most organic farmers have made a conscious and deliberate decision to trade-off pecuniary objectives for others.

In this chapter we examine income objectives only, since a farm business must survive, or be supported financially, if it is to remain in existence and fulfil other objectives. The income-objectives needs to be defined. It might be, for instance, the ability of the farm to survive and to provide the minimum standard of living required by the operators; or it might be the capacity of the farm to generate income surplus to basic requirements. Furthermore, as Chart 5.1 shows, the components of farm family income are not confined to straightforward agricultural production alone. Thus if one is interested in the question - "can a farm provide a decent living for a closely integrated family of owner-occupiers" - the appropriate definition might be Total Family Income minus any mortgage and interest payments plus satisfaction of the required non-pecuniary objectives. Some such concept as this is the one which many organic farmers themselves are likely to emphasise, and to which their "efficiency" is geared. We have not collected information on Total Family Income but certainly there are over 80 organic or semi-organic farms in existence, that we know of, surviving for one reason or another. Of the 68 who told us what role their farm income played in relation to their total family income, 47% derived their sole income from the farm, 23% their main income, and 6% relied on it for part of their income. For a further 7% it was to become their main or sole source of income though it was only supplementary at the moment. For the remaining 16% it was only supplementary or of the nature of a hobby, but this did not detract necessarily from the effort put into the farm. A further five to ten people were heard from who had had to give up organic farming.

If, on the other hand, we wish to compare the ability of different farming systems to generate income this approach is too loose. Firstly, income from non-farm sources must be excluded. Secondly, we need to compare like with like and must therefore ensure for instance that some farm systems do not appear efficient simply because the farmer happens to be owner as well as tenant,

Chart 5.1

The Components of Income for the Farm Family



* minus interest on borrowed tenant's capital if any

† minus mortgage repayments if any

or because he has by chance his own supply of tenant's capital rather than a bank loan, or because he is using family labour rather than hired labour. None of these things will affect the efficiency of the system itself, in terms of using raw materials, but they will affect estimates made of the income-generating capacity of different farms. Comparisons between farms might then be distorted unless such factors as annual payment for the land, money supply and the farmer's labour reward are excluded or standardised.(2)

Part of the solution to these problems is, in terms of Chart 5.1, to exclude items B,C,D and E, and to compare NFI (excluding Breeding Livestock Appreciation) between farms. However, this still overlooks three more factors in a farm's viability and performance. First, interest on borrowed capital has to be met: to facilitate consistency in interfarm comparisons it is common practice to ignore interest repayments, and to this extent the NFI concept used exceeds the contribution that NFI really makes to family income. Secondly, since a well-stocked farm would be expected to have a higher output than an under-stocked one, it is necessary to think of the return in terms of the level of tenant's capital; for this purpose, management and investment income (before deduction of interest) can be expressed as a percentage of tenant's capital. If it is less than current lending rates, then money is being lost on the farmer's investment. Thirdly, it is necessary to allow for farm size, since a large farm might be expected to yield a higher return than a small one of similar type because of economies of scale. The solution here, if we wish to assess the ability of the system to generate income, is to compare farms only when they are in the same size group.

Taking all these problems into account, the most suitable measure to assess the ability of a system to generate income would be MII as a percentage of tenant's capital within each size group. In this report it was decided not to rely wholly on this measure because the investigator felt that comparable assessments of tenant's capital were not possible. In the next section, therefore, we compare: (a)Total NFI; (b) NFI per hectare; (c) MII as a percentage of tenant's capital where possible, but bearing in mind that it is only very approximate. Comparisons are made with:

(i) conventional farms of similar size and type using information published by the Farm Management Survey;

(ii) where possible, other organic farms of similar size and type.

In Section 5.3, the factors determining a farm's performance and Net Farm Income are then looked at in more detail, viz, Gross and Net Output; yields and stocking rates; and variable and fixed costs. Finally, the inter-relations between all these components are discussed in Section 5.4.

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(2) Similarly, for comparative purposes, the simple argument that organic farmers survive, therefore they must be competitive, is inadequate.

5.2 Application of Criteria Relating to Income

5.2.1 Total Net Farm Income (Table 5.1)

There was a tremendous range in Total Net Farm Income with eight farms obtaining less than £1000, three £1000-£2000, and 21 more than £2000. Out of this some have to pay interest on loans before the balance is available for their own use. In some instances, therefore, an apparently comfortable NFI can become very much reduced. On the other hand, many of the farmers grow a good proportion of their own food, have a farm vehicle for transport, and the farm house to live in, so some of the costs of living are carried by the way of life. Out of the eight farmers with a NFI of less than £1000, three were converting or establishing their farming system, one was on very poor soil, and one had non-agricultural objectives (conservation).

Comparing the Total Net Farm Income with that on conventional farms, the majority of organic farms were below standard though there were some notable exceptions: seven farms did better than standard (including three mixed farms which did better even at normal prices, and with organic premiums performed very well indeed); one other farm achieved a high Total Net Farm Income by selling its wheat as flour.

5.2.2 NFI/ha as a % of Standard (Table 5.2)

NFI/ha for each farm has been expressed as a percentage of the average NFI/ha for farms of similar size and type in that area, using figures published by the Farm Management Survey Units. NFI/ha as a % of standard gives a comparative measure of the ability of the two systems to generate income, but does not make any allowance for the tenant's capital involved. Table 5.2 shows a great range in the relative performances of the organic farms. On the basis of the small sample available, there seems to be no particular association with farm type or size except that all four Mixed Farms performed particularly well, while most other farms were below standard.

Table 5.2 also shows NFI/ha (as a % of standard) in relation to nutrient input, particularly manure and fertiliser input to the grass and crops. The table suggests that skilful farmers should be able to obtain a NFI of from 60% to well over 100% of the conventional average, with a substantial input of manure (or vegetable waste as feed), or a low input of fertiliser. With only low nutrient inputs, however, it seems that nearly all farmers (including many whom we assessed as "good farmers") can only expect a NFI 20% to 60% of standard. Organic premiums for cereals, or milling of wheat on the farm, can make a substantial improvement to NFI, taking it up well above standard.

Table 5.1

Net Farm Income and Management Investment Income on some Organic Farms

	Total NFI (£)		NFI/ha (£)		MII/ha (£)		MII as % of Tenant's Capital		Year
	Org. Farm	Std	Org. Farm	Std	Org. Farm	Std	Organic Farm	Standard	
Specialist Dairy									
50 ha and under	5480	6770	147	247	40	101	N/A		77/8
	8370	11230	192	393	104	258	N/A		'78
	54	4660	1	115	-116	-1	-19	0	'79
50.1 - 100 ha	5560	12550	68	215	13	138	2.4	12	78/9
	-9270	7570	-115	91	-132	59	-23	7	78/9
	3730	14760	71	212	30	181	8	43	'76
100.1 - 200 ha	22140	12550	144	167	119	117	25	20	77/8 (5)
	340	18230	3	150	-24	124	-2.9	13	78/9(5)(4)
Mainly Dairy									
50 ha and under	13510	8420	363	162	230	67	21	6	79/80
50.1 - 100 ha	2370	13750	25	103	0	84	0	14	77/78
100.1 - 200 ha	1190	3810	8	30	-12	9	-1.5	1.0	78/79
	16420	3810	108	30	89	9	11	1.0	78/79 (5)
Livestock, Cattle and Sheep									
50 ha and under	650	13500	16	115	-45	81	-17	27	'77
	-770	1890	-49	38	-168	-3	-34	-1	'78
	990	5400	20	54	-15	-2	-5	-0.5	'78
	4630	7240	54	56	9	26	3	8	78/9
	40	5130	1	89	-77	42	-13	8	78/9
	1180	8030	54	73	-28	47	-4	9	78/9
	1270	6130	29	70	8	16	1	2	78/9
50.1 - 100 ha	2470	4190	36	74	-4	26	-2	7	'77
	5330	8630	51	91	20	56	8	12	'77
	11150	9840	106	77	70	47	24	8	'78 (1)
	2540	5130	47	89	-12	34	-3	8	78/9
100.1 - 200 ha	7560	7080	55	53	36	33	14	12	'77
	840	23180	6	159	6	107	2	13	78/9
Mixed									
50.1 - 100 ha	6400	2530	81	34	30	-19	N/A		78/9
	7570	2530	96	34	44	-19			78/9 (2)
	8360	4000	130	45	70	2	15	0	78/9 (5)
	9080	4000	141	45	81	2	17	0	78/9 (2)
100.1 - 200 ha	9230	1220	73	8	39	-25	7	-5	79/80
	11790	1220	93	8	59	-25	11	-5	79/80(2)
Cropping, mostly cereals									
50 ha and under	1080	8690	39	140	-113	72	-16	12	79/80
	4820	8690	173	140	21	72	3	12	79/80(2)
General cropping	90	18460	2	99	-54	85	N/A		77/78
	890	18460	19	99	-37	85			77/78(2)
	2670 to 3760	18460	57 to 80	99	1 to 24	85			(2/3) 77/78

Note: each row shows the results for an individual fully organic farm, with the following exceptions:

1) = same farm as previous row, but different year.

2) = same farm as previous row, but receipts valued so as to take account of the organic premium obtained instead of valuing at "normal" prices.

3) = farm receipts re-estimated to omit an unexpected potato failure.

4) = same farm as previous row, with wheat valued as flour (as sold).

5) = semi-organic.

Table 5.2 Net Farm Income per Hectare on Organic Farms as Percentage of Standard
(number of farms in each category)

Farm Classification	Less than 0%	0-19%	20-39%	40-59%	60-79%	80-99%	100-119%	120-139%	over 140%	Total
(a) BY FARM SIZE										
50 ha and under	1	3	2	2	3	1	-	-	1	13
50.1 - 100 ha	1	-	3	3	-	-	-	1	2*	10*
100.1 - 200 ha	-	2*	1	-	-	1	1	-	1	6*
200.1 - 300 ha	-	-	-	-	-	-	-	-	1	1
Total	2	5*	6	5	3	2	1	1	5*	30*
(b) BY FARM TYPE										
Specialist Dairy	1	2*	2	1	1	1	-	-	-	8*
Mainly Dairy	-	-	2	-	-	-	-	-	1	3
Livestock, Cattle and Sheep	1	3	1	4	1	1	1	1	-	13
Mixed	-	-	-	-	-	-	-	-	4*	4*
Cropping, mostly cereals	-	-	1	-	-	-	-	-	-	1
General Cropping	-	-	-	-	1	-	-	-	-	1
Total	2	5*	6	5	3	2	1	1	5*	30*
(c) BY NUTRIENT INPUT										
No manure input										
Low other nutrient-input	-	2	2	2	-	1	-	-	-	7
Moderate to high other nutrient-input	1(1)	1(1)	2(1,2)	1(2)	-	1(5)	-	-	1*(4)	7*
Small to moderate manure input										
Low other nutrient-input	-	-	-	1	-	-	1(6)	1(7)	-	3
Moderate to high other nutrient-input	-	-	1(2)	1(4)	-	-	-	-	-	2
High manure input										
Low other nutrient-input	-	1(3)	1	-	2	-	-	-	3	7
Moderate to high other nutrient-input	1(1,3)	1(3,4)	-	-	1(1)	-	-	-	1(1)	4*
Total	2	5*	6	5	3	2	1	1	5*	30*

Notes

* two of the farms covered by this table were semi-organic, and their inclusion is indicated by an asterisk.
(1) = feed.
(2) = Humbers.
(3) = farm just started on organic lines.
(4) = low or low-to-moderate use of fertiliser.
(5) = very high waste input.
(6) = standard farm is also low-input type.
(7) = unusual sale of stock.

The better relative performances tended quite strongly to be confined to farms with an outside supply of manure or some use of fertiliser. There were two apparent exceptions but one of these had a very high input of cheap nutrients in another form, as vegetable waste, waste straw and hay. The only real exception, having a low input of nutrients but a NFI/ha almost as high as standard, was a lowland sheep and beef farm selling no crops but growing its own feed.

Relatively high manurial inputs do not, however, guarantee a high NFI, though some of the exceptions are readily explicable. The three "high manure input" farms with NFI < 19% of standard were all in early stages of becoming established (one subsequently gave up). The two cropping farms were also an exception, as was one mainly dairy farm. All three had high nutrient inputs and produced Net Outputs around, or nearly, average for the area. However, labour costs were very high on all of them; manures, fertilisers and semi-organic manures cost more than average on two; and machinery costs were high on two. As a result, NFI's were only 28% of standard (124% with the organic premium), 26% (359% if returns from flour are costed instead of wheat), and something between 57 and 80%.

5.2.3 MII as a % of Tenant's Capital (Table 5.1)

If the performance of organic farms is evaluated solely in terms of a business in which to invest and generate more money (Management and Investment Income as a percentage of Tenant's Capital), then the indications are that only a few organic farms meet this objective.

MII as a percentage of Tenant's Capital was less than Minimum Lending Rate on three-quarters of the organic farms providing information and, though this was also the case on nearly two-thirds of the conventional farms, the shortfall on the organic farms was generally much greater. Only seven organic and semi-organic farms (out of the 25 for whom information is available) exceeded the Minimum Landing Rate, plus one farm on the borderline if flour rather than wheat is costed as output. The return on tenant's capital was greater than standard on eight of the organic farms. It should be remembered that no reward for management has been allowed for in making the above statements, so the situation on both types of farms (organic and conventional) is really worse.

Almost all of the organic farms doing better than conventional had a substantial external input of manure or slurry, or used some inorganic or semi-organic fertiliser. As a result, Net Outputs from these farms were relatively high, between 80% and 110% of conventional. This gave a high enough Gross Margin out of which to pay fixed costs which were not much less than on conventional farms.

There were two low-input beef-and-sheep farms where return on capital compared favourably with conventional farms. One was possibly due to a somewhat untypical year of stock sales, while the other was being compared with conventional farms in an area which does not use much fertiliser anyway.

In the long-term the increasing value of the fixed assets on the farm (land, buildings, breeding stock) may offset, or more than offset, the poor returns on tenant's capital, but even so this benefit cannot be realised until the business is sold. Again, this is true of organic and conventional farms alike, but organic farmers would argue that the problem for them is more acute: because of the intense competition for land to buy or rent, they would not realise the full monetary reward for fostering a well-structured soil that would be justified in an ideal market situation.

5.3 Components of Farm Performance

The performance of organic farms in business terms has already been discussed by referring to NFI/ha and MII as a return on tenant's capital. If ways of improving a farm's financial standing are sought, or if predictions of financial performance under changed price levels are to be made, then we need to understand the components that determine overall performance. Chart 5.2 shows the relationship between the various elements of income and expenditure on the farm.

The rest of this section examines the constituent elements of NFI and MII to identify the significant differences between organic farms and their conventional counterparts.

The information is not from a random sample of organic farms so should not be taken as an average measure of organic farm performance but as an indication of what is being achieved by individuals.

5.3.1 Farm Output (Table 5.3)

Table 5.3 lists, per hectare, Gross Output, Net Output and Net Output Margin over Fertilisers, Manures and Sprays, for 31 organic and three semi-organic farms. The figures are based on conventional market prices except where stated otherwise. Thus on the mixed and cropping farms, some extra income was obtained from organic premiums; in the Table, receipts adjusted to normal prices are quoted as well as actual receipts with premiums included less commission on the premium. Although as we have seen, the premiums had an important effect on NFI, they contributed proportionately little extra to farm output on every farm except for the cropping, mostly cereals farm which carried no stock.

Gross Output on the organic farms was, on the whole, lower than on conventional farms. Nevertheless, within every farm

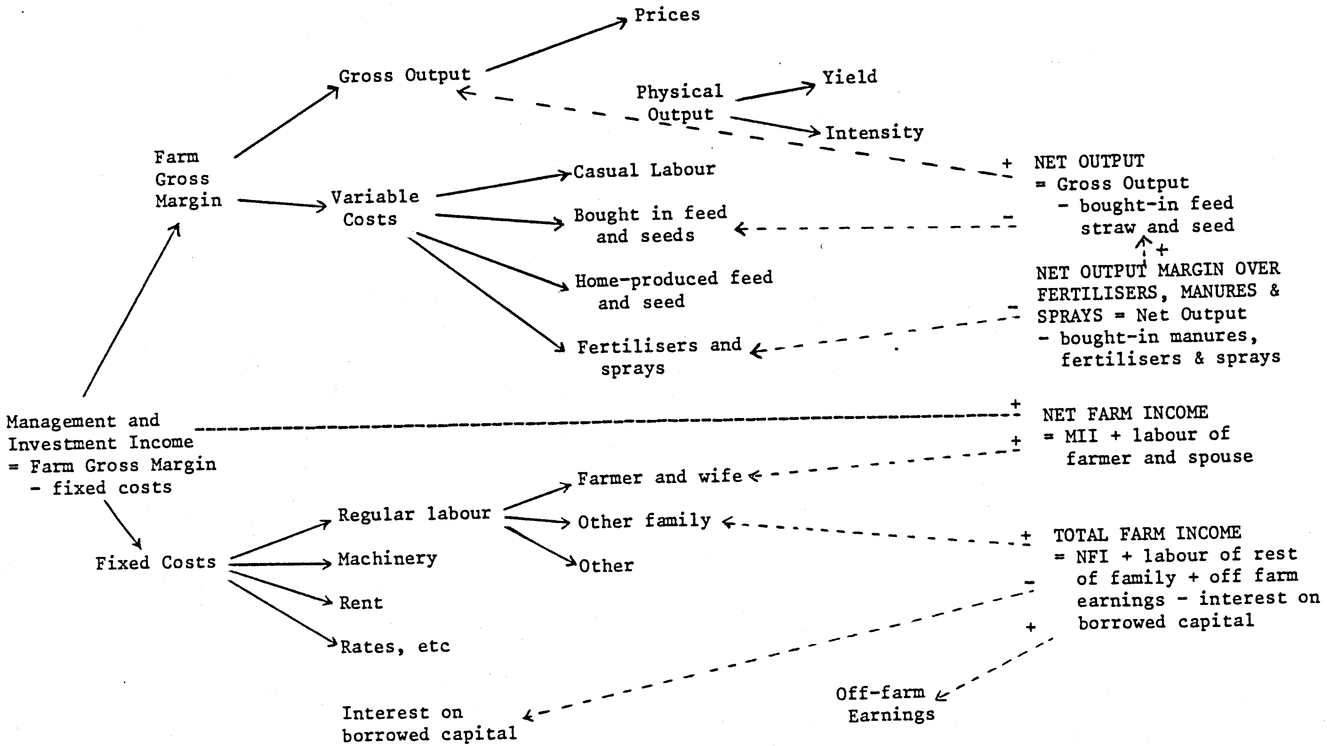

CHART 5.2 Some Whole Farm Account Relationships

Table 5.3 Output from Organic Farms Visited Compared with the Average for the Area and Farm Type (£ per ha)

	Gross Output (excl. miscellaneous receipts)			Net Output			Net Output Margin over Fertilisers, Manures and Sprays			Year
	Organic Farm	Standard	%	Organic Farms	Standard	%	Organic Farms	Standard	%	
Specialist Dairy										
50 ha and under	573	957	60	408	611	67	408	562-599*	73	77/8
	766	1348	57	616	858	72	608	802-792*	76-77	1978
	616	985	63	341	593	57	335	550	61	1979
	796	1090	73	472	693	68	441	630 *	70	1979
	469	1440	33	386	926	42	N/A			78/9
50.1 - 100 ha	426	915	47	261	624	42	261	564-561*	46-47	78/9
	513	773	66	336	558	60	283	502	56	78/9
	369	509	72	216	382	57	196	363	54	1976
100.1 - 200 ha	693	764	91	501	467	107	501	431	116	77/8
	515	826	62	312	574	54	292	520-516*	56-57	78/9 (3)
Mainly Dairy										
50 ha and under	695	969	72	647	610	106	647	556-549*	116-118	79/80
50.1 - 100 ha	330	655	50	288	447	64	283	102-397*	70-71	77/8
100.1 - 200 ha	{589	633	93	529	492	108	463	442	105	78/9
	{690	633	109							78/9 (2)
Livestock, Cattle and Sheep										
50 ha and under	156	225	69	120	196	61	110	188	58	1977
	294	281	105	126	243	52	126	227	56	1978
	154	251	61	133	221	60	132	201	66	1978
	208	338	62	195	295	66	195	265-259*	74-75	78/9
	173	333	52	148	287	52	132	266-260*	50-51	78/9
	236	375	63	191	336	57	191	314-296*	61-65	78/9
	286	531	54	259	456	57	227	407-373*	56-59	78/9
	332	445	75	267	N/A		267	336-328*	79-81	77/8
	471	445	106	394	371	106	384	336-328*	114-117	78/9
50.1 - 100 ha	112	271	41	95	230	41	87	210	41	1977
	147	319	46	145	276	53	144	250-245*	58-59	1977
	278	333	83	235	278	85	227	257-254*	88-89	78/9
100.1 - 200 ha semi:	138	203	68	125	177	71	117	162	72	1977
	133	572	23	133	478	28	130	445	29	78/9
Mixed										
50.1 - 100 ha	{227	330	69	206	280	74	195	243	80	78/9
	{241	330	73							78/9 (1)
	{349	357	98	339	N/A		312	N/A		78/9 (3)
	{361	357	101							78/9 (1)(3)
	221	330	67	220	280	79	189	243	78	78/9
100.1 - 200 ha	{299	325	74	287	274	80	282	228	124	79/80
	{321	325	80							79/80 (1)
200.1 - 300 ha	1174	873	134	729	674	108	716	594*	121-124	78/9
Cropping mostly cereals										
50 ha and under	{547	566	97	466	542	86	390	466	84	79/80 (1)
	{515-681	566	91-120							79/80 (1)
General Cropping										
50 ha and under	{393	408	96	286	N/A		274	N/A		77/8
	{410	408	100	303			291	N/A		77/8 (1)

* In many of the FMS figures, it was necessary to estimate Net Output Margin since they were not sufficiently detailed to calculate the precise value. Estimated values are indicated by an asterisk.

Note: each row shows the results for an individual fully organic farm, with the following exceptions:

1) same farm as previous row but receipts valued so as to take account of the organic premiums obtained instead of valuing at "normal" prices.
2) same farm as previous row but with wheat revalued as flour (as sold)
3) semi-organic farm.

type there were one or two farms obtaining gross receipts around or sometimes above the conventional average regardless of whether output was costed at conventional or organic prices. Comparing output between farms is only meaningful, however, if the variable external inputs used to achieve it are known.

Thus Net Output is a more useful measure of agricultural productivity than Gross Output since some farms are more self-sufficient than others. In one extreme case Gross Output is 105% while Net Output is only 52% of standard, because there was a very heavy dependence on bought-in feed. The mainly dairy farms, on the other hand, were all more self-sufficient in feed than their conventional standards. (Net Outputs of 106%, 64% and 108% although Gross Outputs were only 72%, 50% and 93% of conventional respectively.)

Table 5.4 shows Net Output on the organic farms expressed as a percentage of that on conventional farms. The great majority (24 out of 31) had a Net Output of 40-85% of standard, while five exceptional farms obtained over 100%. The comparative FMS figures are not available for three more farms but it seems likely that two of these (one semi-organic) would also have had Net Outputs in excess of the conventional average. To understand these exceptions we need to look at other inputs to the system which regulate yields and therefore Net Output.

Net Output Margin over Fertilisers, Manures and Sprays. While Net Output can be used to compare net increase in value of agricultural products between farming systems, Net Output Margin over Fertilisers, Manures and Sprays takes into consideration the different types of resources that organic and conventional farms use. This Net Output Margin is the margin left over to pay for fixed and variable resources used in common by both organic and conventional systems. The costs of fixed and variable resources used in common can then be examined to see if they too differ as a direct result of organic management (e.g. vet bills, total labour, fuel for cultivations). It will be seen in Section 5.3.4 that fixed costs do not in fact differ as much between organic and conventional farming as do the inputs determining yield: feed, fertilisers, manures and sprays.

Net Output Margin over Fertilisers, Sprays and Manures (NOM) is shown in Table 5.5 expressed as a percentage of Net Output Margin for conventional farmers. As in the Net Output diagram Table 5.4, the great majority of farms had a NOM somewhere between 40 and 90% of standard, while six organic farms lay between 105 and 125%. Compared to Net Output, NOM shows organic farms more favourably, as one would expect when fertilisers, sprays (and manures) are allowed for.

All except one of the farms obtaining a NOM greater than the

Table 5.4 Net Output per Hectare on Organic Farms as Percentage of Standard

(number of farms in each category)

Farm Type	Percentage																
	25-	30-	35-	40-	45-	50-	55-	60-	65-	70-	75-	80-	85-	90-	95-	100-	105-110	Total
Specialist Dairy	-	-	-	2	-	1*	2	1	2	1	-	-	-	-	-	-	1	10*
Mainly Dairy	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	2	3
Livestock, Cattle & Sheep	1	-	-	1	-	3	2	2	1	1*	-	-	1	-	-	-	1	13*
Mixed	-	-	-	-	-	-	-	-	-	1	-	2	-	-	-	-	1	4
Cropping	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1
Total	1	-	-	3	-	4*	4	4	3	3*	-	3	1	-	-	-	5	31*

* two of the farms covered by this table were semi-organic, and their inclusion is indicated by an asterisk

Table 5.5 Net Output Margin over Fertilisers, Manures and Sprays, per Hectare, on Organic Farms as Percentage of Standard

(number of farms in each category)

Farm Type	Percentage																				
	25-	30-	35-	40-	45-	50-	55-	60-	65-	70-	75-	80-	85-	90-	95-	100-	105-	110-	115-	120-	Total
Specialist Dairy	-	-	-	-	1	1	2*	1	-	2	1	-	-	-	-	-	-	-	1	-	9*
Mainly Dairy	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-	1	-	3
Livestock, Cattle & Sheep	1	-	-	1	-	1	4	1	1	2*	1	-	1	-	-	-	-	-	1	-	14*
Mixed	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	2	4
Cropping	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
Total	1	-	-	1	1	2	6*	2	1	5*	3	2	1	-	-	-	1	-	3	2	31*

* two of the farms covered by this table were semi-organic and their inclusion is indicated by an asterisk.

conventional average had a cheap or free supply of outside manure, slurry or animal feed. Output was thereby increased at lower cost than on conventional farms. The one exception had been partly helped by substantial import of dairy concentrates and calcified seaweed in the past, but continuing good grassland management was also a major factor in the farm's performance. The land could now support a high value in output (as beef) with low recurrent nutrient inputs.

Eleven farms were producing a Net Output Margin between 70 and 100% of conventional. Again most of these (8) had an external manurial input (4) or used semi-organic (4) or inorganic fertilisers (2) on the conservation area or on some crops. The three exceptions were at the other extreme - long established, very low input, farms using just fairly small quantities of bought-in feed and selling off milk and livestock only. These exceptions are consistent with the view, held by some organic farmers themselves, that in the long term soil fertility improves enough to give an adequate output even with low inputs.

All the farms without exception who had a Net Output Margin between 70 and 125% of conventional seemed to be run by very committed, good, generally long-experienced farmers. In addition, as we have seen, most though not all brought in substantial extra crop nutrients.

For those farms obtaining a NOM less than 70%, a wide variety of reasons explain their poorer performance: system in process of being converted to organic (4), reduced personal strength (3), very poor land (2), farming less important than conservation or other hobbies (2), and a higher income unnecessary (1).

To conclude this section on total farm output, we refer the reader back to the discussion of Table 5.2 (c). There we noted that the better Net Farm Incomes on organic farms were similarly quite strongly confined to farms with an outside supply of manure or some low use of fertiliser to boost output. However we went on to note cases where high Net Output did not necessarily guarantee a high NFI because of raised labour, machinery, and/or fertiliser and manure costs.

Of the low output farms, there was only one (Net Output = 66%) that performed financially just as well as conventional, plus one other that may have done. This was the outcome of savings all round.

5.3.2 Variable Costs

Variable costs are made up chiefly of feeding-stuffs (bought and home-grown), fertilisers, seeds and sprays, with smaller additions for other materials and services directly associated with the crop and animal enterprises. Table 5.6 shows

Table 5.6 Variable Costs per hectare on Organic Farms as Percentage of Standard

(number of farms in each category)

Farm Type	Percentage																									
	0-	5-	10-	15-	20-	25-	30-	35-	40-	45-	50-	55-	60-	65-	70-	75-	80-	85-	90-	95-	100-	105-	110-	115-	120-	125-130
Mainly Pasture	1	-	-	-	2	-	1	3	1	1	1	1(1)	1(1)	1	-	-	-	-	1	-	1	1(1)	-	-	-	-
Ley-Arable	-	-	-	-	-	1(1)	2	(1) 1+1	-	(1) 1+2	(1) 1+1	-	1(1)	-	-	(1)* 1+1	(1) -	-	-	1(1)	1(1)	-	-	-	-	1(1)
Arable Rotation	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	(2) 1+1	-	-	-
Total	1	-	-	-	2	(1) 1	3	(1) 4+1	2	(1) 2+2	(1) 2+1	(1) 1	(1) 2	1		(1)* 1+1	(1) -	-	(1) 1	(1) 1	(1) 1+1	(1) 1	(2) 1+1	-	-	1(1)

Notes: * = semi-organic farm

(1) = farm with a dairy enterprise

(2) = farm with no stock.

Variable Costs on organic and largely organic farms, expressed as a percentage of standard. The majority are well below standard though there seemed to be no general reason for this that we could identify. In Fig. 5.1, the relation of Net Output to these lower Variable Costs on organic farms is shown. The majority of cases (16) lie well above the 45^{o} line, i.e. Net Output was not reduced relatively as much as Variable Costs. On these farms, then, the variable costs involved in producing one unit of output were lower with organic than with conventional methods. On eight farms lying close to the diagonal, costs per unit were about the same while on five farms well below the diagonal, they were higher. That Net Output tended to lie between 50 and 80% on the farms visited is also clearly evident in Fig. 5.1.

Obviously Variable Costs on organic farms are usually reduced because of the avoidance of fertilisers and sprays. However the extent to which animal concentrates are used also has a big influence on the unit costs of output on organic farms. Thus almost invariably, the farmers above the diagonal were spending less on animal concentrates per hectare than was the average conventional farmer. Those below were spending as much or more. The wider the deviation of the farm from the line, the greater the discrepancy in concentrate usage/ha compared with standard.

On a few organic farms "fertiliser" costs are not greatly reduced because on these farms, conventional fertilisers are replaced by semi-organic fertilisers or by organic wastes which need a lot of transport or handling. And on some otherwise organic farms, sprays occasionally have to be used.

5.3.3 Enterprise Outputs and Costs

So far we have discussed output in whole farm financial terms only. To understand the situation fully, it is necessary to look at yields, prices and variable costs for each of the main commodities separately.

Cereal yields on organic farms averaged around 90% of standard (range 54-114%) for wheat crops grown out of grass, and 90% (range 50-122%) for spring barley crops, but mostly with a low application of fertiliser.

Yields, variable inputs and gross margins for winter wheat and spring barley are shown in Table 5.7 (a) and 5.7 (b) for individual farms. Winter wheat grown out of grass without fertilisers or sprays had variable costs about one-third of those on conventional farms. Gross margins on some farms were still below average because of the lower yields, but on others were similar to or well above average; all the latter

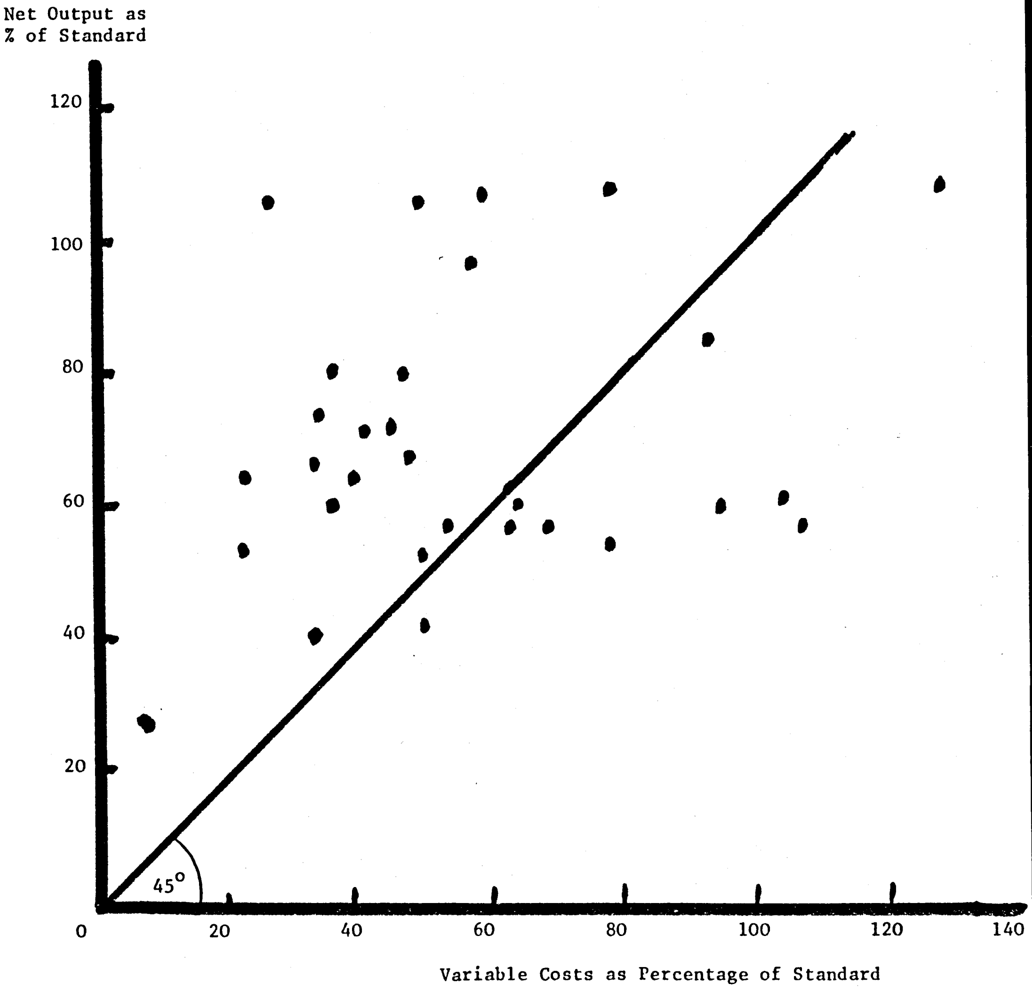

Figure 5.1 Net Output in Relation to Variable Costs both Expressed as a Percentage of Standard

group of farms were importing manure or fertiliser in some form.

Variable costs for spring barley were less reduced, as most of the nine examples quoted used semi-organic or inorganic fertilisers.

Almost all cereal-growing farms spent little on sprays. What was spent, was spent on herbicides†.

Very roughly, it seems from the farm results quoted in Tables 5.7(a) and (b) that yields on organic farms had to be around 90% of conventional if they were to provide the same gross margin as conventional farmers, and on average this yield was achieved*.

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† It is not possible to distinguish between herbicides, insecticides and fungicides in FMS data.

* This conclusion is supported by the following calculation:

$$\text{Gross Margin} = (\text{Yield x Price}) - \text{Seed} - \text{Manures \& Fertilisers} - \text{Sprays}$$

$$\text{G.M.(org)} = (\text{Y(org) x P}) - \text{Seed(org)} - \text{M.F.(org)} - \text{Spray(org)}$$

$$\text{G.M.(conv)} = (\text{Y(conv) x P}) - \text{Seed(conv)} - \text{M.F.(conv)} - \text{Spray(conv)}$$

If it is assumed that: $\text{Seed}_{(org)} = \text{Seed}_{(conv)}$

$\text{Spray}_{(org)} = 0$

$\text{M.F.}_{(org)} = 0$

Then for $\text{G.M.}_{(org)}$ to equal $\text{G.M.}_{(conv)}$

$$\frac{\text{Y(org)}}{\text{Y(conv)}} = 1 - \frac{(\text{M.F.(conv)} + \text{Spray(conv)})}{\text{Y(conv) x P}}$$

Taking figures from the East Midlands Farm Management Survey 1979-80,

M.F.(conv) = £48/ha Spray (conv) = £25/ha

Y(conv) = 5.4 t/ha P = £98/t,

yield on the organic farm would have to have been 86% of conventional to give the same Gross Margin, at 4.6 t/ha (1.85 t/ac).

Table 5.7(a) Costs and Returns for Winter Wheat (results for individual farms)

GROSS MARGIN £/ha					YIELD t/ha		Fertilisers and Manures £/ha		Sprays £/ha		Total Cost of Fert., Spray & Seed £/ha			Year of Harvest	Notes
At Normal Prices			At Organic Prices												
Organic	Std	%	Organic	%	Org.	Std	Org.	Std.	Org.	Std	Org.	Std	%		
N/A	N/A	N/A	N/A	N/A	4.9	4.8	11.5	N/A	0.3	N/A	40	N/A	N/A	1977	Buys manures
242	421	57	278	70	3.0	5.6	0	38	0	17	28	83	34	1978	
305	421	72	-	-	3.7	5.6	0	38	0	17	28	83	34	1978	
362	412	88	-	-	4.3	5.7	9.0	40	0	44	35	110	32	1978	Buys manure
368	400	92	416	128	4.3	5.3	2.3	43	0	19	30	90	33	1978	Little bought manure
369	331	111	-	-	4.7	4.6	26.0	38	3	17	54	83	65	1978	Buys Comp. Fert.
426	376	113	-	-	4.8	4.9	0	40	0	20	30	90	33	1978	Free slurry
N/A	N/A	N/A	-	-	3.5	N/A	0	0	N/A	N/A	N/A	N/A	N/A	1979	Some free slurry
378	398	95	-	-	4.9	5.3	28.0	52	34	35	87	115	76	1979	Buys semi-organic
436	420	104	535	127	4.8	5.4	5.4	48	0	25	34	112	31	1979	Some bought manure
456	375	122	584	156	5.3	5.1	15.0	52	9	35	51	115	45	1979	Uses P, K
585	424	138	668	158	5.8	5.1	0	52	0	35	27.5	115	24	1979	Out of permanent pasture

Table 5.7(b) Costs and Returns for Spring Barley (results for individual farms)

GROSS MARGIN £/ha					YIELD t/ha		Fertilisers and Manures £/ha		Sprays £/ha		Total Cost of Ferts, Manures, Sprays & Seed £/ha			Year of Harvest
At Normal Prices			At Organic Premium											
Organic	Std	%	Organic	%	Org.	Std	Org.	Std	Org.	Std	Org.	Std	%	
-	-	-	-	-	3.7	4.6	11.5	N/A	0.3	N/A	N/A	N/A	N/A	1977
133	252	53	-	-	2.0	4.0	0	30	0	12	26.6	68	39	1978
240	252	95	-	-	3.7	4.0	30.0	30	0	12	57.0	68	84	1978
295	278	106	-	-	4.3	4.4	27.0	46	2.3	11	48.5	76	64	1978
340	252	135	-	-	4.9	4.0	26.0	30	3.0	12	55.6	68	82	1978
N/A	N/A	N/A	N/A	N/A	3.0	4.0	25.0	N/A	0	N/A	N/A	N/A	N/A	1979
N/A	N/A	N/A	N/A	N/A	3.2	N/A	0	N/A	0	N/A	N/A	N/A	N/A	1979
351	314	112	-	-	4.2	4.3	18.5	54	4.5	18	44.0	94	47	1979
317	280	113	359	128	3.7	3.8	5.4	35.4	0	17.4	32.0	80	40	1979

Stocking Rates ranged from 32-132% of standard with an average for 27 farms of about 80%. However, total livestock output per adjusted forage hectare was generally rather less than this at about 70% of standard. Possible reasons that might account for this relative reduction in output, compared with stocking rate, could be slower growth rates (beef) or lower milk yields per cow (dairy).

Table 5.8 shows various measures of grazing livestock output, stocking rate and variable input costs for individual farms. Both stocking rates and livestock output figures tend to suggest that output from grass on organic farms compares less favourably than do cereal yields with the conventional standards. In particular, grazing livestock output minus concentrates per adjusted forage hectare is, on the whole, lower than conventional.

Use of concentrates by individual organic farmers, in relation to the average use for the area and type of farm, varies widely but on the whole tends to be lower per hectare. Since stocking rates also vary, this says nothing about the use per animal. Plotting concentrate expenditure/ha against stocking rate/ha (both expressed as a percentage of standard) shows that in the majority of cases (21 out of 27), organic farmers spent less per animal than their conventional counterparts.

Insufficient information was obtained to examine stocking rate in relation to nutrient input to the grassland. There was no relation between stocking rate and total farm expenditure on fertilisers and manures, but this is not surprising considering the diverse sources and costs of any plant nutrients that were applied.

Subjectively it may be said that those farmers obtaining an output per forage hectare (less concentrates) above about 65% of standard, appeared to be thorough and well-experienced in their grassland management. All farmers obtaining outputs of over 90%, except one, used brought-in manures, semi-organic or low rates of inorganic fertilisers.

From the foregoing brief examination of cereal and livestock output and costs, it would seem that organic farmers fared better, competitively, with cereals than with livestock. Monetary returns around average are obtainable for cereals provided there is some additional input of nutrients to the rotation from off the farm. However, to attain this performance with low inputs a grass break of three to four years is used. Returns from animal production were generally but not invariably lower, both in comparison to conventional farms and to the potential arable crops they displace. This foregone income can be looked upon as additional hidden cost to the arable sector and pulls down the Total Net Output Margin to somewhere between 40 and 90% of conventional (see Table 5.5). The exceptions achieving a NOM greater than the conventional average have already been discussed.

Table 5.8 Costs and Returns for Grazing Livestock

	Total Grazing Livestock Output per adjusted forage hectare (£)		Stocking Rate GLU per adjusted forage hectare		Expenditure on Ferts & Manures for the farm as a whole. (£/ha)		Expenditure on Concentrates (purch. & home-grown) £ per adj. forage ha.		Margin over Concentrates per adjusted forage ha.	Farm NFI as % of Standard	Notes
	Organic	As % of Standard	Organic	As % of Standard	Org.	As % of Std	Org.	As % of Std	As % of Std		
Mainly Pasture Farms											
D (G)	376	45	1.14	60	6.3	16	234	71	28	-188	Poor land, processing excluded.
D,H (F)*	481	50	1.20	74	0	0	117	34	59	86	
D (F)	369	73	1.3	93	20	105	140	115	60	33	
B	133	27	0.97	32	3	11	0	0	36	4	
B,S	122	26	0.7	47	1	3	7	9	29	56	
B,S *	112	46	0.6	54	8	43	15	26	53	49	
B,S	144	70	0.75	58	9.9	132	25	128	64	14	
B,S *	154	65	0.84	-	1.4	7	15	58	66	37	
B,S *	138	66	0,72	82	7.1	51	8	23	74	104	
B,S *	272	90	1.2	100	8.4	40	43	66	96	53	Uses semi-organic manure
B	289	121	1.8	100	0	0	210	463	41	-129	
B	471	112	1.85	116	10	29	59	56	131	-	
B,S *	172	58	1.45	132	14	21	15	23	68	1	
Pasture & Arable Farms											
D,B,S (G) *	344*	41 *	1.1	58	4.8	11	130	42		24	Bulk fodder included in standard.
D,S (A) *	884	65	1.8	63	10.8	19	296	55	71	49	
D,S (AxF)	425	51	1.4	75	0	0	161	61	46	32	
D,S (F)	530	64	1.3	76	19.2	36	258	105	47	2	Trying semi-org. Gave up.
D,S (F+G)	572	76	1.6	88	46.1	88	297	118	55	-126	Farm establishing.
D,B (A)	673	97	1.9	104	51.0	132	182	61	116	26	Low fert. + purch. manures.
D,B (F)	602	76	2.0	103	0	0	208	67	81	61	
D,B,S (F)	792	104	2.0	111	0	0	109	27	192	224	Possibly misleading year.
D,H,S (A) *	880	74	2.1	116	9.1	13	312	81	70	161	Pig slurry boosts.
S	251	75	0.6	43	11.5	39	39	36	93	57 to 80	
B	152	51	0.6	47	12.6	55	46	42	57	-	
B,S	198	68	1.0	68	0	0	19	29	80	96	
B	232	77	1.1	60-80	21.4	66	0	0	99	289	Semi-organic
B,S	277	86 *	1.3	100	5.4	16	23	26	108	912	NFI = 129% of top 50% of farms.
B	280	71	1.5	118	31.7	65	18.5	13	105	41	Poor cereals.

D = Dairy H = Heifers B = Beef S = Sheep G = Guernsey F = Friesian A = Ayshire
* = per unadjusted forage hectare.

5.3.4 Fixed Costs

Total Fixed Costs expressed as a percentage of standard are shown in Table 5.9. The wide range averages out at 90% of the Farm Management Survey farms. These fixed costs are made up of:

(i) Labour
(ii) Machinery
(iii) General sundry and office overheads
(iv) Land repairs and maintenance
(v) Rent/Rental value and rates.

Intuitively it would seem possible that organic farming systems might have different labour and machinery costs but the other items listed would be unlikely to be affected as a direct result of the farming approach adopted. Labour and machinery costs are presented in Table 5.10 in terms of the percentage difference between the organic farm and the standard. The size of our sample is small in relation to the variability encountered and it would be unwise to generalise too far from these figures.

Labour/hectare

Table 5.10 shows that Paid Labour (regular plus casual) tended to be lower than standard but that Total Labour (including payment for the manual labour of the farmer) was about the same. Payment for the farmer's labour (plus the spouse) is given the same standard notional value as used for the Farm Management Survey, assuming a particular number of hours worked. The amount of work actually done is obviously liable to deviate considerably so these costings figures may not be an accurate guide to the amount of time necessary to work the farm. We are not therefore in a position to say whether organic farming is or is not using more labour. Certainly on some arable farms a certain amount of extra labour would seem to be necessary where there is a lot of bought-in manure to be handled and indeed such farms do have higher labour costs. Payment also goes out to contractors for such work. There was evidence too that weed control in some potato crops involved considerable extra payment for casual work when weeds got away, but otherwise there was no evidence of increased labour employment for weed control. Presumably weed control is inherently catered for by the rotation.

Machinery and Power/hectare

Both fuel consumption and depreciation were lower on the organic farms. The reason for the generally lower fuel

Table 5.9 Fixed Costs per Hectare on Organic Farms as Percentage of Standard

(number of farms in each category)

Farm Type	Percentage																									
	35-	40-	45-	50-	55-	60-	65-	70-	75-	80-	85-	90-	95-	100-	105-	110-	115-	120-	125-	130-	135-	140-	145-	150-	155-	160-165
Mainly Pasture	-	1	-	1	-	1	1	-	-	1	(1) 1	-	(1) 1+1	1	-	-	-	-	-	-	1	-	-	-	1	1 (1)
Ley-Arable	(1) 1	-	-	-	(1) 1	-	-	(1) 1	(1) 1+1	2	(1) 1	-	1	(1) 1	-	(1) 1	(1) 1	-	-	-	-	-	-	-	-	-
Arable-Rotation	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1 (2)	-	-	-	1
Total	(1) 1	1	-	1	(1) 1	2	1	(1) 1	(1) 1+1	3	(1) 2	-	(1) 2+1	(1) 1+1	-	(1) 1	(1) 1	-	-	-	1	(2) 1	-	-	1	(1) 1+1

Notes (1) = dairy farm

(2) = farm with no stock.

Table 5.10

Fixed Costs and some of its Components Relative to Published Standards*

(percentage difference per ha)

	Total Fixed Costs	Labour		Machinery and Power			
		Total Paid	Total incl. farmer & spouse	Fuel	Repairs	Deprec- iation	Total Machinery Power & Contract
	%	%	%	%	%	%	%
Pasture Farms							
Beef & Sheep	-16	-14	-3	-83	-80	-40	-55
	-45	-97	-47	-69	-84	-63	-68
	-57	+26	-44	-81	-81	-97	-83
	+57	+219	+115	-43	+64	-57	-26
	+36	-100	+53	-65	-98	-83	-4
	-30	-100	-55	+4	-29	+25	-5
	0	-19	-5		-20	-22	-15
	+2	-100	0	+20	-58	+65	+20
	-36	67	-47	-38	+25	-49	-20
Dairy	-13	18	0	-2	+59	-60	-29
	+61	+152	+44	+24	-60	-69	-51
	-1	-47	-10	-38	-29		-5
Alternate Husbandry							
Cereals	-19	-18	-7	-10	+2	-37	-22
Beef & Sheep	-29	-100	-38	-38	-54	-45	-38
	-16	-20	+6	-57	-14	-76	-38
	-4	-90	-23	-8	+100	-58	0
	+143	+52					
	-62	-19					
Cereals, Dairying	-43	-62	-48	-65	-29	-67	-49
	+17	+108	+47	-32	-4	+15	-10
	-14	+21	+6		-23	-49	-34
	+11	+23	+23	-48	+63	-23	0
	-61	-33	-18		-39	-23	-39
	-21	-99	-38		+40	+9	+7
Arable Rotation							
	-36	-24	-36	-47	-43		-56
	+62	+37	+72	-4	+79		+69
	+45	-90	+16	+127	+126	+42	+58
Average	-10	-18	-2	-26	-7	-35	-20

* $\frac{\text{Farm - Standard}}{\text{Standard}} \times 100$

consumption is not apparent, but the lower depreciation probably reflects the general need for, and practice of, thriftiness via the use of old and second-hand machinery kept in working order. Repair costs average out at much the same as on conventional farms. Variation in all these three items is great. The total of machinery, power and contract operations ranges rather less, and it averages out at somewhat less than conventional (80% on average).

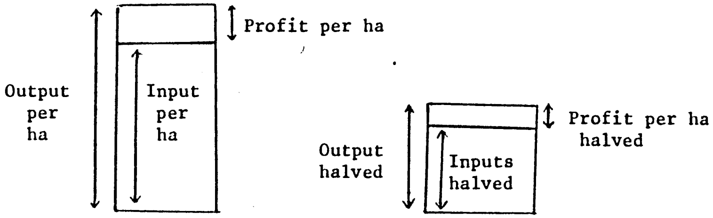
Returns to Labour and Machinery

Net Outputs per £100 Labour, £100 Machinery and Power, and £100 Labour and Machinery and Power, are shown in Table 5.11.

On the pasture farms, returns to labour are on average, somewhat lower (69%) than standard, but on the ley-arable farms they seem to be much the same. Returns to machinery also show an average similar to that on conventional farms.

5.4 Discussion

Net Farm Income is by definition determined by the relation of receipts to costs, and theoretically a low output system with sufficiently low costs could give just as high an NFI as high output with high costs. However, as the following diagram shows, any reduction in output must be offset by a proportionately greater reduction in total costs if the same profit is to be obtained. Thus, for example, a 50% reduction in both output and costs also gives a 50% lower NFI.



Taking the "National Farm" averaged over all farm types and farm sizes* as our model, we see that Total Costs are 81.5% of the value of Total Output, leaving 18.5% as NFI. Using this figure, Total Costs must be reduced by 61% to give the same profit margin on a 50% drop in output,

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*MAFF "Farm Incomes in England 1978/79" and "FMS in England Supplementary Analyses 1978/79". Total Costs excludes farmer and spouse manual labour. Total Output includes Breeding Livestock Appreciation.

Table 5.11 Net Output per £100 of Fixed Cost Items
(Organic Farms as % of Standard)

	Per £100 Labour	Per £100 Machinery & Power	Per £100 Labour & Machinery & Power
Mainly Pasture Farms			
Beef and Sheep	78	129	90
	61	123	72
	50	170	80
	34	42	37
	28	83	36
	156	74	115
	89	89	89
	58	49	56
	94	60	79
Dairy	58	72	63
	60	221	80
	64	58	62
Ley-Arable Farms			
Crops, Beef, Sheep	125	139	132
	98	-	-
	118	119	84
	63	116	76
Crops, dairy	79	83	80
	77	126	98
	57	104	70
	88	108	95
	79	79	79
	127	51	86
	147	104	128
	51	103	60
	122	92	105
	73	91	79
Arable Rotational			
	81	170	103
	72	48	60

and by 31% on a 25% drop in output. Fifty-one per cent of the "National Farm's" Total Costs are Fixed Costs* and though, as we have seen, these vary widely in the extent to which they can be reduced, on average they are not much lower on organic farms, than on conventional ones. This is as one would expect: there would appear to be little scope for reduction, apart from perhaps lower fuel usage, as a direct result of using an organic system. However, thrift and an adequate acreage to absorb the lumpy nature of labour and machinery inputs can give lower fixed costs on some farms. The burden of the required reduction in costs therefore tends to fall on the variable costs, yet at the same time these variable inputs must be materially high enough to support an output which will cover Total Costs and an adequate NFI.

Taking our "National Farm" example, organic farmers must seek to obtain a Gross Output 60% of average in order to cover Fixed Costs and NFI alone. Correspondingly more output than this is required to cover the variable costs incurred.

Scope for reduction through variable costs is thus itself limited by the need to achieve a certain level of output. On the whole we have seen that, while substantial savings in variable costs were made, they were not usually sufficient to maintain the same profit margin. In particular (a) expenditure on animal feedingstuffs (purchased and home-grown) is not necessarily reduced on organic farms, and (b) fertilisers and sprays only represent a fairly small percentage of a farm's total costs**; at least for those farm types commonly practised by organic farmers.

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* Plus casual labour and contract work. Fixed costs as a percentage of Total Costs for different Farm Types 1978/79 were:

Specialist Dairy	41%	Specialist Cereals	63%
Mainly Dairy	49%	General Cropping	61%
Hill & Upland Cattle & Sheep	60%	Pigs & Poultry	32%
Lowland Cattle & Sheep	57%	Horticulture	70%
Lowland Cropping, Cattle & Sheep	52%		

** Fertilisers and sprays as a percentage of Total Costs for different Farm Types 1978/79:

Specialist Dairy	7.2%	Specialist Cereals	18.7%
Mixed Dairy	10.0%	General Cropping	14.5%
Hill & Upland Sheep & Cattle	9.1%	Pigs & Poultry	3.8%
		Horticulture	7.6%
Lowland Cattle & Sheep	8.3%		
Lowland Cropping, Cattle & Sheep	10.6%		

All Farm Types (excluding horticulture) 10.9%

Figure 5.6 showed that variable costs on the organic farms studied ranged widely but generally were below 60 to 70% of standard. If we take the median value of about 50%, then an organic farmer must obtain a Gross Output 80% of standard in order to cover the same fixed costs and NFI as the average conventional farmer.

We have used very rough calculations such as these to illustrate the relative order of magnitude of the different factors involved. On the whole, although variable costs in our sample were reduced more than the resulting output (Figure 5.1), NFI per ha suffered (Table 5.1). This was because Total Costs were not reduced to the same extent. Thus it can be understood from these calculations that the organic farmer must be hard put to it, under present price levels, to achieve a comfortable NFI. Nevertheless some farmers do manage to do so by means of some of the measures outlined in the next section.

The price of inputs and outputs may change in response to supply and demand on the open market, and can be manipulated by national farm support policies and commodity taxes. It is possible that at certain price levels (e.g. of artificial fertilisers) the constraints associated with organic farming will reduce income but, at other price levels (e.g. associated with over-production and, or, changes in fixed costs), organic farming may turn out to be the preferred system. We hope the effects of price changes can be examined further, as a follow-on to this work, by running some hypothetical model farms on Linear Programming assumptions. The model farms would be run on both organic and conventional lines at various price levels.

Potential for Improving Net Farm Income on Organic Farms

There are two approaches to improving Net Farm Income: one is to tap all potential for reducing costs, in particular to be thrifty; the other is to increase monetary output by increasing either the amount produced, or its unit value. Few of the methods are specifically organic. The more economically-successful organic farmers are making use of some of the methods outlined below; those with asterisks are particularly used:

1. Potential for reducing costs

Variable costs (a) through thrift

(b) through benefits from rotational husbandry (counteracted, of course, by the costs of diversification).

Animal feedingstuffs:
- mixing own rations from both home-grown and bought-in constituents.
- *Making high quality (sometimes barn-dried) hay and silage to reduce the concentrates and supplementary protein necessary.

- Some farmers claim home-grown organically-produced feed goes further.
- Making use of local wastes and byproducts.

Vet:
- Published figures are not sufficiently detailed to show savings here.

Crop Nutrients:
- *Substituting fertilisers with cheaper manures and wastes.
- *Using clover and legume crops to fix nitrogen.
- Other green manures between main crops.
- Recycling all of own straw, and other people's via bedding, feeding or chopping behind the combine.

Seed:
- Organic farmers like to use their own organically-grown seed anyway as part of their husbandry.

Sprays:
- Although some organic farmers need to use some sprays in spite of their rotations, spray costs are generally much lower.

<u>Fixed costs</u>:

(a) through thrift
(b) through lower indebtedness
(c) through family labour

Labour: With the specific intention of cutting paid labour, some farmers are:

- *highly mechanised
- run animal enterprises at a lower intensity
- keep the size of the farm small enough to run without help.

Machinery:
- *Many of the farmers were adept at doing their own machinery maintenance and property maintenance, reducing depreciation and making use of cheaper second-hand materials and equipment.
- in our survey the great majority of the farms had a lower usage of direct fuel, though it is not clear why. The use of support energy is discussed more fully in the next chapter.

Machinery and Labour:
- We have already noted that the principle of a wide diversity of enterprises is limited by the additional overheads required to be carried by a fixed acreage. Contractors can be, and are, used for some operations, but, since timing is so particularly important in organic husbandry, it is not necessarily a suitable solution for cutting machinery overheads.

Land: - Larger acreage over which to spread machinery fixed costs.
- Little or no rent or mortgage payments to meet.

2. Increasing Monetary Output

(a) *Importing nutrients to increase the quantity of output. This is one of the chief means by which the more successful organic farmers boost their production to cover fixed costs. The materials made use of may be of low cost, or free, but time and transport need to be considered in each situation. Other materials such as the semi-organic fertilisers are not cheap but (at least in cereals) are thought to give a worthwhile response in output.

(b) Increasing the efficiency of using resources:

- *design of the system
- *grassland/clover management
- deep-rooting plants
- recycling
- catch-crop green manures and fodders
- *winter-housing
- soil structure conservation by shallow ploughing
- healthy stock
- *timeliness of operations
- plant breeding for deep-rooting nutrient-searching plants, for disease resistance and for nitrogen-fixing crops.

(c) Increasing the unit price of produce. Premiums for:-

- organic production (*particularly cereals)
- for quality (keeping ability, taste, condition)
- for pedigree breeding stock sales
- some farmers sell their own cereals at an organic or bread-making premium, and buy in cheaper cereals for stock-feeding.

(d) *Adding value

- by processing and/or retailing
- attention to marketing, particularly by smaller farms and small-holdings.

CHAPTER 6

Competitive Position of Organic Farms

6.1 Introduction

The purpose of this chapter is to make some assessment of the possible future of organic farming in competition with conventional farming; this is a preliminary to Chapter 7 which will examine the present and future social benefits and discuss policy options.

The starting point is the current viability of organic farms - how do organic farms compare with conventional farms simply as business propositions at current prices? Section 6.2 re-iterates the conclusions we drew in Chapter 5 on this question.

Given the current situation, the next question is whether any long-term changes are likely to occur that may affect the competitiveness of organic farms relative to conventional systems. Possible changes may be in output prices, input prices, and technology. Within these three general headings, the aspects attracting most popular attention have been the environmental implications of current farming systems, and the heavy dependence of such systems on support energy. The environmental implications are essentially social costs and are therefore postponed to Chapter 7. It is the dependence on support energy which forms the main subject of discussion in this chapter (section 6.3). Other sources of change are probably less significant and they are considered only briefly (section 6.4).

As a background to this examination of the future competitiveness of Organic Farming, it would be desirable to know how important it is at present. Unfortunately, there are no published statistics. Furthermore, any attempt to produce an estimate must begin with the definitional issues discussed in Chapter 3, for there are of course many farms which have some of the characteristics of Organic Farming (in particular, there are those with low usage of chemical inputs but in many cases this will simply reflect what is optimal in the straightforward economic sense for those particular farms). If we confine our attention to those farms which have consciously adopted all, or the majority, of the principles of Organic Farming, then the numbers are much smaller. In drawing up what was originally conceived of as a "sample" of organic farmers, we approached both the major organic farming organisations in Britain (and some other sources) and eventually identified 82 organic or semi-organic farms (see Chapter 2). This was not a sample but was the closest we were able to get to establishing the complete universe. We recognise that there are other organic farmers whom we missed - in particular there are "biodynamic farmers" and there are farmers using organic principles but not belonging to any group at all. Nevertheless, it seems clear that the present number of organic farmers in Britain must be a very small proportion indeed of the more than 200,000 holdings identified in the June Census.

6.2 Current Viability of Organic Farms

6.2.1 Income position

The viability of organic farms is in part indicated by their current profitability, which was discussed in Chapter 5. There was a tremendous range in NFI/ha expressed as a percentage of the standard figures for conventional farms with which they were being compared. On the whole, NFI/ha was lower unless a considerable amount of cheap waste was imported to boost output, low rates of other fertilisers used, or the produce processed to add value.

Table 5.3 suggested that skilful farmers should be able to obtain an NFI ranging from 60% to well over 100% of the conventional average with the inputs referred to above. With only low nutrient inputs, however, it seemed that even good farmers could expect an NFI of only 20% to 60% of standard. We also saw that relatively high manurial inputs did not necessarily guarantee a high NFI because on some farms other costs were also raised.

MII as a percentage of tenant's capital was less than the Minimum Lending Rate on three-quarters of the organic farms providing information. This was also the case on nearly two-thirds of the conventional farms but the shortfall on organic farms was generally much greater. Again those organic farms performing well almost all had a substantial external input of manures or some use of other fertilisers.

In the foregoing comparisons, no allowance for any additional premiums has been made. Organic premiums for cereals (see Chapter 4.6), or milling of wheat on the farm, can make a substantial improvement to NFI taking it up well above average.

The wide range in performance suggests that management ability and experience were having a great influence on the viability of Organic Farming. The economic success of a few organic farms suggests that there is potential for some of the organic systems to be competitive with conventional. Many of the less economically successful farms could still be described as "viable" in their own terms in that, given survival, ideological returns become more important; but it seems unlikely that many farmers would be attracted to this type of farming without stronger incentives than this.

6.2.2 Long-term stability

Adequate profitability relative to other farming systems is a guide to long-term stability, but there are other considerations to be taken into account.

Firstly, to the extent that farmers own their own land, their incomes are in fact higher than the NFI's calculated would suggest and they are in consequence less vulnerable to adverse economic circumstances. Of the farmers visited in the survey, 79% owned their own land (46% with no mortgage left to pay, 14% with a mortgage or heavy borrowing charges, and 19% owned but borrowing status unknown).

Secondly, the stability of profit from year to year is of importance to the business's long-term stability. Organic farmers sometimes claim that their relative invulnerability to disease and pests, greater drought tolerance in dry years, lower investment risk than with soluble fertilisers in wet years, and their diversity of enterprises, gives them more stability than is available to conventional farmers. Testing of this hypothesis obviously requires a study of such farms over time and we have not been able to do this, nor have we been able to find published information from other sources.

With this summary of the current financial position of organic farms visited in England and Wales, we can now go on to consider whether any long-term changes are likely to affect their future competitiveness.

6.3 Energy and Agriculture

Amongst the changes which, at least superficially, seem likely to alter the economic atractiveness of Organic Farming is a change in energy availability. If such a change occurred suddenly (e.g.,a cut-off in supplies for political reasons), the problems of adjustment would be so severe that organic farming - which, like conventional farming, also requires a mechanical energy input - could offer no solution to the immediate problem even if in principle there were a saving to be had. How far it might be beneficial in the longer run can be examined by exploring the alternative question of how farming systems might react to a long-term upward trend in energy prices. There are four issues that will be examined in this section:

(i) the role of energy in farming;

(ii) quantitative assessment of energy inputs in agriculture;

(iii) the use of energy on organic farms;

(iv) fuel prices and their effect on agriculture.

6.3.1 The Role of Energy in Farming

Agriculture receives two kinds of energy: direct energy from the sun and support energy from fossil fuels. Several studies of the energy situation in agriculture have treated these as equivalent and have examined the efficiency of agriculture in energy terms by measuring, for instance, the ratio of energy output to energy input (Leach, 1976). This approach implies that the two sorts of energy are perfect substitutes. On the supply side, the differences between them are that support energy is a stock resource, limited in extent but conservable, while solar energy is a flow resource in continuous and, for practicable purposes, inexhaustible supply. On the demand side, they are imperfect substitutes in a variety of ways. The question that needs to be answered is whether, given the limited stock of support energy (reflected at least in part by its present and projected price) it is practicable and desirable to conserve that stock by using solar rather than support energy in those areas where they are substitutes. The answer to this question is by no means obvious since solar energy, though in a sense free, involves a cost when it is trapped for use (e.g., more land or a more expensive system may be required). Organic farming can be thought of as a possible way of substituting solar energy for support energy.

Support energy used in agriculture can be classified under three headings: direct use of fuel on farms; "upstream" use of energy by industries supplying agricultural inputs; and "downstream" use of energy by firms processing and distributing agricultural outputs. In this study the focus is on farming systems so downstream uses are of peripheral significance though they may not be entirely irrelevant: a change in energy prices could alter the relative efficiencies of alternative downstream activities, for instance marketing networks. Such changes might in turn have a consequential impact on the farming pattern itself. Upstream uses are much more directly relevant since the prices of numerous agricultural inputs could change in response to an increase in energy prices and this could have an immediate effect on farm systems. Amongst the main inputs likely to be affected are fertilisers, direct fuel and electricity and, to some extent, feeding-stuffs and machinery inputs. It is in this context that Organic Farming presents itself as a possible energy-saving alternative, though it is worth noting that if energy-saving were the sole objective then conventional mixed farming (with some use of herbicides) may offer even greater savings. The energy involved in manufacturing sprays forms a very small part of their cost, so they are likely to become relatively less expensive compared with some other inputs if diminishing energy availability alone is taken into account.

Amongst those who have directed attention to the role of energy in agriculture are Blaxter (1975, 1978), Leach (1975, 1976), White (1975), Slessor (1973), Parsons et al. (1978), Marshall (1980) and Cooke (1975). Blaxter (1978) expresses what is probably a general view that "our present farming methods have developed because oil has been cheap". Nevertheless, he argues that a rise in oil prices would not cause a substantial change in these methods because response curves are so steep: he explicitly rejects for instance the possible replacement of support energy by increased manpower though there seems to be general acceptance that support energy has displaced labour. If the maintenance of agricultural output is the objective then Blaxter's conclusions are pessimistic: "if responses are indeed so steep within the more usual range of farming operations, then economy in the use of support energy could have catastrophic effects on production". How "catastrophic" the effects would be - particularly bearing in mind the fact that industrialised countries are for the most part bedevilled by food surplus rather than by shortages - has not been quantified. Nor is it clear what the indirect effects would be on those countries which do have food shortages if use of support energy in the advanced countries were to be cut back.

While Leach (1975) also emphasises the problems, he nevertheless draws attention to specific inefficiencies in the use of energy in agriculture and to opportunities for economising. The energy loss arising from the production of livestock rather than crops for final consumption is well-known and is controversial since any change involves interference with choice. Drawing in part on a paper by Cooke (1975) Leach lists the following, less controversial proposals. Some, but by no means all of them, have some common ground with the views of organic farmers:

- efficient use of the energy contained in straw
- increase the technical efficiency of the use of nitrogen (only about half the nitrogen applied to the soil is believed to be actually taken up by crops) and perhaps reduce the quantity (since the marginal return may be small)
- greater use of manures either on the soil or to produce methane
- further research on nitrogen-fixing including "the revolutionary possibility of conferring on cereals and other major crops the ability that legumes have of fixing nitrogen from the atmosphere"
- more efficient control of heating in glass houses
- greater use of herbicides instead of ploughing
- greater use of rotations

6.3.2 Quantitative assessment of energy inputs in agriculture

In order to assess the possible contribution of organic farming systems to energy saving, it is necessary to quantify agriculture's use of support energy. The difficulties involved are such that the estimates are imprecise and definitions not always clear; furthermore, estimation for one sector of the economy alone, means that there is no test of accuracy. Despite these weaknesses, the estimates quoted in Table 6.1 are at least in broad agreement with one another and probably indicate the orders of magnitude involved. It appears that the total food and agricultural system in Britain uses some 200×10^6 GJ or about 25% of Britain's total use of support energy. A large part of this however is represented by food processing and distribution, domestic food processing and garbage and sewage, so farming itself accounts for only about 5% of all support energy use. It is within this 5% that the areas of interest in this report fall, with direct fuel and power probably the main user (29-34% according to which authority one follows), fertilisers probably second (22-34%), and a variety of miscellaneous uses accounting for the remainder. For organic farms, the main area of savings is likely to be in use of fertilisers but what has to be examined is how far there may also be savings under the other headings or whether, indeed, organic farms may actually be using additional energy (e.g., extra machinery and fuel costs to spread organic fertilisers).

Table 6.1 Energy Inputs to British Agriculture (10^6GJ)

	Blaxter	Leach	White
Agriculture			
Direct fuel	121	108	122
Fertilisers and agrochemicals	129	82	84
Machinery, repairs, etc.	51	32	52
Transport to and from farm	16	...	...
Buildings, services and miscellaneous	...	52	52
Imported feed	60	51	...
Processing feed	...	53	53
	377	378	363
Food Processing and Distribution			
Imported food	208	260	...
Food industry	527	476	...
Food distribution	451	139	...
	1563	1253	...
Subsequent			
Home expenditure on preservation & cooling	728	449	...
Garbage and Sewage	26	...	...
Total	2317	1702	...

Source: Derived from: Blaxter (1978)
Leach (1976)
White (1975)

The previous paragraph discusses the importance of agriculture as a user of energy, but it does not show how important energy is as an agricultural input nor does it show the diversity that exists as between farm type and size. These issues are covered in subsequent paragraphs using two alternative approaches: the total farm energy budget expressed in physical units (GJ) and an itemised financial budget detailing the energy cost of each input.

Physical energy budgets for each of the main farm-types have been developed by Leach (1976) who has estimated the support energy content of each agricultural input. A summary of his results is presented in Table 6.2. Column (1) brings together the various energy-intensive inputs in a common unit to show the dependence on energy of each farm type; it does not, however, indicate which farm types would be most seriously affected by energy-price rises since the level of the other inputs to the farm is not shown. Columns (3) - (7) show various measures of the efficiency of energy use by each farm type. If the objective of agriculture is (or becomes) to produce energy-giving foods with the minimum use of support energy, then Column (3) is a relevant measure and reflects the well-known fact that animal production is an inefficient way of converting energy; cereal production, on the other hand has an energy ratio greater than one because of its use of solar energy. This does not of course mean that agriculture should be switched exclusively to crop production for two main reasons: first, many consumers are willing to pay for animal products (a fact indicated by Column (6) which shows remarkable consistency in the level of energy input per £ of output); and secondly, much land is suitable only for grass which cannot be converted for human use except through the use of animals (though if the energy output-input ratio is below one such land should not be used at all if this ratio were the criterion).

The efficiency ratios derived from these physical energy budgets are not an adequate guide to action, firstly, since they are total farm budgets and, secondly, because they focus attention on rather narrow objectives. The second approach adopted was to examine the cost of support energy contained in each individual input relative to total farm inputs.

As a preliminary, Table 6.3 lists the relative expenditure on different physical inputs to farms (labour, rent and rates are left out). It shows that, for all farms together (except horticulture), direct expenditure on fuel, oil, electricity and heating fuels represents about 4% of total inputs and there is little variation either by farm-type or size except for the very smallest holdings. Fertilisers, averaging 8%, vary considerably by farm type and there is a marked increase in their use, together with sprays, with farm size. Feeding-stuffs (2 to 54%) and Machinery (9 to 22%) generally constitute the greatest items of expenditure though there is a great deal of variation between farm types.

Table 6.2 Physical Energy Budgets

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Support -energy input	Energy output	Energy efficiency ratios				Gross output per unit of land
			Energy output ÷ Support -energy input	Energy input per unit of protein	Energy input per unit of labour and machinery	Energy input per £ output	
	GJ/ha	GJ/ha		MJ/kgP	GJ	MJ/£	£/ha
Farm Type							
Specialist Dairy	33.2	12.8	0.38	240	2.59	210	215
Mainly Dairy	26.5	14.6	0.55	183	2.55	211	164
Cattle and Sheep	14.8	8.7	0.59	185	2.24	211	75
Sheep	4.5	1.1	0.25	372	1.52	220	21
Pigs and Poultry	44.8	14.1	0.32	316	3.72	225	549
Cereals	24.0	46.1	1.90	64	3.35	218	116

Source: Leach (1976)

TABLE 6.3 Expenditure on Inputs, excluding Labour, Rent and Rates, By Farm Type and Size 1978/79

	Bought Feed and Fodder	Fertilizers	Sprays	Power			Machinery		Water	Other Expenses		Total Input excluding Farmer and Spouse	Total Output incl. BLSA
				Fuel & Oil	Electricity	Heating Fuel	Repairs + Depreciation	Contract & Mach.Rental		Vet, bought seed	Other Livestock Crop & General Farming Costs		
	£ per hectare												
By Type of Business (full-time)													
Specialist Dairy	301	48	2.3	13	11.6	1.0	26 + 57	13.3	3.9	17	49	693	856
Mainly Dairy	121	39	6.8	10	6.5	0.4	20 + 43	7.8	2.6	19	30	459	560
Hill and Upland Cattle and Sheep	18	8	0.6	3	0.8	0.1	4 + 11	1.8	0.2	5	8	95	136
Lowland Cattle & Sheep	56	21	2.2	9	2.7	0.5	11 + 29	6.3	1.6	10	24	284	329
Lowland Cropping, Cattle and Sheep	73	32	7.8	10	4.1	0.4	17 + 38	9.2	1.6	18	26	390	467
Specialist Cereals	16	38	21.4	12	3.4	0.2	16 + 47	7.6	1.0	22	19	318	403
General Cropping	43	44	26.6	16	5.2	0.5	26 + 65	10.2	1.5	33	36	487	596
Pigs and Poultry	835	39	20.0	22	25.8	2.3	37 + 90	15.3	5.1	36	71	1545	1831
Horticulture	43	87	88.0	45	36.1	229.3	76 + 141	26.1	14.1	129	395	2311	2566
By Size of Business, ESU (excluding Horticulture)													
4 - 7.9	81	13.60	3.93	10.82	5.87	0.63	14 + 28	6.92	1.60	7.57	38.12	313	379
8 - 15.9	115	23.16	4.07	8.46	4.83	1.07	14 + 37	6.99	1.64	12.70	26.78	346	435
16 - 23.9	124	29.65	6.60	9.30	5.41	0.42	16 + 40	8.93	1.92	15.55	27.37	398	503
24 - 39.9	123	38.27	11.31	11.53	6.20	0.34	15 + 49	8.61	1.94	21.72	32.11	470	575
40 - 99.9	116	44.62	20.23	13.13	6.30	0.44	22 + 58	8.79	1.95	27.11	31.50	527	642
100 -249.9	84	45.72	27.00	15.95	6.09	0.13	27 + 57	9.74	1.78	31.22	29.50	525	632
All Types, All Sizes	111	35.35	13.50	11.68	5.81	0.50	19 + 48	8.47	1.83	21.04	30.28	450	552
	As a Percentage of Total Inputs (excl. farmer and spouse)											Total Input as a Percentage of Total Output	
By Type of Business (full-time)													
Specialist Dairy	43.3	6.9	0.3	1.9	1.7	0.1	11.9	1.9	0.6	2.5	7.1	80.9	
Mainly Dairy	26.4	8.5	1.5	2.3	1.4	0.1	13.7	1.7	0.6	4.1	6.6	81.9	
Hill & Upland Cattle & Sheep	18.7	8.4	0.7	3.1	0.8	0.1	16.6	1.9	0.2	5.2	8.1	70.2	
Lowland Cattle & Sheep	19.7	7.6	0.8	3.0	1.0	0.2	14.1	2.2	0.6	3.6	8.3	86.3	
Lowland Cropping, Cattle & Sheep	18.7	8.6	2.0	2.7	1.0	0.1	14.1	2.4	0.4	4.6	6.6	85.7	
Specialist Cereals	5.0	12.0	6.7	3.6	1.1	0.1	19.8	2.4	0.3	6.7	6.1	78.9	
General Cropping	8.8	9.1	5.5	3.2	1.1	0.1	18.7	2.1	0.3	6.8	7.4	81.7	
Pigs and Poultry	54.1	2.5	1.3	1.4	1.7	0.2	8.3	1.0	0.3	2.3	4.6	84.4	
Horticulture	1.9	3.7	3.8	2.0	1.6	9.9	9.4	1.1	0.6	5.6	17.1	90.1	
By Size of Business, ESU (excluding Horticulture)													
4 - 7.9	25.9	4.3	1.3	3.5	1.9	0.2	13.5	2.2	0.5	2.4	12.2	82.6	
8 - 15.9	33.2	6.7	1.2	2.4	1.4	0.3	14.8	2.0	0.5	3.7	7.7	79.5	
16 - 23.9	31.1	7.4	1.7	2.3	1.4	0.1	14.0	2.2	0.5	3.9	6.9	79.1	
24 - 39.9	26.1	8.1	2.4	2.5	1.3	0.1	13.5	1.8	0.4	4.6	6.8	81.7	
40 - 99.9	22.0	8.5	3.8	2.5	1.2	0.1	15.2	1.7	0.4	5.1	6.0	82.1	
100 - 249.9	16.0	8.7	5.1	3.0	1.2	0.0	16.0	1.9	0.3	5.9	5.6	83.1	
All Types, All Sizes	24.7	7.9	3.0	2.6	1.3	0.1	14.9	1.9	0.4	4.7	6.7	81.5	

Source: Farm Incomes in England 1978/79; Farm Management Survey in England Supplementary Analyses 1978/79

It is difficult to draw general conclusions about energy use from Table 6.3 because the net effect is unclear unless the energy content of the various inputs can be identified. Table 6.4 has been obtained by combining Leach's information on the support energy content of each input with the data from Table 6.3 in order to assess total energy input in monetary terms. The second to last column of Table 6.4 shows the cost of support energy used as a proportion of total input costs. The last column, showing the net return per £1 of energy used, was calculated as:

$$\frac{\text{Total Output (incl. BLSA) - Total Input (less farmer \& spouse's labour)}}{\text{Total Energy Cost}}$$

For all farm types together, energy represents 8.9% of total input costs. This means that a doubling of energy prices would, on average, raise total input costs by under 10% and indeed farm-gate prices would need to rise by only about 7% to compensate fully for the extra cost (Total Input is about 80% of Total Output). Obviously any reduction in demand or substitution in production methods would make the increase in price even smaller (though off-farm effects would also have to be taken into account for a full assessment).

Such calculations put the energy issue in place, but should not lead to its importance being underestimated: a doubling of energy prices with no consequential change in selling prices or production methods would cause NFI to drop by about one-third.

After the extent of agriculture's dependence on fuel, the second most striking feature is the lack of variability in the degree of dependence as between farm types apart from horticulture. The horticulture result is surprising until one realises it is due to the high heating bill; if heating fuel is omitted, then energy costs as a percentage of total inputs are 5.0%.

The variation in degree of dependence is also small between farm business size groups, though there is a clear tendency for energy dependence (as a percentage of total inputs) to fall with increasing size of business to 24-39.9 E.S.U. This is not due to a reduction in energy input per hectare with increasing farm size (the reverse is true), but to a greater marginal return of output for each £1 of energy invested, up to 16-23.9 E.S.U.

The constituent elements of energy cost are also shown by the table. For agriculture as a whole the pattern is in line with that already presented in Table 6.1, though the relative proportions are a little different. Thus direct fuel and power (fuel, oil, electricity and heating fuel) is the main item (39% of total energy cost) followed by feed at 22% and fertilisers at 18% of total energy cost.

TABLE 6.4 Expenditure on the Support Energy Content of Individual Inputs, 1978-79 (£/ha)

	Bought Feed	Fertilisers	Sprays	Machinery and Power						Other Expenses		Total Energy Cost	Energy Cost as a % of total Inputs	Net Return per £1 Energy Input, £
				Fuel & Oil	Electricity	Heating Fuel	Repairs & Depreciation	Contract & Mach.rental	Water	Vet, bought seed	Other Livestock Crop & General Farming Costs			
By Type of Business (full-time)														
Specialist Dairy	24.1	9.6	0.1	12.9	7.2	1.0	5.0	0.9	0.4	1.2	3.0	65.3	9.0	2.5
Mainly Dairy	9.7	7.8	0.1	10.4	4.0	0.4	3.8	0.6	0.3	1.3	1.8	40.1	8.7	2.5
Hill and Upland Cattle & Sheep	1.4	1.6	0.0	3.0	0.5	0.1	1.0	0.1	0.0	0.4	0.5	8.5	8.9	4.8
Lowland Cattle & Sheep	4.5	4.3	0.0	8.6	1.7	0.5	2.4	0.4	0.2	0.7	1.4	24.8	8.7	1.8
Lowand Cropping, Cattle & Sheep	5.8	6.7	0.2	10.4	2.5	0.4	3.3	0.6	0.2	1.3	1.6	33.0	8.5	2.3
Specialist Cereals	1.3	7.6	0.4	11.6	2.1	0.2	3.8	0.5	0.1	1.5	1.2	30.3	9.5	2.8
General Cropping	3.4	8.8	0.5	15.8	3.2	0.5	5.5	0.7	0.2	2.3	2.2	43.0	8.8	2.5
Pigs and Poultry	66.8	7.8	0.4	21.6	16.0	2.3	7.7	1.1	0.6	2.5	4.3	131.0	8.5	2.2
Horticulture	3.4	17.3	1.8	45.1	22.4	229.3	13.0	1.8	1.6	9.1	23.7	368.4	15.9	0.7
By Size of Business, E.S.U. (excl. Horticulture)														
4 - 7.9	6.5	2.7	0.1	10.8	3.6	0.7	2.5	0.5	0.2	0.5	2.3	30.4	9.7	2.2
8 - 15.9	9.2	4.6	0.1	8.5	3.0	1.1	3.1	0.5	0.2	0.9	1.6	32.6	9.4	2.7
16 - 23.9	9.9	5.9	0.1	9.3	3.4	0.4	3.4	0.6	0.2	1.1	1.6	36.0	9.0	2.9
24 - 39.9	9.8	7.7	0.2	11.5	3.8	0.3	3.8	0.6	0.2	1.5	1.9	41.5	8.8	2.5
40 - 99.9	9.3	8.9	0.4	13.1	3.9	0.4	4.8	0.6	0.2	1.9	1.9	45.5	8.6	2.5
100 - 249.9	6.7	9.1	0.5	16.0	3.8	0.1	5.1	0.7	0.2	2.2	1.8	46.2	8.8	2.3
All Types (full-time)	8.9	7.1	0.3	11.7	3.6	0.5	4.0	0.6	0.2	1.5	1.8	40.1	8.9	2.5

Source: derived from Table 6.3 using data from Leach (1976)

To the extent that higher fuel prices might lead to a change in the enterprise pattern of British agriculture, so as to reduce total energy usage, Table 6.4 indicates a few possible directions of change. Firstly, if energy use were the sole criterion, horticulture (presumably only glasshouse horticulture) is at a marked disadvantage compared to other types. Secondly, again on the basis of energy criteria to the farm-gate alone, cattle and sheep systems are best confined to hill and upland as opposed to lowland where energy can be better used in other ways. Thirdly, with respect to size of business, we have already noted that while less energy is used per hectare on the smaller businesses, the return to energy use increases up to 16-23.9 E.S.U. before falling again.

With this background, an attempt is now made to show the extent of energy dependence on organic farms.

6.3.3 The use of energy on organic farms

It is commonly supposed that organic farms are less dependent on support energy than are conventional farms, and the purpose of this section is to present data to test this hypothesis. It has been remarked earlier that one of the outstanding features of organic farms is their diversity; for this reason information is presented here either on a farm-by-farm basis or in terms of distributions.

Table 6.5 shows the input of energy (in all forms) per ha for each organic (or semi-organic) farm for which the survey provided adequate data, with a standard for comparison derived from FMS results for the most similar category of farm in the same area. Energy input per ha is in all but one case lower on organic farms than standard (the exception is caused by very high costs for machinery and power spread over a fairly small acreage, with slurries and manures carted in frequently during the year). The extent of the difference in energy input is by no means negligible - in eight cases the organic farm uses less than half as much energy per hectare as standard, these farms generally being pasture, or having a very high proportion of pasture, and selling almost entirely animal products.

The second column for each farm-type shows that output per unit of land is likely to be lower with the less energy-intensive methods employed on organic farms. Thus there are only two of the fully organic farms for which detailed energy calculations could be made where output per hectare exceeds standard, and both these achieve their output with very substantial amounts of bought-in feed or slurry.

The third column suggests, although very tentatively, that organic farms are comparable with or even superior to conventional farms in terms of output per £ of energy used. This measure is a good indicator of effectiveness of energy used, though not necessarily of efficiency. In 17 cases (out of 28) the organic farm has a higher ratio than standard, in 10 cases it is lower and in one it

Table 6.5 Energy Inputs on Conventional and Organic Farms

	Organic Farms			Standard (Conventional) Farms			Year to which Data Relates
	Energy Input (£/ha)	Total Enterprise Output (£/ha)	Output per £ Energy used £	Energy Input (£/ha)	Total Enterprise Output (£/ha)	Output per £ Energy used £	
Pasture Farms (Beef &/or Sheep)	8.7	154	17.7	23.6	251	10.6	1978
	6.8	143	21.1	20.1	271	13.5	1977
	5.2	133	25.7	38.9	531	13.7	1978/9
Largely Pasture (Beef &/or Sheep)	9.0	156	17.3	11.8	222	18.8	1977
	25.6	294	11.5	26.2	281	10.7	1977/8
	9.8	138	14.0	13.1	203	15.4	1977
	21.4	278	13.0	22.3	333	14.9	1978/9
	22.0	173	7.9	25.3	333	13.1	1978/9
	8.7	147	16.9	21.6	319	14.8	1977
	9.1	208	22.9	27.0	358	13.2	1978
Pasture Farms with Dairy Enterprise	60.4	611	10.1	78.1	992	12.7	1979
	40.2	693	17.2	55.0	764	13.9	1977/8
	30.0	369	12.3	31.2	509	16.3	1976
Arable Rotation	27.0	286	10.6	58.4	531	9.1	1978/9
	39.0	393	10.1	43.7	461	10.6	1977/8
	70.2	547	7.8	42.1	566	13.4	1979/80
Ley-Arable Rotation							
Beef & Sheep output only	11.3	208	18.5	30.0	338	11.3	1978/9
Cereals, Beef &/or Sheep	18.1	299	16.5	28.1	325	11.6	1979/80
	17.4	227	13.0	33.3	330	9.9	1978/9
With Dairy Enterprise (selling livestock products only)	44.6	824	18.5	77.6	957	12.3	1977/8
	37.7	695	18.4	83.2	969	11.7	1979/80
	36.2	330	9.1	56.3	655	11.6	1977/8
Dairy & Arable sales	30.8	427	13.8	70.5	915	13.0	1978/9
	51.7	513	9.9	70.3	773	11.0	1978/9
	47.2	589	12.5	62.6	632	10.1	1978/9
	74.8	1174	15.7	79.5	939	11.8	1978/9
Cereals, Beef & Sheep (semi-organic)	26.9	361	13.4	32.2	357	11.1	1979
With Dairy Enterprise (selling L'stock products only, semi-org.)	42.3	515	12.2	67.5	826	12.2	1978/9
Small-holdings	200.0	1149	5.7	-	-	-	1978/9
	263.5	1664	6.3	-	-	-	1979
	88.7	729	8.2	-	-	-	1979/80

is the same. The only group of farms with a regular pattern was the All Pasture ones where the organic farms consistently performed better - indeed almost twice as well - as standard. On other farm-types, the picture was much more mixed with a very few examples in which the organic farms were substantially worse than standard and a number in which they were substantially better. The two substantially worse farms were both regularly carting manure over four or more miles onto the farm throughout the year, but so were some other farms which did not compare unfavourably. If a general conclusion is possible it is that organic farms are, on average, no worse in terms of output per £ of energy and may be somewhat better.

An alternative way of looking at the figures is presented in Figure 6.1 where enterprise output (£/ha) is plotted against energy input (£/ha) for each farm and its conventional counterpart. The chart is not a return to variable factor relationship since the other factors are not being held constant. Rather, if other factors increase roughly in proportion to energy usage, it can be conceived of as showing returns to scale over the range covered by the data. Although one might expect to observe a meaningful relationship only if different farm systems are analysed separately (Organic v Conventional, Pasture v Arable etc), it turns out that a very strong relationship is observed across all farm types. Striking features are, first that there is a strong tendency (but not a rule) for arable and dairy farms to use more energy, secondly that conventional farms have a smaller deviation round the line (not shown) than organic farms, and thirdly that organic farms use less energy/ha. These aspects are overshadowed, however, by the strong positive correlation between Enterprise Output and Energy Input on both types of farm, with the implication that a reduction of £10/ha in the use of energy (and consequential changes in other inputs) is associated with a drop in output of about £130/ha.

One might conclude from the evidence so far: (i) that if the objective of agricultural policy were to maximise output without regard to support energy costs then not surprisingly, energy intensive methods could be encouraged (noting that some organic as well as conventional farms are energy-intensive); (ii) if the objective were to minimise energy usage with reductions in food output acceptable, then organic farms generally use substantially less energy per ha; (iii) in terms of efficiency of energy use (measured by output per £ energy) organic farms and conventional farms are roughly on a par with a tendency if anything for organic farms to perform better.

The figures that have been presented raise almost as many questions as they answer, in particular which are the practices of organic farms that cause them to use less energy than conventional farms? Table 6.6 presents a distribution of energy-usage on the two types of farm; for this purpose, all enterprise types have been taken together since a separate analysis by enterprise type revealed no consistent pattern. Despite a few marked exceptions, there is a striking tendency for organic farms to use less energy in terms of all the main inputs though, as would be expected, the difference

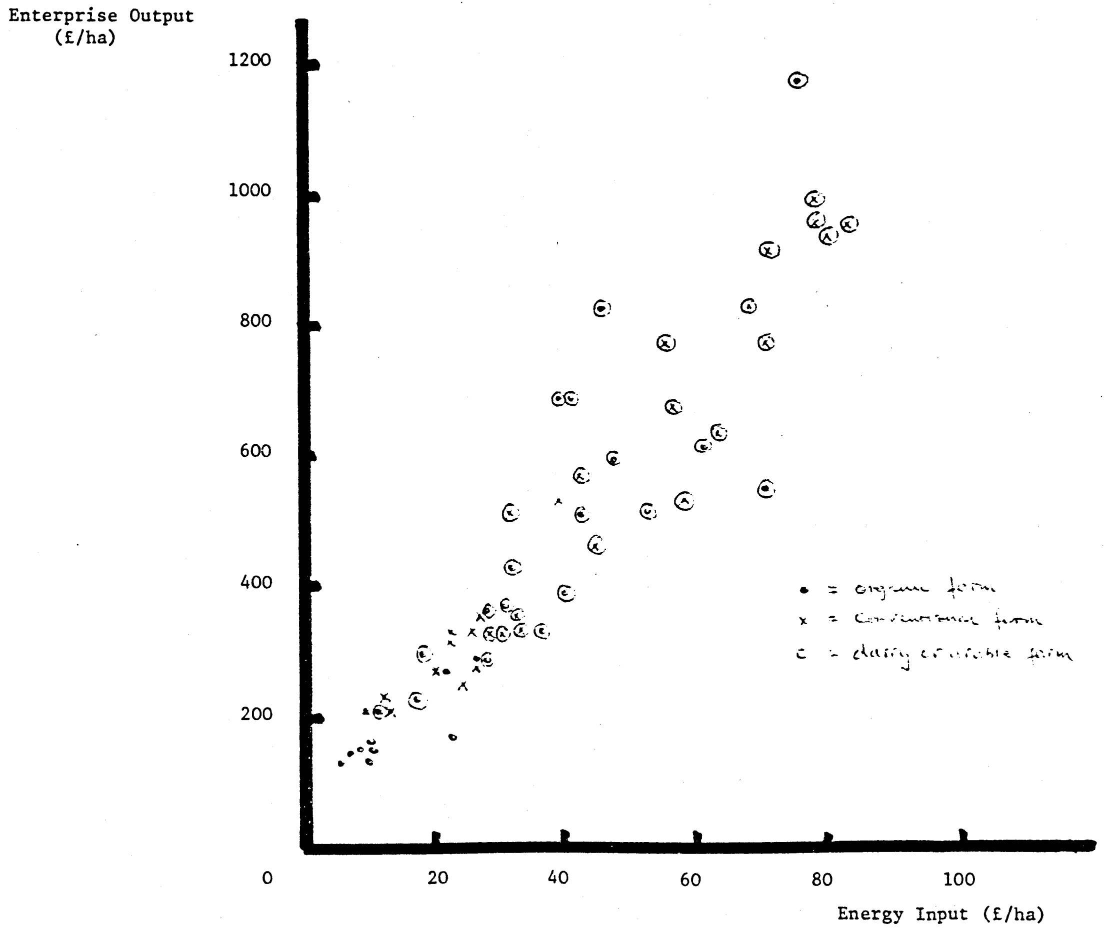


Figure 6.1 <u>Energy Input and Enterprise Output on Organic and Conventional Farms</u>

Table 6.6 Energy Usage per Hectare: Organic Farming Relative to Standard*

(number of farms in each group)

Organic Farms as percentage difference from standard	Feed	Fertilisers	Total Feed and Fertilisers	Machinery			Total Energy
				Fuel	Repairs and Ironmongery	Depreciation	
-100 to -76	8	19	8	2	4	3	1
-75 - -51	8	5	11	5	3	7	8
-50 - -26	6	4	5	8	6	6	7
-25 - -1	4	-	3	4	5	4	11
0 to 24	2	2	2	4	1	2	-
25 - 49	1	-	1	-	1	2	-
50 - 74	-	1	-	-	4	1	1
75 - 99	-	-	-	-	1	-	-
100 - 124	1	-	-	-	1	-	-
>124	1	-	1	1	2	-	-
Total	31	31	31	24	28	25	28

*100 x (Organic Energy Usage - Standard Energy Usage)/Standard Energy Usage

N.B. Totals in each column vary according to the availability of data.

is strongest in the case of fertilisers. Exceptions are generally explicable in terms of particular features of individual farming systems (for instance those organic farms with a very high input of bought feeding-stuffs were usually ones with a very low usage of any sort of fertilisers including those acceptable to organic farmers). It may seem remarkable that organic farms tend to use less energy under all headings - one might, for instance, have expected direct usage of fuel and power to be higher. The lower energy usage seems to have several corollaries: the generally lower level of output per hectare has already been noted, and so has the tendency for NFI to be lower; in some (though not all) cases, organic farms have a higher input of labour so it appears that manual labour may sometimes be a substitute for support energy to some extent. In practice this extra labour (where it occurs) is being used to handle and acquire alternative sources of nutrients, to run more diverse enterprise mixes, and probably in some cases is a diseconomy of a small scale unit compared to the standard with which it is being compared.

It was shown in the last section that energy accounted for about 9% of the input costs of an average conventional farm with remarkably little variation by farm-type and size apart from horticulture. Table 6.7 presents comparable information for 28 organic farms and for the standards that were used for comparison It is noticeable that, though there is again much more diversity between organic farms, they are typically less energy-dependent than conventional farms: for the modal organic farm, energy dependence is 8-8.9% compared with 10-10.9% for conventional farms. Organic farms are thus marginally better placed to face energy price increases than are conventional farms in the sense that a rise in energy prices has a smaller effect on their total input costs. However, as has been noted elsewhere, incomes are often low on organic farms and so it is also relevant to examine how a change in energy prices would affect these. Table 6.8, showing Net Farm Income per £ of energy suggests that the very best organic farms can perform well but these are exceptions. As usual, variations in management efficiency obscure variations associated with the system.

This analysis does not lead to a clear case 'for' or 'against' organic farms in terms of energy usage. There is a great deal of variation, much of it probably associated with differences in managerial efficiency. Despite this, it is clear that organic farms as a group have a strong tendency to use less energy per hectare than their conventional counterparts and, as would be expected, they have a lower level of output in consequence. In terms of output per unit of energy, there is no clear difference between the two groups. The fact that energy content forms a smaller proportion of total inputs on organic farms than on conventional ones suggests on the surface that they are better placed to face a future of rising energy prices and that conventional farms may be forced to adopt some of their methods. But the lower NFI that many of them earn and its sensitivity to energy price rises, must suggest caution in drawing such a conclusion.

Table 6.7 Energy as Percentage of Total Input Cost
Organic and Conventional Farms: Frequency Distribution

Energy as % of Total Input Cost	Number of Organic Farms	Number of Conventional Farms
0 - 4.9	1	-
5 - 5.9	1	-
6 - 6.9	2	-
7 - 7.9	3	-
8 - 8.9	7	3
9 - 9.9	6	8
10 - 10.9	2	10
11 - 11.9	4	4
12 - 12.9	-	3
13 - 13.9	2	-
	28	28

Table 6.8 NFI per £ of Energy Used: Frequency Distribution

NFI (£ per £ energy)	Number of Organic Farms	Number of Conventional Farms
<0	3	-
0 - 0.9	6	2
1 - 1.9	3	10
2 - 2.9	4	4
3 - 3.9	3	6
4 - 4.9	3	4
5 - 5.9	4	-
6 - 6.9	-	1
7 - 7.9	-	-
8 - 8.9	-	-
9 - 9.9	1	1
10 - 10.9	-	-
11 - 11.9	1	-
	28	28

There is a final and important difference that should be noted here. Conventional farms perform as well as they do partly because they benefit from a heavy volume of officially sponsored research and advice. There has been less corresponding official input into methods favoured by organic farms and this almost certainly is a part-explanation of the diversity of their results which depend unusually heavily on the experience and knowledge of the individual farmers. The comparison between organic and conventional farms is in a way biased in favour of the conventional systems. It can at least be argued that if some organic farms can achieve reasonable incomes despite their lower usage of energy, more could do the same if official support for optimising management practices were available to them. Most of the best performers import nutrients in some form (manures, high feed, semi-organic fertilisers, or low to moderate rates of conventional fertilisers) and the most effective placement of these inputs, for instance, into the system as a whole could be a step towards reducing support energy dependence.

6.3.4 Fuel prices and their effect on agriculture

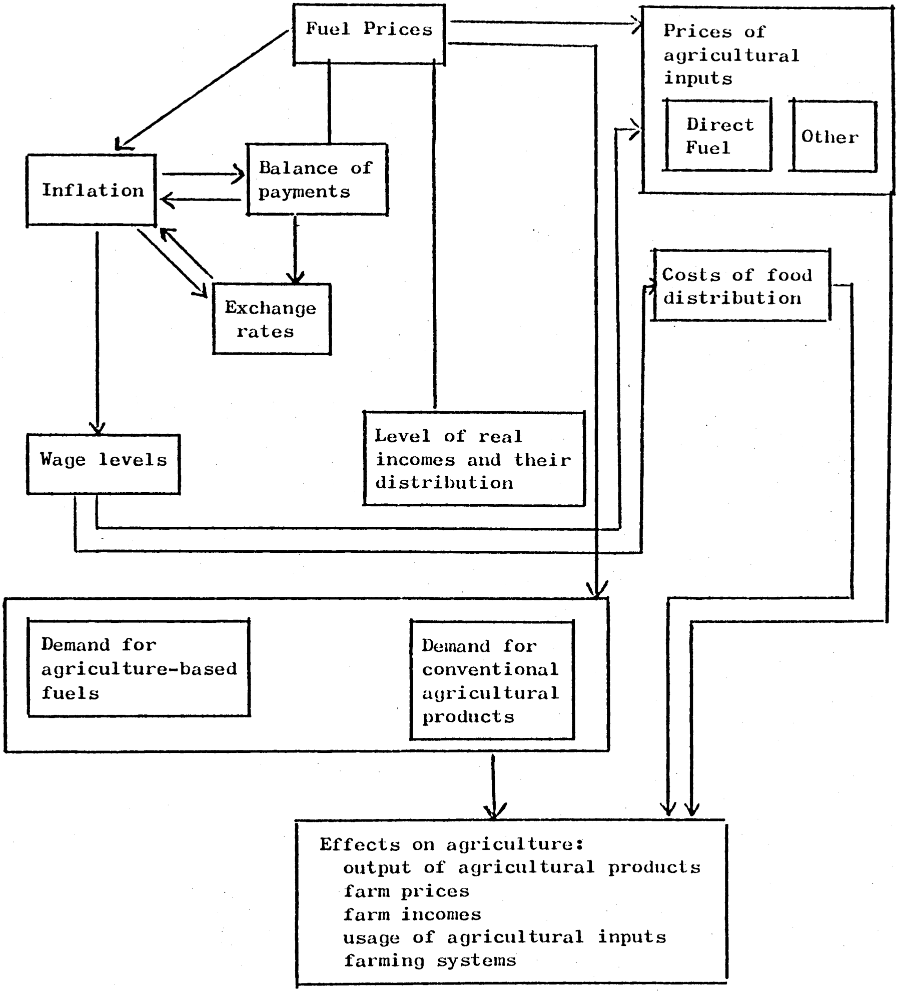
Pearce (1981) has recently brought together the results of the main studies which have tried to forecast fuel prices. While recognising the enormous uncertainty involved - uncertainty made manifest by the very wide range of the forecasts he quotes - he concludes with some confidence that "the real price of oil will rise systematically throughout the remaining two decades" of this century. The formal models yield estimates (in percentage real price change per year for OPEC oil) ranging from -4.0% to +10.4%; his conclusion, based on judgement rather than formal modelling is that a real price rise of around 3% per year is not unlikely. Over the 20 years to the end of the century, a doubling of fuel prices (the arbitrary assumption made in section 6.3.2) corresponds to an annual rise of about 3.5% - roughly in line with Pearce's judgement.

How is agriculture likely to respond to such a change? The problem is simplified to the extent that agriculture is a small enough user of fuel to mean that fuel price changes can reasonably be treated as exogenous rather than endogenous, but this is the only source of simplicity. Some of the many ways in which a change in fuel prices would affect agriculture are indicated in Figure 6.2. Even this is a simplification in many ways. It treats fuel as a homogeneous commodity while in practice different fuel prices do not necessarily move together, and the effects on agriculture will clearly be different depending on whether gas or oil prices rise more. Furthermore it does not indicate the different implications for different farm products.

Possible directions of change indicated by this chart and which seem intuitively plausible are:

- a change in the commodity structure so that agriculture itself becomes a source of fuel: this seems unlikely in Britain though

Figure 6.2 Fuel Prices and Agriculture



it may occur elsewhere.

- a change in the commodity structure of agriculture towards enterprises with lower dependence on energy: Tables 6.4 and 6.5 have shown that energy usage per hectare varies very substantially by farm-type but neither the value of output per unit of energy nor energy as a percentage of total inputs varies as much as might be expected.

- a change in production methods in favour of less energy-intensive techniques: Section 6.3.3 has shown that organic farming is less energy-intensive per hectare in general than conventional farming, but is perhaps only on a par per unit of output; furthermore, incomes are generally low on organic farms.

In order to confirm and quantify such changes, it is necessary to have detailed econometric studies of the various relationships involved. Some of these have been undertaken on a piecemeal basis (e.g. Lingard, 1971; Stoeckal, 1980).

An unsophisticated examination of trends over the past 25 years suggests that both agricultural product prices and the price of fertilisers tend to have risen roughly in line with fuel prices - indeed the ratio of barley to fertiliser price has actually moved in the farmers' favour (Peake, 1980). But so many other changes have occured over the same period that it would be wrong to draw firm conclusions from such simple correlations. The only attempt we have found to examine in a formal way the effect of fuel prices on agriculture is Parsons et al. (1978) using input-output analysis to predict the effect on production costs of different products: glasshouse production is found to be most severely affected, followed by cereals and cereal-based enterprises such as pigs. Different farm systems were not examined. A possible approach would be the construction of normative farm models (e.g. linear programming models) to show how organic and conventional farms might respond to different constellations of price though as far as we know this has not been attempted.

6.4 Other Changes that may Affect the Competitiveness of Organic Farms

This chapter has focused on energy prices as a possible cause of change in competitiveness of organic farming, but there are other possible changes too and these will be considered more briefly.

Labour

Dealing first with inputs, labour has been shed by agriculture in large quantities over a long period and the shedding has been in part associated with the increase in energy-usage. In a time of high unemployment, it can be argued that a reduction or a reversal of this trend might be desirable, and that a reduction in the rate of growth of real earnings might bring about such a result.

A priori it would appear that Organic Farming requires more labour than conventional farming in order to deal with weeds mechanically or manually, and in order to handle wastes additional to those used by conventional farmers, or in a more efficient manner. Thus it is commonly said to be more labour-intensive. Our evidence on this will be presented in Chapter 7; briefly there is a little support for the view that arable organic farmers use more labour than their conventional counterparts, but that on pasture farms the position is reversed.

It is possible that, with an increase in demand, machinery could be developed to replace the labour tasks on organic farms, just as it has been for conventional practices. At present what is restricting the use of labour on organic farms is not an absence of work to be done but the fact that additional work does not generate sufficient, or any, additional income to pay for it (an argument equally applicable to conventional farmers). It seems unlikely that either type of farming can increase labour usage unless relative labour costs fall. Even if they did, Blaxter (1978) has estimated that "if we wish to maintain production using half our present inputs of support energy, manpower would have to be increased 15-fold". The implication is that labour costs would have to fall very substantially relative to machinery and power before any significant substitution would occur.

This whole discussion thus suggests that Organic Farming is unlikely to offer more opportunities for paid employment than conventional farming, even if real labour costs were to fall.

The labour of the farmer himself constitutes a special case in this context, since organic farmers, influenced by non-economic objectives, are for the most part willing to work for less than the conventional rate. Any substantial change in the number of farmers with such objectives would constitute a change in the cost of farming, but we have no evidence on this.

Increasing skill in the management of organic farms (through experience, advice and improved relevant technology) might well be expected to improve the competitiveness of organic farms, provided perhaps they also had some outside supply of nutrients. Both our results and those of the USDA (1980) survey suggest that currently successful organic farms are under highly skilled management.

Crop Nutrient Inputs

An adequate supply of available nitrogen at critical times of the growing season is a matter of particular difficulty to some organic farmers. The nitrogen problem is less important on well-managed grass-clover pastureland with facilities allowing for lenient early spring grazing. Organic farmers seem to be able to maintain a good proportion of clover in their swards. Nevertheless, on the farm as a whole, the grassland and arable yields necessary to cover the fixed costs of the farm do highlight a problem with nitrogen availability in the spring, under present conditions of competition with more conventional farms.

On the organic farm leguminous crops, ploughed-in long-term leys or green manures, and animal excreta contribute to nitrogen availability. Apart from slurry, however, these internal sources tend to be slow-release and low in quantity compared to the potential uptake of current varieties. In consequence a few farmers are prepared to use semi-organic or non-organic fertilisers for early bite, conservation crops, and spring cereal dressings.

On the whole, the more successful organic farmers in the survey were bringing substantial quantities of nutrients (crop nutrients and/or animal feedingstuffs) on to their farms. The availability of acceptable external nutrient input to an organic farm depends on:

a) Availability of manures and other by-products of agriculture and agricultural processors in the locality.

b) Accessibility to non-toxic sewage sludge, bearing in mind transport costs: it seems that in principle there is room for increased usage of this material near to its source of production, but whether it is taken up may depend more on technical developments than on economic incentives alone.

c) Organic farmers are dependent, like conventional farmers, on external supplies of phosphate and potash (except when they are buying in a large amount of animal feeding-stuffs). Doubts have from time to time been expressed about the supply of phosphates since the UK is dependent on supplies from abroad for which there is increased competition. Potash is mined in this country.

Some of the farmers met were finding difficulty in obtaining sufficient supplies of organic manures locally. Such farmers would have to seek other forms of nutrients - either more expensive ones over a greater distance, or perhaps compromise on what they found acceptable. As we have seen, 20 out of 35 farmers brought in manure, slurry or sewage from outside the farm. Seven of these said the availability of such material was essential to their farming and on a further six it appeared that this was likely to be the case.

We have not attempted to quantify the sources of crop nutrients available to the organic farmer from off the farm. The discussion on wastes in the report of the Royal Commission on Environmental Pollution (HMSO, 1979) can be referred to as an initial source of information.

Sprays

Organic farmers try to avoid the use of conventional formulations as much as possible. For weed control, however, it seems possible that herbicides combined with rotational farming could become increasingly more competitive than organic methods as fuel prices increase.

In respect of diseases and pests, on the other hand, the organic farmers met do seem to suffer very little from them, and their practices may repay further attention from this point of view. According to the Royal Commission on Environmental Pollution (HMSO 1979) "resistance to insecticides and fungicides is a matter of serious concern; strategies should be developed to delay the onset of resistance". MAFF in a paper prepared for the report, do not however expect pesticide resistance to become a major constraint on production.

Soil Management

Organic farmers sometimes cite deteriorating soil structure, as exemplified in the extreme by wind blows in the United States and in parts of East Anglia, as evidence of long-term damage caused by conventional farming methods. They also point to the very pale green strips of growth on conventional farms where the fertiliser spreader has missed. Such obviously deficient growth they interpret as showing that the fertility of the soil has now become dependent on the application of crop nutrients to a degree which their own unfertilised land has not.

In 1970 the Agricultural Advisory Council was asked to consider whether modern farming practice was having an adverse effect on the structure and fertility of the soil in this country. Their conclusions were, among others, that:

- soil structure was suffering "on unstable soils ... the influence of organic matter is all important. It is by no means obvious to those not scientifically trained what is or is not an unstable soil but it is essential when considering the importance of organic matter that this knowledge should be acquired by farmers. Some soils are now suffering from dangerously low levels and cannot be expected to sustain the farming systems which have been imposed on them. A whole range of soils is suffering too from the effects of the passage of heavy machinery over them in unsuitable conditions. This is often due to the adoption of tight cropping sequences on difficult land on areas of medium or high rainfall, especially in the absence of leys".

- Soil structure problems are accentuated where drainage is inadequate. "There is much draining and redraining, together with ditch maintenance, to be done all over the country and there can be no doubt that the use of heavy machinery has made this all the more necessary".

- "as far as the nutrient fertility of our soils is concerned, we have few misgivings. There is no evidence to show that the disappearance of livestock from certain areas and the replacement of ley-farming and farmyard manure by chemical fertilisers has led to any loss in inherent fertility. Nor is there any evidence that organic matter is an intrinsically better source of nutrients. However, we are somewhat concerned

> about the decline in the use of lime in some parts of the country and the lack of knowledge of the distribution of trace elements where intensive systems are practised. Thus, there is no great fertility problem resulting from modern farming methods."

Since that report was written a) energy prices have escalated and b) more farmers have become concerned with maintaining the structure of their soils and conserving its organic matter content*. Thus there is much interest by conventional farmers in minimum cultivation techniques i.e. the use of herbicides to clear the surface, combined with shallow cultivations to prepare a seedbed. Similarly, it has always been one of the tenets of Organic Farming to avoid inverting the soil (though by no means always possible in Britain) - hence their preference for chisel rather than mold-board ploughs - and they are well aware of the increased rates of organic matter oxidation as a result of cultivation. However, they would seriously question the long-term effects of regular herbicide usage for minimising cultivations. Their concern is with possible effects on soil flora and fauna, such as the all-important (to them) earthworm on whose activities they probably rely quite heavily. It is worth noting in this respect that one of the chemicals marketed as a systemic fungicide was first marketed as a wormicide for grass turf (Stewart and Salih, 1981).

It is therefore pertinent to quote one further conclusion of the Agricultural Advisory Council (HMSO, 1970) which again points to the importance of rotation design (whether conventional or organic):

- "weeds associated with continuous cereal growing have been causing some anxiety. They are relevant because they are competitive and thus may be said to affect fertility. Control of broad-leaved weeds presents few problems, but there has been an alarming spread of grass weeds, the most serious of which is now wild oats; combined husbandry and herbicide methods of mastering couch have been developed on some soils but these methods are not reliable on others and moreover are very expensive. In short, unlike broad-leaved weeds, grass weeds cannot be completely controlled by chemical methods; they need the farmer's skill and knowledge of the land; there is no alternative at present but to control them by avoiding unwise cropping sequences and by precise husbandry methods."

Organic farmers and conventional farmers being both concerned about soil structure and soil organic matter conservation, Organic Farming may therefore come to benefit from increased technical interest in shallow cultivations, straw recycling and design of rotations.

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* a number of conventional farmers were met, in the east and the north-east of the country, who belonged to the organic organisations for this reason.

Price of Organically-Grown Produce

On the output side, the most obvious change that could cause an expansion of Organic Farming would be a rise in the price of organically-grown produce. A premium is available for cereals and beans, but so far rarely for livestock or dairy products. We have not attempted to examine consumer attitudes to organic produce and, though it certainly does not seem impossible that a "spray-scare" or some similar effect could cause a shift in demand, we are not aware of any current evidence that demand is likely to change in favour of organically-grown produce.

General Level of Availability and Prices of Agricultural Produce

The general level of availability and price of agricultural produce is also relevant: those impressed by world food shortages are likely to see the advantage of conventional methods, but a continuing period of European food surpluses lends some strength to the case for less intensive methods.

CHAPTER 7

Summary and Recommendations

7.1 Summary

The purpose of this report has been to examine the farming systems of Organic Farmers to assess what role such systems, or modifications of them, might have in Britain in the future. By modifications we mean systems that emphasise the recycling of organic wastes, the biological fixation of nitrogen, and biological control, but which use supplementary quantities of artificially derived materials as well. The subject has assumed particular significance in recent years because the prospect of continually rising fuel prices seems to some to place in jeopardy those conventional systems which depend heavily on fuel-intensive inputs.

The first impression derived from a detailed survey of some organic and semi-organic farms in Britain was the variability of the practices adopted by these farmers. We found the phrase "Organic Farming" difficult to define and even when different farmers had the same objectives the diversity of farm system was considerable. This variety of practice meant that the danger of generalising from a sample of the size available to us was greater than we had expected when the project was planned. The generalisations we have made are based as much on the intuition and feel of the investigator as on formal statistical methodology. In the introductory part of the report (Chapters 1-3) we have outlined our methodology, explained the problems of defining Organic Farming and put forward the objectives of organic farmers.

In Chapter 4 we have described in considerable detail the systems used by organic farmers (case studies of individual farms are in the Appendix). System design is one of the most significant inputs to an organic farm in determining its success. In particular:

(a) the sequence of events

(b) the balance between crops and stock, or crops, green manures and legumes

(c) the provision of adequate machinery and equipment (including buildings) (i) to enable jobs to be done at the right time (timeliness of operations is critical in a system without recourse to herbicides and fertilisers); (ii) to recycle wastes efficiently; (iii) to relieve the grassland in winter and early spring.

On all but permanent pasture, rotations provide the framework for the management of soil fertility, for weed control, and for minimising pests and diseases. In Britain the rotation tends to be 3-4 years of grass followed by 2-3 years of arable, but this ranges in either direction depending on the climate of the region.

Soil fertility is built and maintained by the use of grass/clover medium-term leys to build up soil organic matter and structure; by careful recycling of all organic waste; by the dunging of animals; and by import of nutrients - substantial on those farms with high output. Organic farms are not necessarily low-input.

Weed control presents little difficulty on pasture land, but on cultivated land weeds were quite often cited as a major problem. The design of the rotation is very important in enabling their physical control but, even so, about half the farmers find they have to make use of herbicides occasionally.

Crop pests and diseases seem to present little problem and, on the whole, organic farmers also reported little occurence of infertility problems, stress diseases and mineral deficiencies in their livestock (minerals were almost always supplemented in some form anyway).

In Chapter 5 we have examined Organic Farming as a business, i,e., we have asked the question "insofar as the objective of farmers is to make money, how well does organic farming do compared with conventional systems and how far is it possible to identify the reasons for differences in terms of ordinary farm account analysis?"

Chapter 5 serves two purposes within the report. On the one hand, though we recognise that organic farmers (to a much greater extent even than conventional farmers) are not motivated exclusively by profit, few of them can be indifferent to at least a minimal pecuniary return: we hope that individual organic farmers (particularly new and potential organic farmers) will benefit from being able to compare their results with those of other farmers with similar systems. Indeed this chapter can be seen as a first attempt to provide organic farmers with the necessary data to permit comparative analysis of their records - a facility which is a major part of the farm management advisory service available to conventional farmers.

The second purpose of Chapter 5 was to provide a background from which we could form some impression of the possible growth of Organic Farming: we were concerned with the question "how do organic farmers' returns compare with those of conventional farmers?" because, whatever the non-pecuniary benefits of organic farming, we do not think it (or low-input farming) will gain a more substantial hold in Britain unless it can offer financial returns reasonably comparable with conventional farming. We found that, at current prices of conventional farm produce, the majority of organic farms had lower financial returns (however defined) than they might have expected if they had used conventional systems. We then sought the reasons behind the current financial returns.

On the variable cost side, cost per unit of output was generally lower than on conventional farms: there was a saving on fertilisers and sprays (except where semi-organic fertilisers were substituted instead) but very often animal feeding-stuffs still formed a substantial cost item just as on conventional farms. On the fixed cost side there seemed to be less or no scope for reduction in costs as a direct result of Organic Farming except that, as we were surprised to note, machinery and power costs tended to be a little lower. General thrift also clearly played a part in reducing costs so not all savings can be attributed to the system alone.

In total, costs were almost always lower but so, in many cases, were yields. The small reduction in fixed costs, added to the sometimes substantial reduction in variable costs, was not generally enough to offset the lower yields obtained, with the result that net financial returns suffered. There were exceptions. It would seem that there are two contrasting situations in which NFI is comparable to conventional. In the first, nutrient inputs are made high enough (even though this may involve additional expenditure) to support an output which will cover the more fixed of the fixed costs, as well as the variable costs incurred. In the second situation, in contrast, fixed costs are substantially reduced for the individual farmer (e.g. through long uncosted working hours, old but adequate machinery, or foregone investment income from the land). As a result, output and nutrient input could be lower and yet still cover the fixed and variable costs adequately. Such reductions in fixed costs are,of course, not attributable to organic savings.

Although the majority of organic farmers had lower financial returns, it should be noted: firstly, that the variety of systems and levels of management were such that <u>some</u> organic farmers outperformed the conventional average; secondly, that in the case of some arable products, premiums for organic produce are available and can shift the organic farm from a position of poor returns (compared with conventional) to one of good returns; and, thirdly, that, the competitive position of organic farming could change if output prices changed relative to certain input costs.

Chapter 6 examines the plausibility of this hypothesis with particular reference to the possibility of price rises for the fuel-intensive inputs on which conventional farming depends. The claim that organic farms use less direct and indirect support energy per hectare than their conventional counterparts is examined and, with the usual comment about diversity, is found to be true in the vast majority of cases: the difference is most marked in terms of feed and fertilisers, but exists also for other, less expected, inputs such as direct fuel, repairs and ironmongery and depreciation. To put what is almost the same point differently, organic farms are slightly less vulnerable to fuel price rises in the sense that energy constitutes, in most cases, a smaller percentage of their total input.

These measures are partial and do not establish that organic farms would strengthen their competitive position if fuel prices rose. The problems about drawing such a conclusion arise at two levels. First, the consequences for agriculture of fuel price rises are very complex and can only be examined by formal model building which was beyond the scope of this report. Secondly, and more directly, the consequence of the lower usage of energy per hectare on organic farms is that, in consequence, they usually have a lower level of output per hectare. A comparison of output per £ of energy used suggests (with the usual diversity) that organic farms perform at least as well as conventional farms. The best single guide to competitiveness, however, is perhaps NFI per £ of energy used for this is likely to be a good indicator of the extent to which rising energy prices will diminish farmers' incomes. The position here is unclear: the best organic farmers in this respect outperform their conventional counterparts, the worst ones compare badly and the average (however defined) is not markedly different. More clearcut results might be obtained by simulating the responses of model farm systems to different price sets.

The most plausible conclusion from the analysis presented here is this: that the majority of organic farms at present have lower incomes than their conventional counterparts; that organic farms do not emerge as being clearly superior to conventional farms in terms of their ability to maintain their incomes in the face of rising fuel prices; that the variability in their performance (greater than that of conventional farms) lends some support to the view that their relative position could be made stronger if advisory facilities were available specifically geared to their methods; and that any decision as to whether Organic Farming should be specifically encouraged must depend on national considerations which we have not so far discussed. These include: the relative importance to be attached to maintaining agricultural output as against consuming fuel; long-term effects of different systems, effects which may not be apparent from our comparisons for a single year; and "externalities", i.e., benefits or costs which may be important for society as a whole but which are not reflected in the costs and prices of individual farmers.

These issues are outlined briefly in the following section.

7.2 Long-Term Effects and "Externalities"

7.2.1 Food output implications

Cereal yields on organic farms averaged around 90% of those on comparable conventional farms while stocking rates were about 80% and livestock output per adjusted forage acre was even lower - around 70%. (In the case of cereals, the organic premia meant that the relative value of output was often higher than the relative yield.) As usual, diversity on organic farms can be taken as an indicator of possible scope for improvement, (though diversity also exists on conventional farms and has tended to be masked in the averages we have used). Our averages for organic farms are derived from both low and high-input types, the low-input farms having yields closer to 60% of standard. Total Net

Output figures also show the same range and rough correspondence to external nutrient input; they suggest that Net Output was of the order of 40 to 65% for low-nutrient-input farms and greater than this for higher-nutrient-input. Any significant extension of organic production would seem to imply an increasing proportion of lower-yielding farms because of limited availability of off-farm sources of organic nutrients.

Given such estimates, what would be the national implications of any substantial expansion of Organic Farming, i.e., how much would it matter if we produced less food? Several lines of argument are possible. First, it could be said that the existence of European food surpluses implies that food is over-priced; secondly, and in contrast, world food shortages can be held to imply that output should be increased (though of course problems of distribution are equally important here); thirdly, any judgement should take account of the distortions in international food markets, particularly within the EEC; fourthly the political and strategic importance of food self-sufficiency needs to be considered.

We do not attempt to express a view on these complex matters, but simply draw attention to the fact that the comparisons we have made between organic and conventional farms have been based on prices actually received; if the value of food to society is held, for the reasons we have just listed, to be different from these prices, then our results could easily be reworked.

A further complication is that any change towards Organic Farming would affect not just the total level of output but also its mix. Organic Farming generally requires a grass/ley break which in turn requires stock to use it. The adoption of Organic Farming in predominantly arable areas would reduce the quantity of corn available for animal and/or human consumption and would increase the quantity of animal production off grass.

7.2.2 Rural employment

One of the claims put forward by at least some advocates of low-input farming systems is that they use more labour than conventional systems. To the extent that it is considered desirable to maintain rural employment, this would imply that Organic Farming would benefit society in a way not reflected in the profit and loss calculations.

Our evidence does not support this claim. Table 7.1 shows how organic farms compared with the conventional standard ones in terms of total expenditure on labour per hectare (including imputed farmer and wife labour). It is likely that a physical measure (number of hours worked per ha,

Table 7.1 Total Labour Costs Per Hectare. Organic and Conventional Farms: Frequency Distribution

Organic Farms as % Difference from Standard	Number of Pasture Farms	Number of Rotational Farms	Total
-75 to -51	1	-	1
-50 to -26	4	5	9
-25 to - 1	4	3	7
0 to 24	2	5	7
25 to 49	1	1	2
50 to 74	1	2	3
⩾ 75	1	-	1
Total	14	16	30

particularly by the farmer himself) would have produced a different result from our value measure (£ per ha) but we did not attempt to obtain information on this.

Taking all 30 organic farms for which data were obtained, just over half used less labour per hectare, but an examination of the pasture and rotational farms separately indicated that it was the pasture farms in particular that were relatively low labour users. A possible explanation of this would be that organic pasture farms, being less heavily stocked than the conventional farms, can get by with less labour; of those employing more labour, at least two did so as a deliberate policy. Amongst the rotational farms, our expectations had been that they would employ more labour because of their greater mix of enterprises and their greater need for activities such as weed-control and handling organic materials. In fact, eight did employ more, generally for such reasons, but eight employed less.

Altogether, differences are so small that the only possible conclusion is that there is no evidence to support the view that organic farms offer more jobs in practice than conventional ones. Both types of farm are perhaps restrained by economic consideration rather than shortage of work to be done.

7.2.3 Environmental effects of farming

Another argument for Organic Farming is that it has less deleterious effects on the environment than does Conventional Farming.

There are several strands to this argument. One strand is that Organic Farming encourages natural or automatic responses to pest problems and that it is less likely to be associated with disease. Although we have no formal "scientific" evidence to quote, we found many organic farmers whose experience, they said, gave strong confirmation of this argument and we have no reason to doubt their word. Strictly speaking, in economic terms, this is not an "externality" since it is reflected in the lower costs of organic farms (lower expenditure on pesticides or vet bills) and has therefore already been allowed for in the analysis of Chapter 4.

A second strand to the environmental case for Organic Farming is that Conventional Farming depends on pesticides whose effectiveness may only be short term because the pests concerned develop resistance. As long as new effective pesticides continue to become available at acceptable prices this is not a problem; if they do not, Organic Farming, not subject to such dependency, has an advantage. The Royal Commission on Environmental Pollution (HMSO 1979) examined this problem and says:

- "MAFF considered that to propose (certain) controls at present would be to overreact to the resistance problem .... the Ministry suggested that circumstances might arise in twenty years' time when controls of this kind might be needed .... We think this view is too sanguine."

- "Resistance to insecticides and fungicides is a matter of serious concern; strategies should be developed to delay the onset of resistance."

A third strand to the argument is the problem of pollution associated with conventional farming. The Royal Commission's view was that the influence of Organic Farming will remain negligible because "it will not become a large part of the agricultural scene". Nevertheless they recognise that "if there were a general change to organic farming ... many of the pollution hazards associated with conventional modern farming practices would be eliminated". These hazards are referred to as follows:

- "We do not doubt that the large increase that has occurred in the use of inorganic nitrogen fertiliser is, directly or indirectly, a major cause of the rising nitrate levels that are observed in many water supply sources .... We have reached the conclusion ... that the anxiety that has been engendered about those risks is not justified on the information at present available."

- "We are concerned ... about the scale of pesticide use. The official view ... is that ... the increasing quantities applied give no grounds for anxiety ... We take a different view. Pesticides are by design biologically active and hence hazardous chemicals ... there is the possibility of unforeseen and unforeseeable effects."

There is clear recognition here that, in this respect, Organic Farming does have advantages to society not associated with Conventional Farming. The important question, however, is not whether Organic Farming will remain small but rather whether it should be allowed to remain small, i.e., are its advantages sufficient to justify its encouragement? On this, the Royal Commission does not express a view.

Finally, there is the effect of farming on wildlife. Amongst the changes in farming practice that Mellanby (1981) refers to as supposedly affecting wildlife are: the increased frequency with which arable crops are taken from the same area of soil with the disappearance in some parts of England of the grass ley; the burning of wheat straw on the stubble; the adoption of minimum cultivation and direct drilling; and the use of pesticides and artificial fertilisers.

His assessments of the effects of these changes on wildlife are as follows. On the negative side, "the effect of continuous cultivation using only chemical fertilisers is to reduce the soil fauna and also the flora"; furthermore, reduced use of pesticides "can only be good for wildlife".

The disappearance of leys has been harmful since "the longer a ley persists ... the greater the resemblance to old grassland" with its wide variety of wildlife. But not all the effects are negative. The increasing use of minimum cultivation enables soil animals to flourish and the use of a herbicide in this connection, properly applied, "has little harmful effect on wildlife". Again, "careful straw-burning does not, directly, do much harm to wildlife".

Taken together, these extracts lend at least some support to the view that Organic Farming is likely to be beneficial to wildlife and, indeed, Mellanby concludes that if Organic Farming (and mixed farming generally) were to expand as a result of rising fuel prices the changes would "probably ... be beneficial to wildlife".

On all these environmental issues, there are clearly areas of uncertainty that our survey did not help to resolve. Even where the physical relationships are known, their evaluation relative to one another can only be subjective.

7.2.4 Long-term effects on the soil

Yet another benefit of Organic Farming which might not be apparent in the financial comparisons we have made is the supposed long-term benefit to soil structure and fertility. Stewart (1975, 1981) sees the rationale behind Organic Farming to a large extent in terms of encouraging deep, exploratory rooting systems and this, he argues, will take place in water-stable granular soils, i.e., soils in which soil particles are held together in such a way that pore sizes range from those large enough to allow sufficient air into the soil for root respiration, to those small enough to retain water even when the rest of the soil dries out.

Around 75% of the land area in Britain is covered by loam soils, soils which contain insufficient clay to structure themselves by cracking, yet too little sand to avoid the problem altogether. A granular structure does develop in such soils and this is variously attributed to the agency of plant roots, and to earthworms.

"However, this type of aggregate structure, though stable to the impact of raindrops, cannot be other than vulnerable to collapse, returning to a compact, totally micropore state, prone to water-logging, if abused physically by excessive cultivation, treading or wheel traffic. Furthermore, because much of the water stability depends on organic components liable to be inactivated by further decay, this necessary structure is only transient and requires to be continually re-created. These are the structually-sensitive soils characteristic of much of the land that today experiences a temperate climate with its inherent requirement for effective soil drainage."

Stewart argues that, whatever the relative emphasis on plant roots or earthworms as structural agents "the activities of burrowing earthworms are one of the essentials. Therefore, any form of soil management that neglects their welfare should be avoided. For example ... the regular application of highly concentrated, readily-soluble, ammonium and nitrate fertilisers ... the use of pesticides with uncontrolled, or unknown, side effects. Some widely used, systematic fungicides were first used as wormicides in turf..."

To test the economic advantage of a long-term improvement in soil structure and fertility, a study over time would be necessary and this was not possible for us. We can only report therefore on the views of the organic farmers we spoke to. It was widely accepted that the process of converting from conventional farming to organic is a difficult one both technically and in the sense that it takes time. Organic farmers often felt that during the first two or three years the returns (both physically and financially) were poor and that the system only showed its full benefits after two cycles of the organically-managed rotation. The claim could be made that the land, once converted, was more valuable: yields could be maintained under organic management, albeit at a lower level, with lower input costs. In principle, this benefit should be reflected, not only in a lower annual fertiliser bill but in a higher capital value to the land: (a) to the organic farmer since the conversion process (which takes time as mentioned above) no longer has to be gone through; (b) to the conventional farmer since presumably it would reduce his fertiliser bills at least for some (unknown) period of time. To this extent, Organic Farming would be more profitable than has appeared so far. In practice, land values are affected by many factors other than their agriculturally-productive value, and it is difficult to see how this benefit could be quantified.

7.2.5 Benefits to consumers

As in the case of environmental benefits, problems of evaluation arise in connection with the view that organically-grown food may be "better", either in the sense that it is more tasty or that it is more healthy. If we define "better" in terms of consumers' willingness to pay, then one piece of evidence is that at least some consumers are willing to pay and do pay more for organically-grown produce. For those who seek answers to the question of whether there is a "real" difference, we can only quote the USDA's generally sympathetic review of Organic Farming in the United States (USDA, 1980):

> "Several nutritionists and other research scientists have examined the evidence available on the comparative nutritional quality of foods from organic and conventional farms ... In each case, the authority involved has denied the validity of the claims for nutritional superiority made by others for organic foods ... Further research could conceivably uncover previously unsuspected evidence of superior content of beneficial nutrients."

On the issue of health safety as distinct from nutritional quality, they again say "no information uncovered in the preparation of this report conclusively proves that pesticide residues in foods have caused such health problems as cancer, miscarriages, birth deformities or nerve disorders".

In the present state of knowledge it does not seem possible to go beyond these cautious and inconclusive judgements.

7.3 Conclusions and Recommendations

Drawing on the arguments of 7.1 and 7.2 of this Chapter, we arrive at the following conclusions and recommendations:

7.3.1 Competitive position of organic farming

The majority of organic farmers at present have lower incomes than they could achieve by conventional farming. Whilst they are prepared to accept this because of their commitment to organic methods, it seems unlikely that Organic Farming will become very much more widespread unless its competitive position changes.

Rising fuel prices are the most likely cause of a change but our analysis does not suggest that the competitiveness of Organic Farming would necessarily be improved.

7.3.2 Benefits to society from organic farming

It could be claimed that Organic Farming offers several benefits not reflected through the price mechanism and that it ought therefore to be encouraged. There were three aspects of this argument that we felt deserve further consideration: (i) possible long-term benefits to the soil, to wildlife conservation, and to pest and disease control strategies; (ii) the extent to which low-to-moderate-input Conventional Mixed Farming could also provide the benefits associated with Organic Farming; (iii) the fact that price-support for farm produce is likely to encourage intensive (high-input) specialised systems with their concomitant disease and pest problems, use of fungicides and pesticides, and (possible) threat to human health, - rather than low-input multi-enterprise systems.

We found no evidence to support the view that Organic Farming provides more rural employment than conventional systems.

7.3.3 Advisory assistance to organic farmers

It may seem a tautology to say that a successful organic farm is one organised by a person who has anticipated all needs, interactions, repercussions and weaknesses. Nevertheless, in replying to the question "is Organic Farming viable?" the first response must be that it depends greatly on the farming flair of the individual farmer. Organic Farming needs to be done within the scale at which a particular farmer can farm well since, for economic success, the standard of management must be high.

Organic farmers feel, perhaps with some justification, that the conventional advisory services are not aware of nor interested in the particular constraints that such farmers have chosen to impose on themselves and that no body of data exists against which they can evaluate and improve themselves. We have tried, in Chapter 5, to meet some of the data deficiency but we recognise that much more could be done. Some organic farmers themselves would argue that their performance relative to conventional farms might be better if they had a comparable advisory service available to them. Although we have not been able to support all the arguments put forward by advocates of Organic Farming, we do think that the methods being developed offer something of possible value to conventional farmers. A strengthening of advisory services in this area could be a low-cost way of encouraging the private experimentation being undertaken by organic farmers.

7.3.4 Further research

There have been so many issues arising in this study where we have had to depend on superficial analysis or intuitive judgement that we are, above all, impressed with the inadequacy of information or methods of evaluation. We have identified the following areas for further research:

(i) Technical

(a) Farming Systems. The diversity of organic farm systems and the extent to which farmers have to rely on gradually accumulated experience suggests that a large scale study of systems and a formal attempt to identify a reasonably small number of efficient systems would be advantageous. Such a study should cover low and moderate input systems which are not entirely organic, ranging from "flexible organic" (e.g. organic farming but with herbicides) to traditional mixed farming.

(b) Substitution of Technologies

In considering alternatives to present agricultural technology, strategic aspects for the farmer need to be raised as Oelhaf (1978) has pointed out. Is it possible for change to be a matter of piecemeal substitution as conditions arise, or must an internally consistent system be adopted more or less as a whole, if the parts are to operate effectively? This may be particularly important in a system based on biological resources and feedback.

For example, organic farmers rely on earthworms and soil micro-organisms to render available plant nutrients from both organic matter and soil particles. There are repeated reports of a time-lag of three to four years after giving up artificial fertilisers before this becomes effective enough to produce adequate economic yields. Why is this, and how is the transition to be financed? As a second example, below what sort of rate of application does the use of readily-available nitrogen (in whatever form) cease to render plant tissues more susceptible to fungal or aphid attack, and hence tend to eliminate the need for the continued use of fungicides and insecticides? For a last example, over how big an area does biological and integrated pest control have to be practised if it is to be effective on each individual farm?

Clearly, questions such as these on the effects of introducing each particular organic practice separately into farm practice on a national scale are of interest in the formulation of government policy.

(c) Materials

(ci) Availability and costs of Alternative Sources of Crop Nutrients, e.g. sewage, surplus straw, seaweed harvesting, green manures. We think that the contribution these alternative sources could make on a regional or a national scale should be quantified and, where costs are prohibitive, technology or organisation developed to render them more financially worthwhile. In particular, the rising cost of fuel restricts the radius over which bulky low-value material can be transported. Possibilities of co-operation in the setting up of a distribution infrastructure as in Holland could be explored.

(cii) Methods of Fertiliser and Manure Application to increase the proportion of applied (and soil) nutrients actually taken up by the plant. Attention to the semi-organic manures with their fast and slow-release components may be of value in this regard.

(ciii) Variety Testing and Maintenance of Reservoirs of Genetic Diversity. The former would involve the extension of variety testing to organic regimes (i.e. not simply the "no fertiliser" treatment).

(civ) Deep-rooting grass/clover/herbal leys of the type advocated by Eliot (1943). Their productivity without the use of fertilisers was impressive and could merit further attention.

(cv) Soil Analysis Techniques. Organic farmers are just as anxious as conventional farmers to remedy any nutrient deficiencies in their soils. There is a suspicion/conviction among them that standard soil analysis procedures do not detect available supplies in their soils, because they are told on paper that they have such-and-such deficiencies which in practice they have not observed.

(cvi) The Biology of Agricultural Soils, in particular, the quantitative evaluation of the contribution of earthworms to structuring soils and to recycling soil nutrients; husbandry practices promoting or limiting their activity.

(ii) Economics of Organic Farming

There are two areas where we have been particularly aware of the need for more work on economic aspects:

(a) First the economics of organic farms over time requires study since our results are generally for one year only. Such a continuing study could: confirm or refute our conclusions; check the view that organic farms offer greater stability; examine the view that there is a continuing build up in soil fertility on organic farms; examine the problem for the organic farmer of how to finance transition costs.

(b) Second, we would like to see a study in which the effects of low input and conventional farming systems are simulated (e.g. using a programming model). Such a study would seek to identify the financial costs of being organic and, more important, could test the sensitivity of the systems to different price-sets.

APPENDIX A

Characteristics of the Farms Visited

This Appendix provides, in Table A.1, information on the sample of organic farms used in the survey, supplementing the account given in Chapter 2. It also provides, for each group of farms, an account of the variations found between farms within the group: in this respect, it provides a link between the examination of organic systems in Chapter 3 and the case studies of individual farms in Appendix B.

Table A.1 Characteristics of Farms in Survey

	Type of Farm							
	Pasture			Ley-Arable				Predominantly Arable
	Pasture-only Dairy	Pasture-only Livestock Rearing	Largely Pasture Livestock Rearing	Livestock Output only - No Dairy	Livestock Output only Including Dairy	Arable and Livestock Output - No Dairy	Arable and Livestock including Dairy	Rotational
Farms Contacted 82								
Number	14(1)	15	11	3	9(5)	11(4)	11	8
Organic Status	F B S	F B S	F B S	F B S	F B S	F B S	F B S	F B S
pre-1960	4 - -	6 - -	2 - -	- - -	2 - -	3 - -	3 - 1	2 - -
1960-69	3 - -	2 - -	1 - -	1 - -	1 - -	1(7) - -	2 - -	- - 1
1970-75	3 1 1	2 - 3	1 2 1	- 1 -	1(5) - -	1 2 2	- 1 -	2 1 -
1976-80	1 1 -	- 1 1	2 2 -	- 1 -	1 2 2	1 1 1(7)	2 2 -	1 - 1
Total	11 2 1	10 1 4	6 4 1	1 2 -	5(5) 2 2	6(7) 3 3	7 3 1	5 1 2
Location								
N	1	-	-	1	-	2	-	-
NW	-	1	-	-	-	-	-	-
NE	-	-	1	-	2	-	2	3
N Midlands	1	-	2	-	-	-	1	-
Central	1	2	-	-	-	1	1	1
Cotswolds and Chilterns	-	4	-	-	-	-	-	-
E	1	1	1	-	-	4	1	2
S	3	2	-	-	-	3	4	-
SW	5	2	4	1	3	1	1	1
W	1	1	-	-	2	-	1	1
Wales	1	2	3	1	2	-	-	-
Total	14	15	11	3	9	11	11	8
Size of Farms (ha)								
0-20	5	3	2	-	1	-	-	-
20-40	6	4	4	-	1	2	-	2-
40-80	2	7	3	-	2	5	4	3
80-120	-	-	1	2	3	1	4	3
120-200	1	1	1	-	2	1	1	-
200-300	-	-	-	1	-	1	1	-
300-400	-	-	-	-	-	1	-	-
400-500	-	-	-	-	-	-	1(3)	-
Total	14	15	11	3	9	11	11	8
Ownership								
Tenanted	4	1	2	-	1	4	1	2
Owned, no mortgage	3 }+4	10 }+4	3 }+3	1 }+1	5(6)	5 }+2	7(2)	5
Owned, mortgage heavy borrowing	3	-	3	1	3	-	3	1
Total	14	15	11	3	9	11	11	8
Farms Visited (70)	12(1)	12	11	3	6(5)	10	8	8
Farms for which details available on usage of nutrients and herbicides (see Table A.2)	6 ✓	6 ✓	11 ✓	3 ✓	6(5) ✓	10 ✓	8 ✓	8 ✓

Notes: F denotes fully organic
B denotes becoming organic
S denotes semi-organic

(1) Two farms have part of the farm organic
(2) Three of these farms are Trusts
(3) Consisting of three inter-linked farms
(4) Three farms have substantial part of the farm organic
(5) Plus two small-holders
(6) Including one Trust
(7) One farm changed status from organic to semi.

A.1 The Pasture Farms

A.1.1 Pasture-only dairy farms (e.g. Farms B.1.1.1 and B.1.1.2)

Twelve farmers were contacted who were or had been running dairy farms on an all-pasture organic system, plus two other people who were trying parts of their farms without fertilisers.

Most of the farms carried Channel Island breeds, three were Friesian, one Dexter, one Ayshire, and one milked about twenty goats as well.

Nutrient input in the form of animal concentrates was an important feature of these farms. Wholly-pasture farms carrying a dairy herd must have a high input of nutrients (animal feed or manures and fertilisers) from off the farm if they are to produce a large enough output from which to pay the high fixed costs of dairying.

One farm encountered was somewhat of an exception to this, the farmer being only partly dependent on the farm for a living and content with a simple system requiring little capital servicing or employed labour. He used about five cwt concentrates per cow, plus a further equivalent in brewers' grains, yielding 650 gallons per year. The low cost system provided a reasonable income per hectare nevertheless, after paying a normal rent.

Other farmers used more normal quantities of concentrates of between 20 and 40 cwt per cow. Further sources of nutrients commonly brought onto the farm were minerals or seaweed meal, lime, slag, and liberal quantities of straw for bedding. Two farms bought a certain amount of Humber or Palmer semi-organic manures, and so did a third farm which was becoming organic. Two out of eight grew root and fodder crops for winter or early spring use.

On the whole, people dairy-farming on an all-pasture system without the use of fertilisers either had particular circumstances enabling them to do so, or specific additional reasons for their choice of enterprise and organic system. Thus two farms processed and retailed their own milk, yoghurt and cream. One very unusual farm was based on a massive recycling of vegetable, straw and hay waste from surrounding businesses (Farm B.1.1.2). Another was a part-time farm run together with an additional occupation. Two were under organic tenancy clauses. Another was particularly involved in furthering a rare breed; one had become organic after suspecting spray damage to his livestock; and one (of the more productive farms) was run in accordance with spiritual convictions.

Of the two producer-retailers one was on very sandy soil which had not responded well to fertilisers in the past, although the change to Organic Farming was actually made for its own sake. This farm (40 ha) depended for its survival on a processing and local retail trade in a well-populated area. The other producer-retailer (13 ha) sold goat and cow milk products to a specialist market involving a lot of travelling and student pupil help.

Five farmers were met who were no longer or were not yet, organic dairy farming on an entirely pasture farm. One of them, Farm B.1.2.3, had been very successful under the system for years. The productivity of the farm had been built up with brought-in cereals, calcified seaweed for the grassland, and careful grassland management. The recent change from dairy to beef was only done to make the work-load easier.

Another of the five had also changed to beef and sheep, after problems with labour and capital on a poor farm. A third is temporarily non-organic, stepping up production with 3 cwt/acre of 20:10:10 on silage fields to meet targets required for an FHDS grant. He too is building up the nutrients on his farm with bought-in feeding-stuffs, and hopes to become organic again once the farm has been adequately capitalised and the level of production stepped up to a higher plane.

Two of the farmers in this group are experimenting with organic pastures. One has one-third of his farm down to Clifton Park deep-rooting herbal leys. He is assessing their management and performance before committing his farm, which is on mortgage, further.

The other farmer experimenting has stopped using nitrogen fertiliser on four areas totalling five hectares to get some idea of their comparative carrying capacities. The first year with no nitrogen performed poorly, the second and third years were better, and by the fourth year the pasture grew well though less productively than his conventional fields. Given a choice, cows always grazed the no-nitrogen areas, possibly suggesting better utilisation. The reasons for the experiment are almost entirely economic. Money invested in soluble nitrogen fertiliser runs the risk of being lost in a very wet or very dry season, either through leaching or through not being dissolved into the soil when the plant is at its most productive stage of growth. This happened to his neighbour and nearly bankrupted him. A considerable amount of money is also locked up, at current interest rates, in extra stock to use the extra grass. These potentially organic farmers therefore question how much overall profit would be affected if they were to abandon high nitrogen and intensive stocking. (The same line of reasoning led an alternate husbandry farmer (Farm B.2.1.3) to change to Organic Farming.)

Estimates of Net Farm Output could be made for five of the farms. Four had Net Farm Ouputs between 45% and 75% of their conventional standards, and one (the recycling farm) had just over 100%. These net outputs seem to have parallelled fairly well the amount of nutrients brought on to the farm.

Net Farm Income could only be calculated for three of these farms. Two were between 25% and 35% of standard, while one was around 85%.

On the whole it seems that it is a difficult system under which to make a living organically unless particular circumstances enable value to be added, feed to be bought cheaply, major costs to be lowered, or a low income acceptable.

A.1.2 Pasture-only livestock-rearing farms (e.g. Farms B.1.2.1, B.1.2.2 and B.1.2.3)

There were 15 farmers contacted who were rearing beef and, or, sheep on land entirely down to grass except one had half a hectare of cabbage and roots. Three of these were not visited.

All the farmers under this system either had an additional source of income and, or, owned the land outright. Even paying an economic rent, however, three of the farms would still have provided a reasonable NFI per hectare (80% of standard).

The type of management effort put into the farms varied widely. Six were run primarily as commercial enterprises. Four were managing their land with non-agricultural objectives to the fore, largely conservational; these ones were extensively run on very low inputs. Two farms were run down because of age or illness. Only the performance of five of the first six will be discussed here. The sixth has only recently moved into beef and sheep from dairying.

The five fully-farmed holdings bought in concentrates, one at the rate of 1.5 t/ha, two at 0.6 t/ha and two at 0.15 t/ha. The other farms used virtually none. The farm bringing in 1.5 t of concentrates per hectare had a very high stocking rate and output. Net outputs from the next two were about 100% and 70% of average, with high stocking rates similar to those on conventional 'premium farms'. Net outputs from the other two farms were about 40-60% of standard, with stocking rates about 55% and 65% of average. Apart from concentrates, and straw for bedding, very little else was brought on to the pasture-only livestock-rearing farms. Two used a little calcified seaweed, two a little compound fertiliser, and four used slag or rock phosphate.

The most productive farm (apart from that buying in 1.5 t concentrates per hectare) was on the side and bottom of a river flood plane. It was formerly a dairy farm (Farm B.1.2.3) and had had its productive capacity built up over many years by bought-in feed, calcified seaweed, straw for the farmyard manure, a high stocking rate and good grassland management. Inputs to the farm were now much lower and home-mixed concentrates fed to the calves only.

The second most productive farm was on permanent pasture over 20 feet of clay. Stocking rate was similar to the first farm but carried a single-suckling herd of cows and their progeny, rather than bought-in calves multiple-suckled off a few nurse cows; one would expect output to be lower. On both farms electric fences were used to exercise control over the grazing of the stock. The first farm was able to keep stock off the land over the winter but the second did not, and so fed concentrates to the breeding stock as well.

The other two farms were on poorer land and brought in less material. Variable inputs were about one-third of average. One at 600-1000 ft had a stocking rate of 0.84 GLU/hectare (65-75% of average) on improved good pastures. Careful grazing control in particular, together with reseeding and some mucking, had been used to build it up.

Fixed costs were reduced rather less (77%). Net output was around 60% of standard, but with total costs at 60%, Net Farm Income was reduced to just under 40% of average for that farm type in that year.

The other farmer was in a better financial position (though lower in output) in that he employed no labour and had his fixed costs spread over a larger acreage. The farm achieved a Net Output 40-50% of standard. It was stocked at 0.59 GLU/hectare, half the standard for the area. Variable costs were 34%, fixed costs 55%, and NFI/ha that particular year only 50% of standard. Output, however, was not typical that year as lamb mortality was high in a bad spring.

A.1.3 Largely-pasture, livestock-rearing farms

Eleven farmers were contacted who were rearing livestock on land which was mainly down to long-term leys or permanent pasture, but which had a small area ploughed up each year and put down to a fodder or cereal crop. This would be cultivated for one or two years and then resown to a complex grass and clover mix generally containing some herbs. Almost all the food grown would be fed through the stock in winter. All the farms carried beef cattle and most had sheep as well.

The position of the largely-pasture farms was in sharp contrast to the wholly-pasture livestock-rearing farms. The latter were generally in equilibrium, long-established systems run by people without mortgages, tenancies or growing children. Eight out of ten of the largely-pasture farms, on the other hand, had started their Organic Farming since 1970, three changing over from conventional farming and five entering direct. Most of them, therefore, were in the process of development, enterprises being built up, land improved and their organic functioning consolidated. All but two were owner-occupied though how many had mortgages is not known. At least half had borrowing charges to meet for improvements. Seven of the farms had growing families to support.

The relative performances of the farms in terms of net output per hectare did not seem to bear as close a parallel to nutrient input as on the wholly-pasture farms.

Nutrient inputs to the farms were very variable. Four, possibly five, of them set out to be low-input, particularly reflected in their bought-in feed. Nevertheless, output on two of the farms was unnecessarily restricted even apart from the low inputs, because most of the stock had to be outwintered. This both set the grass back, and did not provide sufficient FYM to boost conservation and any arable feeding crops. Both farms were therefore increasing their winter housing and the use of straw bedding, which would step up the cycle of production on the farm. Meanwhile one, a tenanted farm with a young family to support, occasionally used 20-30 units of N in a compound fertiliser for early bite, conservation or reseeds. The other was gradually taking sewage sludge round all his farm. He intended to move over to a more ley-arable, but still low-input, system of farming as the area was suitable for it, and he had a son moving into the business with him. Both farms, as far as can be seen from one or two years' data, were performing quite well financially, per hectare, and avoiding borrowing costs - one of their aims.

Two of the other low-input farms had subsidiary incomes. They were steadily improving the farms by ploughing up and subsequently increasing stocking, but had no pressure on them to seek a higher turnover.

The most productive farm whose accounts were seen had replaced straight nitrogen fertiliser on the conservation fields with Humber semi-organic 7:7:7 manure. They were going through a pasture improvement programme and increasing stocking with the help of an FHDS grant. Concentrate feeds were bought in at the normal rate for the area, but (as did three other of those farms) they grew oats for feeding as hay, harvested whole when the grain was still milky. Stocking rates were just above average.

The second most productive farm in terms of net output per hectare was the low-input farm using a small quantity of compound fertiliser, mentioned above. Net output was 71% and NFI about 90% of standard; stocking rate was 0.72 GLU/ha, 82% of its standard. The farm was tenanted.

A third farm was probably producing a fairly high output, 170 fat and store lambs plus some bullocks off 30 hectares of high grassland, but full details are not known. Straw, oats, slag and lime were bought in, and all the stock inwintered.

One farm had stopped using fertilisers in 1976 and a bit later established a pig-fattening unit on (non-organically-grown) swill. The slurry fed the farmland, providing pasture for cattle and wheat for the pigs. The farmer thinks the abundance of clover which he now has, has lead to an increase in killing-out percentage and that the organically-grown hay "goes further".

One other farm is being built up and run on imported manure. Three to five tons of broiler manure per hectare are carted onto the farm from four miles away and spread at the rate of about 2.5 t/ha at a time. It enables the farm to carry the same stocking rate as on conventional farms. Stubble turnips were tried but abandoned in favour of grass only.

As most of the farms were in a state of transition, their performance at the moment cannot indicate the potential of the system. Net output per hectare ranged from 45% to 85% of the local standards, £120-£235/ha. Net Farm Income showed much greater variation from a loss of £50/ha (-70% of standard) on a farm using a great quantity of bought-in feeding-stuffs, to a profit of £100/ha (140% of standard) on a low-input low-output farm with a large acreage over which to spread fixed costs. Both results, however, had exceptional non-technical reasons behind them that year.

A.2 The Ley-Arable "Alternate Husbandry" Farms

There were 28 organic and 6 semi-organic alternate husbandry farms contacted altogether, of whom 27 were visited. Two organic alternate husbandry smallholdings were also visited and at least 8 farmers were met, or heard from, who were experimenting on a small scale. The farms fall into four groups for the purpose of description:

(a) Farms feeding all crops through the livestock (9 + 2 smallholdings):
    Farms carrying beef and/or sheep only (3)
    Farms carrying a dairy herd (6 + 2)

(b) Farms selling cash crops as well as livestock (18):
    Farms carrying beef and/or sheep only (10)
    Farms carrying a dairy herd (8)

The ability to grow reasonable cash crops obviously underlies the split of farms into those selling livestock only, and those selling cash crops as well. Thus farms in the latter group (Group (b)) tend to be in the drier southern, eastern, and north-eastern parts of the country where the climate in general suits cereals and other annual crops better than grass. Indeed in the more eastern areas the grass ley tends to become reduced to one or two years only, as a break crop, and animal output becomes a decreasing component of total output. Winter wheat, being the most valuable of the cereal crops, particularly distinguishes the output of these farms from those in Group (a) who cannot grow it so well.

The ley-arable farms in the wetter, western areas of the country can still grow barley and oats, which they feed through their own stock rather than buy in more expensive concentrates. There tends to be a shortfall, rather than a surplus, of home-grown concentrates so output on these farms is almost entirely confined to livestock.

A.2.1 <u>Farms feeding all crops through the livestock</u>

A.2.1.1 <u>Beef and/or Sheep only (e.g. Farms B.2.1.1, and B.2.1.2)</u>

Three organic, (plus one farmer who used to use Humber semi-organic manures) were met. The farmer using the semi-organic manures had done so for five years but has now had to revert to a low input of conventional fertilisers because of expense. The farmers are all in the wetter, hillier parts of the country, on family-sized, owned, farms, but one at least had a heavy overdraft to meet.

Considerable proportions of the farms were down to permanent pasture (two farms) or long-term leys. Herbal leys were generally used on the ploughed land. Winter housing on two of the farms, and eventually on the third, helps the management of the grassland and produces FYM for the arable section and conservation.

Inputs to all three farms were kept low, confined to lime (all three), an organically-acceptable slow-release form of phosphate (three farms), straw (one farm), liquid seaweed (two farms), and possibly the introduction of Chilean Nitrate on one farm for the last cereal crop in the rotation. Virtually all feed was home-grown.

One of the farms had been fully organic for over 10 years. Although Net Output per hectare was only 66% of standard in 1978-79, corresponding to a 68% stocking rate Net Farm Income was the same as that obtained by the average farm of similar type in the area. This was because variable costs were so low (one-third) - very much lower feed and fertilisers - and fixed costs somewhat spuriously reduced due to lower fuel and machinery depreciation costs on a smaller arable section (7% of land area in arable cultivation compared with 24% on the standard farm). Labour costs were similar.

The organic systems on the other two farms were not yet fully established. The one described in Appendix B has been relying more and more on organic methods since 1974. Yields and stock output are, according to the farmer, higher than those on other farms in the area. This is probably due to first class management. For instance, very careful attention is paid to timeliness of operations on the land, which has been made possible by planning on adequate capitalisation in machinery.

The other farm had only been organic for one year and so was in early stages of learning and adjusting.

This low-input farming system, in parts of the country not suited to arable cash-cropping, would seem to be a relatively self-contained, stable system with its low dependence on fertilisers and bought-in feeding-stuffs. The financial performance of the first farm suggests that it can be economically competitive with higher input systems. From the second farm, there would seem to be ample scope for improving output in at least that farm's area, by skilled management only (and capital investment in equipment?) without making use of higher variable inputs.

A.2.1.2 Farms carrying a Dairy Herd (e.g. Farms B.2.1.2)

There were five wholly organic farms heard from who were following a ley-arable rotation and feeding all the grain and forage crops through dairy cows plus other stock. Only two of them were visited. However, a sixth farmer who had recently exchanged dairy cows for beef and sheep was able to give a lot of information from when he was dairying. Two organic smallholdings were also visited.

Another three farmers, who were met, used low quantities of fertilisers and some herbicide on their cereals. One of these farms, formerly organic for many years, was temporarily using fertiliser and selling grass turf to raise capital for new buildings. The second has followed a ley-arable rotation with low to moderate fertiliser input for years, but it is now the policy of the Trust owning the farm to become fully organic and fairly self-contained. The third has since given up trying to be organic because the output he obtained on his thin dry chalky soil (poor summer growth of grass) was too low to support his commitment in staff.

Again, like the beef and sheep farmers who fed all their arable produce through stock, almost all these farms were situated in the west with its wetter climate. Apart from their location, the farms were all very different from one another - in size, length of establishment, and financial pressures to be met.

Barley, oats and fodder crops of kale, rape and rye, were grown in rotation with three or more years of grass. Nevertheless, some concentrates still had to be bought in: 15% on one organic farm, for instance, and 60% on another. One farm intends to become as self-sufficient in feed as it can, but total self-sufficiency is not thought possible in a 40" rainfall area where beans are susceptible to chocolate spot.

Feeding-stuffs, some straw, and - on some farms - an outside supply of slurry or poultry manure, made up the main nutrient inputs to the organic farms. As far as is known, two out of six of the organic farms had a supply of pig manure associated with the farm, one was seeking a manure input, and two were much more self-contained with only relatively low feed inputs and very occasional lime and slag.

The three semi-organic farms used low quantities of fertiliser in addition - up to two cwt/acre of compound on cereals. Two of them were on soils where soil organic matter was very soon oxidised, and they found themselves heavily dependent on outside supplies of manures and slurries. The third will be giving up fertiliser use.

Net output per hectare on two of the organic farms was 65-70% of standard in 1977-78. Net output on one of them increased to 100% of standard, two years later. The first farm was low input, variable costs only 40% of standard (no fertilisers, no bought-in manures and 25% of feed purchased). Gross output on this farm was low (50%). This, together with only a 20% reduction in fixed costs, resulted in a NFI per hectare only 25% of standard, in spite of much lower variable costs and good performance per animal. Set against this were no borrowing charges, sufficient acreage to support farmer and employee, little stress and risk, and a good standard of living. Herd size and purchased concentrates are to be increased, which will change the output and returns of this farm.

The other farm was also relatively low in bought-in input, but it had formerly built up the soil with a lot of outside manure, it had access to pig slurry at 2000 gal/acre on one-fifth of the farm every year, and it brought in considerably more concentrates. It would seem that the productive ability of the farm is now comparable to the average conventional farm using fertilisers, given that it has the pig slurry. Financially, the farm is now in a very strong competitive position, well equipped to do jobs well without paid labour, and with excellent grassland management on Clifton Park leys - both perhaps key factors in the farm's success.

Unfortunately it was too early to take quantitative information from a relatively self-contained system also under very good management. The farmer expects reduced output and increased importance of sheep as a management tool, but financial performance remains to be seen.

The organic dairy smallholdings. One (10 acres, milk output only, sold, with a premium, to a cheesemaker) had excellent output per hectare from deep-rooting herbal Clifton Park and Newman Turner leys, but it has to be run in conjunction with another income. The other smallholding (15 acres) building up to a high level of productivity with the temporary help of some bought-in manure, hopes to be able to provide a whole income, albeit monetarily fairly low, for a family. The farm achieves a high output per hectare, comparable to that on a specialist dairy farm using fertilisers. The farmers achieve this by processing their milk produce and selling it, plus various other livestock products, to high quality restaurants and shops, and local outlets. However, bought-in feed, fuel for marketing, and repairs are very high too, so costs are not yet completely covered. Another source of income is therefore needed at the moment. Whether this continues to be necessary remains to be seen, but there is no time to spare to hold down another job at the same time. Output is still increasing as the farm gets built up, and as more markets are acquired.

A.2.2 Farms selling crops as well as stock

A.2.2.1 Farms without a Dairy Herd (e.g. Farm B.2.2.1)

There were eight organic and three semi-organic farmers contacted who were running an alternate ley-arable system with beef and/or sheep as the stock and a substantial proportion of the crops sold. Another seven farmers were met or heard from who were experimenting with a small acreage to see how they got on and what the problems would be (half were large land owners). There were also a number of conventional ley-arable and arable farmers met or heard from, who took an interest in supporting the organic movements out of concern for sound rotational farming methods and "to keep their system sane".

The farms were generally in the south, central, northern and eastern parts of the country. Most were owned, some tenanted - though two of the tenancies were within the family and the third had an organic tenancy clause to it.

The grass leys lasted from three to four years in the south and east, to five years on two farms in the north. Most of the farmers went in for complex herbal-grass-clover leys, though one considered his Luing cattle did not justify the extra cost. Another put down Kent Wild White clover and grass only; a clover seed crop was taken off the first year.

Following the grass, everyone grew a crop of winter wheat out of it, except for one person in a cool northern climate who put in winter oats instead. The winter wheat was generally a bread-making variety with its slightly higher premium. The first crop out of grass was sold as OFG1 with the 21% premium (after commission), or as home-ground flour.

After wheat, the rotations then differed.

Five grew a second crop of winter wheat, winter oats or barley, followed by either:

- a fodder year of turnips, swedes, kale and/or Italian Ryegrass/Red Clover, and then a spring cereal undersown to grass. (Substantial amounts of FYM or slurry were imported, or semi-organic manures and low fertiliser;

- a spring cereal only, undersown (using 50 to 75 Kg N/ha on the second and third cereal crops);

- or straight back into grass (where the farmer relied on the three-year ley alone).

Two other farmers followed their winter wheat with either spring barley, then oats and tares for silage; or with beans and another winter wheat crop, before returning to grass.

All except one of the farms were either bringing in fairly substantial additional quantities of manure or slurry, or were using semi-organic fertilisers. One, possibly two, were going for a low-input - low-output system and both of these were the ones which milled their own wheat and sold it at added-value as flour, boosting the returns per hectare that way. Other inputs varied with the farm. Some bought in supplementary feed, some straw, two sewage sludge (uneconomic at 17 miles and since dropped by one), and almost all except the low-input farms bought some organically-acceptable form of phosphate. One farmer with four years of cereals now (instead of roots in the third year) is considering using Chilean Nitrate.

On the whole, then, the quantity of nutrients brought onto the farms is quite high, as one would expect with crops being sold off as well as livestock. The exceptions make good a lower output by processing the produce first.

None of the semi-organic farmers had access to outside supplies of organic manures. One did start off by bringing a lot in, but he found the time required too great without taking on the expense and trouble of employing labour. Instead, these farmers used either semi-organic fertilisers or low rates of inorganic ones.

Farm accounts were seen on three organic and one semi-organic farm. Variable costs on the three organic farms were very considerably reduced to 34-47% of standard. This was supplemented by outside manures and slurries, free or cheap except for the carting. The Net Farm Output which resulted ranged from 75-105% of average for that farm type in that area. Fixed costs showed less savings (they were 70-100% of standard). Net Farm Income was comparable to that of the top 25% of farmers, on one farm; well above average on another; and only about 65% of average on the third - which was not operating in full swing. These figures are based on output costed at normal market prices. At organic prices the comparison is more favourable still.

The two high-performing organic farms were under very careful and experienced management. The figures are from one year only, but suggest that ley-arable rotational farms with access to enough manure or slurry for one-sixth to one-quarter of the farm per year, can produce a Net Output somewhat below average (75-100%), and net returns to the farmer well above average.

The semi-organic farm, seeking to become more organic, spent two-thirds of conventional expenditure on fertilisers. This expenditure went mainly on Fisons minigranular slag and Kainit. His variable costs were reduced to 57% but there was no reduction in fixed costs. With a gross output the same as average, and with the reduction in variable costs, he obtained a NFI almost as good as the top 25% of farmers in his comparison group. This was with wheat grown out of four years of organically-managed grass, and the second wheat crop and spring barley dressed with 50-75 Kg N/ha plus some herbicides. Gross margins for the cereals were above average, markedly so for the first wheat crop. This was counter-balanced by lower grassland output - stocking rate 60-80% of average, bought in store cattle fed entirely off grass, silage and hay.

One farmer was visited who, while upholding organic principles, interpreted them more liberally than usual. In fact he used as much fertiliser as conventional farmers and cannot be regarded as semi-organic for the purposes of this report. It was sprays that his system cut down on as a result of ley-arable rotation and diversity of enterprises. He obtained a slightly lower Net Output in the year looked at, but a similar NFI per hectare to the standard.

Finally, one unusual bulb farm visited was using 6-7 year organic leys in rotation with two years of bulbs, his principle enterprise and source of revenue. The leys were used as a break against bulb eelworm, and to improve the structure of the soil. Herbicides were essential for the bulbs. There are no appropriate published figures against which he can be compared, but he achieved a very high NFI per hectare, well above that for all other farm types in his size group of less than 40 hectares.

A.2.1.2 Farms carrying a Dairy Herd (e.g. Farm B.2.2.2)

Ten organic farms of this type were contacted or heard of, and one semi-organic one. They were almost all owned (10 out of 11), including three Trusts, but at least three were carrying a mortgage or substantial borrowing. Eight of the farms were visited, five of whom gave detailed financial information and two partial information.

On those farms visited, leys were generally 3-4 years, sometimes longer, and were usually complex grass-clover-herbal leys. The ley was followed by winter wheat just as in the previous group, except for one farm which grew potatoes (also a potentially valuable cash crop).

After the first year in wheat (generally) rotations varied considerably. On the whole, only two cereal crops were grown altogether (frequently winter wheat and spring barley) plus a nitrogen-fixing crop (beans; oats and peas for silage; red clover for silage), and a small acreage of kale for winter grazing.

The chief cash enterprises on these farms, then, were firstly milk and secondly winter wheat for milling. Half of the farms also had sheep. The barley grown was generally fed through the stock.

The amount of nutrients brought in varied. All farmers brought in dairy concentrates to a greater or lesser extent, but one intended to become self-sufficient in them.

The great majority of the farms visited also brought substantial quantities of FYM or slurry into their systems from nearby pig and poultry units. Concern about copper and antibiotic content made one farmer stop this practice; he decided to opt for 1½-2 cwt of compound fertiliser in preference, or - even better - semi-organic manures because they left a slower-release residue. Straw for bedding was also regarded as a valuable investment towards FYM. These farms using a lot of bought-in manures were generally selling two or more crops off their land, as well as the milk.

Table A.2 shows quite a high proportion using inorganic fertilisers, but this needs qualifying: three of these people were still using some compound fertilisers on some fields whilst changing over from conventional to Organic Farming. A fourth used a little nitrochalk regularly, while one farmer made regular use of about two cwt compound fertiliser (e.g. 20:10:10) per acre as part of his "good husbandry" programme. Semi-organic

Table A.2 Usage of Nutrients and Herbicides by Organic Farms

	Type of Farm																																																									
	Pasture																						Ley-Arable																														Predominantly arable - rotational							
	Pasture-only dairy						Pasture-only livestock rearing						Largely-pasture livestock rearing										Livestock output only - no dairy			Livestock output including dairy								Arable and livestock - no dairy										Arable and livestock including dairy															
	F						F						F						B			S	F			F			S			S-H		F							S			F				B			S	F						S	
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	1	1	2	3	1	2	3	1	2	3	1	2	1	2	3	4	5	6	7	1	2	3	1	2	3	4	1	2	3	1	1	2	3	4	5	6	1	2
Nutrients																																																											
Feed	L	H	H	H	H	H	L	H	H	H	H	H	L	H	L	L	H	H	L	H	L	H	-	-	-	H	H	H	H	H	H	H	H	?	-	H	-	?	L	L	-	?	L	H	H	H	H	H	H	H	?	-	-	L	L	L	-	-	H
Straw	H	H	H	H	H	H	L	-	H	H	H	H	-	H	H	H	H	H	-	H	L	L	-	H	-	-	H	H	-	-	H	-	-	-	-	H	-	-	H	H	-	-	-	H	-	-	-	H	H	-	H	-	-	-	-	H	-	-	H
Manures	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	H	-	-	H	-	-	-	-	L	H	H	-	H	H	-	-	-	-	H	H	H	H	-	-	-	-	H	H	H	H	H	H	-	-	-	-	H	H	-	H	H
Sewage	-	-	-	-	-	-	-	-	-	-	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	L	H	-	H	-	L	-	-	-	H	-	-	-	H	-	-	-	-	H	H	L	-	H
Foliar sprays	-	-	-	-	-	-	-	-	-	-	-	-	-	-	L	-	-	-	-	-	-	-	-	H	H	-	-	-	L	-	-	H	-	-	-	-	-	-	L	-	-	-	L	-	-	H	-	-	H	-	H	H	H	H	H	-	H	-	-
Cal. seaweed	-	-	-	L	-	-	-	-	H	L	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	H	-	-	-	-	-	-	H	-	-	-	H	-	-	-	-	-	-	-	-	H
Slow-release PO4	-	-	-	?	H	H	H	L	-	H	H	-	-	-	H	H	H	H	H	H	H	?	H	H	H	L	-	-	-	-	-	-	-	-	-	H	H	H	H	H	H	H	H	H	-	-	-	?	H	H	-	-	H	H	H	-	H	H	H
Semi-organic fert.	-	-	-	-	-	H	-	-	-	H	-	-	-	-	-	-	-	H	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	H	H	L	H	-	-	-	L	H	-	-	H	H	-	H	H	H	-	-	-	L	H	-	-	-
Chilean nitrate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	L	-	-	-	-	-	-	-	-	-	-	-	?	-	-	-	-	-	-	-	-	-	-	-	-	H	-	-	-	-	-	?	H	-	?
Inorganic fert.	-	-	-	-	-	-	-	-	-	-	L	L	-	-	-	-	-	-	-	-	L	L	-	-	-	-	-	-	H	H	H	-	-	-	-	-	-	L	-	-	H	L	L	-	-	-	L	L	L	L	H	-	-	L	-	-	-	H	H
Sugar beet lime	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	H	-	H	-
Herbicides	L	-	-	-	-	L	-	-	-	L	-	-	-	-	-	-	L	-	L	L	L	L	-	-	L	-	-	-	L	L	H	-	-	-	-	-	L	?	-	L	L	L	L	-	L	L	L	-	L	L	L	-	-	-	L	L	L	H	L

Notes: Each column corresponds to an individual farm.

H denotes high usage of feed, straw, and bought-in manures, and regular use of all other materials including herbicides

L denotes low or irregular usage

? denotes some usage likely

- denotes no usage

F denotes fully organic

B denotes becoming organic

S denotes semi-organic

S-H denotes small-holder

fertilisers were also important inputs to five of the farms, and they were well thought of.

The performance of the five dairy arable farms which provided detailed information varied widely. Two were functioning at full strength (one long established, one fully converted after six years). Two were in the process of being changed a section at a time to an organically-managed rotation. The fifth, a long-established organic farm, was having a temporary setback due to liverfluke and land somewhat too heavily cash-cropped relative to the nutrients going into it (since alleviated). One of the farmers converting was a tenant with no subsidiary income behind him, unlike the other two converts. He is changing rather more slowly, but without making the loss that the other two farms took on for some time.

Net outputs per hectare were around, or a little above, average on three of the farms, and should be so on a fourth, once it gets going. Performance of the fifth farm is mentioned on its own at the end.

The first four farms all have variable costs approaching those on conventional farms (78-128%) even though they do not use fertilisers, chiefly because feed is such an important component of input. The lowest farm at 78% is actually going to increase feed input to boost milk production, whilst the highest farm at 128% (plus a lot of uncosted free slurry) sells three cash crops as well as milk off the farm, and buys in all its feed.

Fixed costs on two of these four farms are higher than average (110-120%), average on one, and 86% (perhaps more) on a fourth.

Net Farm Income per hectare, before processing, is higher than average on two of these farms and 27% on a third. A large loss is made on the fourth farm but its management and the herd are not yet fully established. One of the first two farms goes on to process all its arable output; none of the costs and returns associated with this have been included in comparing its performance with other farms. The third farm with an NFI 27% of standard also mills some of its own wheat; in this case the costs of processing are inseparable from the farm accounts so 27% is an underestimate. If returns from flour instead of wheat, are costed, NFI becomes three times that of standard.

The fifth farm, with temporary liverfluke and other difficulties, has since changed the system to a much greater emphasis on pasture and dairying, with more purchased feed. Gross output of milk has increased and the nutrient drain implicit in the sale of arable crops has been stopped - the farm does not import manures as the others do. At the time the accounts refer to, variable costs were 50%, fixed costs 57%, Net Output 42% and NFI 31% of other dairy farms in the area.

As with the beef/sheep/arable cash-crop farms, the dairy/arable cash-crop system is financially competitive with conventional farms, and - perhaps more so than them - productively competitive as well. That is, given first-class management (which the first three farms had); access to ample outside sources of manure, or at least to some outside manure plus semi-organic fertiliser; and quite a lot of bought-in feed.

A.3 The Predominantly Arable Rotational Farms (e.g. Farm B.3.1)

(i.e. those farms with 0,1 or 2 years of grass in the rotation, frequently complemented by permanent pasture)

Six organic and two semi-organic farmers (who used up to 50 or 60 units N/acre on some crops) were visited. They were mainly in the east and north-east of the country.

The sorts of rotations used on these farms, and the nutrient inputs to them, have already been outlined in Chapters 4.4 and 4.5. Three of the farms were run without stock on the land, while the other five all had permanent pasture or long-term grass associated with them.

Two of the farms without stock were still establishing themselves and their performance is not known; the third brought in very large quantities of animal processing wastes and manures to support an entirely arable output all sold off the farm. Both his variable and fixed costs were higher than average (112% and 145% respectively). Semi-organic manures, lime and foliar sprays gave a higher "fertiliser" bill than average, while haulage of wastes on to the farm raised machinery and power costs. Nevertheless, Net Output only seems to have been somewhere between 55 and 85% of standard at normal prices. At organic prices this was raised to 80-110% of average. With relatively higher costs, income obviously suffered: if the farmer's labour and rent are costed at standard rate, and produce at normal prices, NFI would have been substantially negative. However, the farmer was still experimenting to some extent, and has also since increased the acreage over which fixed costs are spread. Furthermore, the organic premium he actually receives in return for his farming methods, renders his system rather more competitive.

The accounts of two farmers with short-term leys as part of their rotation, and a very small to moderate amount of permanent pasture, were also looked at. One farmer finds he has been cropping his land too heavily in proportion to the nutrients going in (two years cereal, one year nitrogen-fixing break, and no bought-in manure). Nevertheless, with low variable costs (43%), fixed costs (64%) and Gross Output (54%), he achieves a NFI per hectare 41% of standard. Net Output of 57% seems to be reduced by poor cereal performance under this system, rather than by the forage acreage which is stocked a little above average.

Another farm, with a lot of manurial inputs from outside, produced as much as conventional farms in his area. High oat and average livestock outputs balanced out slightly lower wheat and much lower barley yields. However, in the year looked at, a disastrous potato year for him badly hit the farm's NFI. A lot of money was laid out on seed and manual weeding for a poor crop (12t/ha) in a poor market. Without the potatoes NFI might have been about 80% of standard. Substantial savings on fertilisers and sprays are obtained, but more labour was made use of than average, and higher machinery and property repair costs were needed that year. Nevertheless, the farm has been running organically for many years and rarely made a loss (the land is owned).

The evidence available from which to comment on this system is limited. Apart from Farm B.2.2.2, it really remains to be seen how most of these farms will perform once they have been going a bit longer. Three of them have been set up fairly recently by ambitious farmers with many years ahead of them and young families to provide for. These are the three farmers who use, or are prepared to use, semi-organic fertilisers, Chilean Nitrate, low rates of inorganic fertiliser, and MCPA on some crops - within the limits prescribed by their marketing co-operative OFG2 standard. Three of the older farmers who rely more exclusively on green manures, and/or the recycling activities of stock, need to make less of a living from their farms, but their systems form the basis to which the younger farms, and Farm B.2.2.2, bring in added nutrients.

APPENDIX B

The Farming Systems: Selected Case Studies

B.1.1.1 A 31-ha dairy farm

This small upland pasture farm is run on entirely organic lines within itself but has a heavy dependence on bought-in cereals, straw and hay while its productivity is being built up. Lime, slag and a little Humber 40% fish manure are also brought onto the farm. Although the farm is high input at the moment, it is thought that it should pay off in terms of greater productive capacity soon. The farmers are aiming to be as self-contained as possible in the end after a considerable amount of pasture renovation has taken place and pasture output has increased. Fodder crops - kale, rape and rye are also grown on about one-sixth of the land. The farm carries 35 milking cows and 15-20 young stock. The farmers are having to improve by entirely organic methods as part of the tenancy clause, but if they had the choice they would tackle it differently, perhaps making one field organic at a time and using some fertiliser to get things going. The farm is making a profit due to the dedication of the farmers with their very difficult task, but the business is very vulnerable to high borrowing costs at this stage. The material standard of living has so far had to be very basic; this is probably more a reflection of the returns to be expected from any small, rough, upland farm that needs building up, than of organic farming *per se*.

Restoration of Pastures

Apart from a substantial amount of scrub-clearance the following procedure is being taken round the farm to improve the grassland. Old pasture is ploughed up and put into kale. Kale is followed by a two-year ley of Italian tetraploid ryegrass and red clover from which late silage is made giving 7-8 tons per acre. Then the sward is ploughed up in the autumn and reseeded to a five-year ley of Cocksfoot, Meadow Fescue and Timothy. Herbs invade this ley of their own accord.

Muck is spread at at least 10, probably more like 12-15 tons/acre. The farmers prefer to concentrate it thickly on a smaller area, rather than thinly on a larger area, whilst they are building up the productivity of the fields. This rate of mucking makes a tremendous difference and, together with lime and slag, has brought back the clover and earthworms. A considerable amount of straw is brought in, it being regarded as an investment in fertiliser. A liberal quantity of about one ton per cow is allowed for. Recently a covered bedded yard has been built (by themselves), which will greatly further the management of the farm in a number of ways.

A small quantity of Humbers 40% fish-meal manure is also found necessary at the moment.

Stock

The 35 cows (Ayshires) give a yield of about 3860 litres per cow (850 gals), average for the breed, on 20 cwt of cake, which is rather lower than usual. A yield of 1000 to 1100 gals is being aimed for without any stress problems, but they would not push any higher by feeding.

The cattle are basically very fit with walking up and down hill. The usual veterinary measures are used. In particular Fluke has to be dosed against every winter, and there is a very occasional case of milk fever, magnesium staggers, retained afterbirth, and foul in the foot.

More detailed information on the performance of the system is not available.

B.1.1.2 A 162-ha dairy recycling farm

This farm is a very unusual wholly organic farm built on a gradually acquired reputation for taking in anybody's waste vegetable residues, straw or old haystacks. As the farm is in the eastern part of the country amidst largely arable and horticultural farms, there is plenty of unwanted material available. 400 acres of permanent pasture supports two pedigree Friesian dairy herds of 90-100 dairy cows each, plus another 160-180 young stock.

There are two main principles to the farm's management:

(i) to take advantage of whatever materials are available in the neighbourhood

(ii) to keep the stock content and comfortable.

In effect the farm is one gigantic "crew-yard" to which they, or other people, bring in huge quantities of plant residues. In one year they get through about 3000 tons of straw and hay, 1800 tons of vegetable and 900 tons of potato waste from the food processing industry.

The older stock and cows stay outdoors all the year round, their winter living quarters being rather like unenclosed straw-bedded yards. Some of these areas are sheltered by proper stacks of hay and straw bales to one side. The bedded areas, or "stacks", are built up layer by layer over the winter as fresh straw, hay and vegetable waste are brought onto the stacks and spread. The cows eat this ad lib, fresh quantities coming in every day. It is the, perhaps unique, skill of the farmer that he is able to judge whether the animals have been adequately fed on their somewhat unpredictable varied diet. Just as with a bedded yard, the depth builds up and muck is trampled in by the cows wandering over it. As the weather improves, they spend more time on the pasture, grazing swards containing much white clover. "Weeds" are valued because the cows seem to seek them out and be restored to appetite when off colour.

The cows give about 1070 gallons (4880 litres) of milk a year each on 24 cwt of dairy nuts. They are stocked at 1.7 Grazing Livestock Units per hectare (0.7 cows per acre), just over average for the area. In addition to milk (840,000), about 100 calves and 40 adult animals go off the farm each year, more when they are not building up herd numbers.

The farmer tries to avoid spending anything on capital outlay or on things he can get by recycling. This extends to the machinery which is all second-hand. Indeed a two-acre field is covered in tractors and implements from which to salvage parts as required. However, he spends a great deal on labour; 9¾ men, himself and his wife work the farm. The high labour expenditure is partly because of the nature of the system, and partly because the farmer thinks it a pity to substitute machinery for labour. About 30% of expenditure goes on animal concentrates and 40% on wages. Surprisingly enough, only 7% goes on machinery and power, but much of the transport costs are paid by the people trying to get rid of their wastes. Obviously there is an energy cost here not taken into account.

It was emphasised very strongly by the farmer's wife that the whole system revolved around her husband's ability to judge the comfort of his cows on their unusual rations.

B.1.2.1 A sheep and beef farm (69 ha)

This farm is a medium-sized, low input-low output, pasture farm producing fat lambs, fat cattle, and one or two bulls for breeding. The farm has been almost entirely organic for nearly 20 years, though a very small amount of artificial fertiliser is used on the hay fields. There is also a small quantity of animal feed and straw coming on to the farm, plus some slag and rock phosphate by way of bought-in nutrients. The farm is owned outright by now, and no employed labour is necessary beyond a contractor for the hay. It is a viable farm, and is likely to continue so, in spite of output per hectare being about half that on comparable farms in the region. It seems likely that it will continue viable because it is relatively independent of outside costs, including fertiliser, labour, rent, and no borrowing charges. The need for feedstuffs and machinery is also low.

The farm is quite exposed on the west coast of Britain. Parts of the land are dry, parts heavy. The land rises from sea level to 400 ft, some of it very steep and some of it flat.

The farmer has always felt within him that something was wrong with the conventional approach to farming. Then he came across the writings of Newman Turner. Unfortunately there was not time for a longer discussion on Mr A's objectives.

Grassland

Most of the stock are outdoors all winter, only the young cattle being kept in. As a result, the hay fields are not shut up till June, when one cwt per acre of compound fertiliser 10:25:15 is applied to them. About five tons of straw are bought in for bedding and put out as FYM but only a very small portion of the farm can be covered with this. Slag and rock phosphate are taken round every four or five years on average, basic slag being used for the drier land and rock phosphate doing better on the damp fields. Lime is also used but only about once in 20 years, or when a field is being reseeded. This takes place every 12-15 years on the cultivable land, with an NFU 50 seeds mix plus cocksfoot added. Subsoiling is considered important and done during the driest part of the year, in August.

Stock

Cattle and sheep are grazed together in rotation and there are a few horses as well which further complement the grazing pattern, and help with grazing of the steeper banks.

The short, good quality hay produced after shutting up in June, rich in clover at that time of the year, (yielding about one ton per acre) is kept for the ewes and supplemented with protein-mineral blocks. The lambs are sold fat off grass. Lambs get drenched once for worms, and after that only if they need it. Ewes get two doses against fluke every autumn but nothing else. Most ewes are kept about nine years and as a result replacement costs are very low in terms of numbers of lambs retained for the breeding flock.

The young cattle are housed and fed from January 2nd onwards on bought-in barley, sugar beet pulp, cake and hay, so that their growth rate is kept up right the way through. They are then sold fat off grass the following year.

Magnesium-rich minerals are provided during very early spring. Total bought-in feeding-stuffs for all the stock only amount to about four tons of cereals and concentrates, five tons sugar beet pulp and one ton of Rumevite blocks.

Performance

As a result of low inputs, stocking rate and output per hectare are half that of the average for the area, supported by about half the amount spent on lime, phosphate and fertilisers and only 30% on feeding-stuffs.

While the system is viable for the present owner who has paid off his capital requirements over earlier years, it would be rather more precarious, though not impossible, if someone had to face borrowing charges. There is probably considerable room, though, for intensification organically if the farmer felt inclined to do so, but as it is, he has no need. For instance, he could grow his own cereal feed, or allow the grassland to be more productive by housing in winter. But all such improvements involve an escalation in capital investment during a period of high interest rates. Under the present system the farmer has his independence and is looking after his stock and land the way he wants to. He needs employ no labour apart from the occasional help of contractors.

B.1.2.2 A beef and sheep farm (49 ha)

This farm is an upland low-input, low-output beef and sheep farm growing almost entirely grass plus a very small acreage of cabbage and mangolds for winter fodder. The lambs and single-suckled calves are sold fat, the lambs off grass, the cattle with a winter of indoor feeding, plus grass. The farm has been run completely organically, and always on low-input, low-cost lines - partly as a matter of necessity - for over 20 years. Rock phosphate and lime are brought in, particularly when reseeding, and there is also a small dependence on concentrate feeds from outside. The mortgage has been paid off a few years ago and from now on the farmer is taking things a bit easier by letting half the land for grass keep. Total output per hectare is just over half that for the region, and stocking rate about 60%. While variable costs are only one-third of average, fixed costs are still three-quarters, so net farm income works out at rather under half that on comparable farms in the area. However, one particularly bad winter did give a 20% lamb mortality that year, with a large effect on farm performance which lies somewhere between 44 and 66% of standard.

The farm is in the south-west of the country on land that rises from 650 to 1000 feet above sea level, sheltered in the valleys but the remainder exposed. The soil, too, is variable, from good loam to shillet.

When Mr B came into farming, he questioned the accepted beliefs then prevalent, and felt by intuition that this was not the right way to treat the land. He noticed in particular the behaviour of the garden lawn and eventually came to appreciate "the overall life-forces that modern farming was destroying". Stewardship of the land, maintenance of traditional craftmanship, and reverence for the interacting balance of nature are the motivating forces behind his way of farming, together with a desire to be as self-sufficient and independent as possible.

The farm was taken on in 1958 in a very poor condition with no access road. Since then by much physical effort at scrub-clearance, reseeding of existing pastures and of steep banks, planting of trees, restoration of walls and buildings, the farm has been put in good order and greatly increased its value. Good grazing management in particular ("a feel for grass"), even more than reseeding, has upgraded the productivity of the pastures tremendously. Some of the build-up will have been helped in the past by FYM from pigs (when bought-in feed was cheaper) and cattle, but only to the extent of 15 acres per year at 10 tons/acre.

A few points of particular interest with regard to the improvement of this farm, by organically-approved means only, will be made.

Grassland

(1) Reseeding of steep banks once the scrub had been cleared, was made possible by the use of a Merry tiller for preparing the ground, and a fiddle - an old-fashioned hand-operated sowing instrument carried in the arms as the sower walks along. The fiddle is also used for all other sowing. A mixture of cocksfoot, ryegrass, red and white clover is sown, and indigenous species soon re-appear. He has no trouble in growing clover, even at 1000 ft.

(2) Grazing control, rather than the seeds mixture, is chiefly responsible for the major improvement in yield, which has been great. Two tons of hay per acre were cut off a valley field in July after it had been grazed all winter. It seems that visiting farmers are very impressed with the amount of grass production without fertilisers. Lack of rabbits helps. Both sheep and cattle are grazed, and he does not cut hay on the same field two years running.

(3) Topping for control of weeds and stemmy grass is possible even on the steep banks because a Mayfield grass mower is used.

(4) The use of Farm Yard Manure has already been mentioned, though quantities are small now.

(5) Rock phosphate and lime are applied.

(6) He gets flea-beetle with undressed swede seed.

Livestock

(7) Other nutrients brought onto the farm are 9¼ tons of concentrates and high protein feed blocks, 2-3 tons of hay, and 6 tons of straw for bedding.

(8) Most of the vet-bill goes on preventative measures (sheep dip, worming and warble fly), and a little on lambing.

(9) The occasional case of redwater still crops up; it was rife on the farm when he first arrived. Ducks were introduced to help clear it up.

Performance

The performance of the farm is very much like that of the previous one (B.1.2.1), except that it is 'handicapped' by higher fixed costs due to payment of an extra half-wage to one of the sons - allowing the farmer more time to pursue his other interests. He has a large family to support and a subsidiary income linked with the farm has therefore been necessary - holiday guests. However, the farmer has managed by dint of sustained physical work and good grassland management, to build up a very run-down farm to good condition, buy it and greatly increase its value. He has created a lovely steading, and farms along the principles he believes in. Although the amount of cash coming in is low, in terms of assets they have a comfortable material standard of living, independence, and a wealth of other interests.

Could it be done nowadays, by a new owner? Probably not, because there is no margin left over for investment and borrowing charges, though the techniques themselves obviously work.

B.1.2.3 A beef farm (27 ha)

This farm is a small pasture farm producing beef from bought-in calves, suckled on nurse cows and sold fat off grass at 24 to 30 months old. The farm has been wholly organic for 25 years and only recently changed over from dairy to beef. The main feature of this farm is that the farmer has built up the inherent productivity of the land over twenty or more years, by a combination of plentiful bought-in feed (when it was really cheap) for the dairy cows, and first-class grassland management. Now there is very little dependence on bought-in materials - a little calcified seaweed, straw for bedding, and a small amount of cereals and protein for the young stock. Nevertheless, stocking rate is high, equivalent to just under one cow per acre, supported by the continuing high level of grassland management. The farm provides a comfortable income and fulfilment of other objectives.

The farm is low-lying, on a river plain, parts of which are subject to flooding.

The farmer's interest in the organic approach to growing food began when he was young and keen on building up health and strength. Following that, he became interested in the concept of balance in nature and applied it to agriculture. He does not like chemical fertilisers: "in nature, nothing comes in isolation, but in combination, and it is this combination that makes it work. There will always be the 'unknown factor' however much we know, and we must allow for it with an element of humility". The farmer started at nothing and now, with very hard work and an enjoyment of business, owns his own farm. His sense of achievement is that he is improving the farm all the time, turning out a good product, and handing over the farm in a better condition to the next generation.

Grassland Management

Some of the swards have been reseeded in the past, but it is all established as permanent grassland now. The farmer's main principles in grassland management are:

1. *A high stocking rate.*

2. *Use of paddocks.* This is regarded as essential so that the

herbage can be grazed off tightly in as short a time as possible. As a result the clover is able to compete with the grass during regrowth as it is not shaded out. The rapid movement of animals on and off an area also reduces poaching on this high-water-table land.

There must be enough paddocks to ensure that the animals do not go into a paddock "before the grass is ready". With dairy cows he had 21 paddocks. Mr B warns that for the first two years of paddock grazing after reseeding, you can not expect the pasture to do very well. This is an example of a transition cost that has to be weathered.

As a result of the paddocks, no worming is necessary except when the animals come in for the winter.

3. *Resting the land over the winter*. The animals should be kept off for at least four months. In this way he is able to turn out in spring just as early as his neighbours in spite of no spring-dressing of nitrogen fertiliser.

4. *Time of applying the muck*. In his experience the farmer considers the middle of the summer as pre-eminently the best time to spread FYM on grassland: at this time, microbial activity is at its highest and the manure quickly disappears into the sward. Ten tons per acre is applied. The FYM comes from the cattle's winter quarters - a covered barn bedded with bought-in straw.

5. *Use of calcified seaweed*. He has always used calcified seaweed. He recommends that it be applied at the rate of five cwt per acre for three years, followed by three without, to start with. Subsequently it will need to be topped up with another five cwt to the acre rather less often.

   However, Mr B. suggests trying five cwt of lime every year (as opposed to two tons much less often) instead, until the farm can afford seaweed - it may even prove to be completely substitutable by lime. The lime makes the grass sweet and palatable, so leading to good utilisation of what grows.

Productivity of the Grassland

As a conservative estimate, the farmer reckons that the 67 acres of pasture can maintain an average of 100 one-year old beef animals all year round, including the hay fed in winter. This is equivalent to 55-60 Grazing Livestock Units. With five nurse cows, 50 calves 0-1 year old, 50 1-2 year olds, and 50 2-2½ year olds for about three months, the Grazing Livestock Units amount to 64, i.e. just under one cow per acre in some years.

Stock

The calves are given a 16% protein home-mixed ration which works out about 25% cheaper than a proprietary cake. The nurse cows also get it, in winter. Otherwise no other concentrates are fed.

The layout of the farm makes it easy to check the cattle for signs of bloat. The farmer wonders whether the docks, occuring in some places, act as an antidote. Most of the other 'weeds' and herbs in the sward are also appreciated, dandelions at one time for butterfat.

Why does the farm work?

1. Good grassland management and the built-up fertility of the soil support a good output per hectare.
2. Low variable costs - very little is bought onto the farm apart from the capital invested in calves for two years.
3. Low fixed costs - the farm has been kept to the size of a one-man farm as this gives less trouble. No contractors are used, he does all his own machinery repairs, and he has no rent to pay - in return for the very hard work of earlier years.

The advice that Mr C would give to a new entrant to organic pasture farming is to go for a high stocking rate and sink all available capital in that; bring in whatever manures, wastes and feeds possible, to build up the soil; cut down on non-productive money going into fixed capital costs - land on mortgage and machinery. Instead, rent the land and buildings and use contractors.

There seem to be no difficulties.

B.2.1.1 A beef and sheep farm with home grown feed (37 ha)

This farm is a low-input completely organic farm based on an alternation of Clifton Park leys with fodder and cereal crops. It lies in a good grass-growing area so concentrates on livestock production. Virtually all of the crops are fed through the stock, formerly through dairy cows and now through beef (from bought-in calves) and some sheep. A lot of animal feed and muck have been brought onto the farm in the past but now only a very small quantity of supplementary material is brought in for calves and lambs, plus a little extra straw. A fair quantity of slurry (enough for one-fifth of the farm) still continues to be provided by a pig-fattening unit housed in buildings on the farm and consuming brought-in feed. No fertilisers or sprays are used. The farm is highly mechanised so that it can be run by one man.

The farmer made the change from high-input conventional dairy farming to an organic relatively low-input dairy system primarily for the economic reasons that it did not pay any better to farm intensively, and that there would be less risks involved. There would also be less stress on himself and on the animals. The change from dairy to beef has been made for an easier life, now that the farm has been capitalised.

Net output per hectare was 67% of average as a dairy farm and at the moment is about 106% as a mainly beef farm, with the tail end of the dairy winding up and the sheep just coming into production. The standardised fixed costs are still as high as on other comparable farms (labour, machinery and power, rental value, rates and other overheads), but variable costs are much lower. The standardised fixed costs can be comfortably met from the profit margin. However, the farm is also actually buffered to some extent against outside rises in fixed costs because the farmer does not employ any labour, has finished buying the land and is able to do most of his own machinery maintenance. All borrowing has been repaid. The only weak point of the system is that it does have a nutrient input of bought-in concentrates via the pigs, and presumably performance would be lower without this.

Nature of Land

The farm lies in the south-west of England with quite heavy rainfall. There is one foot of medium to light loam over a free-draining shillet sub-soil. Most of the farm is readily cultivable and follows a rotation, but 12 acres of steep banks are ploughed up less often. The land is classified as grade

History

Mr C took on the farm in 1964 and by 1975 had furnished the capital equipment needed to run it as a one-man unit; in 1978 he finished paying off the mortgage and now the farm is debt-free.

When he first started, he farmed like any other 'modern young man' with lots of pigs in their own buildings, and then intensive dairying. However, his ideas changed because of the demands and pressures of his way of farming. The intensive set-up involved 60 cows in milk plus their followers on about 90 acres of grass, 300 units of nitrogen per acre, searching for grass keep on neighbouring farms when he was short, payment of a man's wage, and money locked up in high stock numbers costing 16% interest. Intensiveness meant high vet bills, milk fever, knife-edge inputs and dependence on outside labour. Costly labour problems in particular finally led him to change to a more self-contained, lower-input, system. By cutting down to 45 cows, a lot of the extra overhead problems were removed. Thus his primary reason for adopting a low-cost system of farming was economic.

Change-over

Mr C started the change-over in 1971-72, with much trepidation and no advice beyond farming books written at the end of last century. Over a period of three years he changed quite rapidly from a dependence on chemical inputs to a dependence on biological activity alone, recycling organic wastes through the soil and penetrating to greater depths of nutrient supply with deep-rooting plants.

His blue-print for changing over any farm is two-fold. Firstly, plough up every piece of land that is ploughable and put it down to Clifton Park ley type of mixture, whether the grass is wanted in the end or not. Only after the ley has been down for two or three years can it be expected to function as an organic field, i.e., be cropped without fertilisers. Secondly, at the same time, bring in large quantities of muck from whatever neighbouring sources are available. He carted in 10 tons of pig and poultry manure per acre every year but found this was in fact too much. After a certain input there was no further response in yield, the grassland appeared somewhat soured in that the animals tended to reject some of it, and some of the barley crop was laid. From his experience, he thinks he need only have used about half the quantity of muck; this would have reduced the very large number of hours that went into collecting it.

Apart from building up the content of organic matter in the soil, another important aspect of establishing a more self-contained low cost system is to decide on the "correct stocking rate" for the farm, i.e. what the land will carry in a poor season without forcing the farmer to look elsewhere for expensive supplements. In other words risk avoidance is an essential management tool on an organic farm because one does not then turn to 'desperate measures'. He considers it very important that an organic farmer should stock to a difficult year. In a good year of surplus production he can always buy in extra stock for fattening, or conserve for the next year. Another way of judging "correct stocking", in his terms, is to assess what the land will carry without escalating the cost of investment in labour, machinery, buildings, fertiliser, feed, extra breeding stock and veterinary measures. A similar attitude was expressed by other people considering changing to a low-input, if not organic, system. It should be noted, however, that his stocking rate is not low.

One further feature of the less risky, more self-contained system he has established is that he has set out to be highly mechanised and well-equipped with buildings. Once capitalised, his depreciation is lower than the average figures given in handbooks because he is able, and has time, to maintain the equipment himself, again a factor in common with a number of other organic, and no doubt many orthodox, farmers. Thrift pervades the whole system.

Crop Rotation

The farm is in a good grass-growing area so the crops in the rotation are geared towards supplementing the feeding of the livestock carried on the grass. An occasional cash crop of cereals could also be taken. More cereal and silage crops were grown when the farm was in dairying, but the system has been considerably simplified since changing to beef and sheep. In setting up his rotation he has always attempted to keep the ground covered throughout the year, but he is now questioning the economics of this catch-cropping. The labour, energy and machinery wear involved may result in only a "fizz" of a crop. In his present system, however, it is not necessary anyway as the barley is undersown direct to grass.

Rotation used with Dairy Cows up to 1979

On the flatter land i.e., most of the farm, grass alternated with cereals and fodder crops. The order of growing the arable crops might be changed so that grass was ploughed to kale, and the last arable crop was the arable silage. Arable silage was a good cover crop into which to sow the next grass ley.

4-5 years grass
↓
Arable silage
↓
Rape over winter
↓
Spring barley
↓
Kale over early winter
↓
Spring barley
↓
Undersown with grass

On the steeper land grass was reseeded every 8 to 10 years by ploughing up, putting into kale for two years, and reseeding with the Clifton Park ley.

Rotation used with Beef and Sheep from 1980 onwards

4-5 years grass
↓
Kale
↓
Spring barley undersown to grass or/ Spring barley
Rape over winter
Grass sown direct

Grassland. A Clifton Park deep-rooting mix is used throughout the farm, producing very good swards. The more fastidious feeders strip-graze the field first and then it is opened up to the second class of stock. Thus the dairy cows were followed by the heifers and any bullocks being fattened (but this could lead to worm problems). Now the sheep should follow the cattle but there are fencing problems. Mr C considers it very important to have adequate fencing so that you can dictate exactly where the stock are to graze. Many of the fields give five heavy grazings, if left uncut. If cut for hay, they yield 100 bales per acre and for silage they give 12 tons/acre (the same yield as he obtained with soluble fertilisers). In addition, the aftermath of both is strip-grazed heavily two or three times. Alternatively, two silage cuts can be obtained, plus one grazing.

A certain amount of opportunity grazing takes place in early winter. Whenever there are dry periods, up to February, the stock are let out of their winter quarters to graze, and silage feeding stops.

Clover has not led to any bloat problems on this farm, but the red clover may have slowed down conception in the dairy herd. Milk yields stayed up so this was not regarded as a problem.

Arable silage. A mixture of peas, oats and vetches was used in preference to Italian ryegrass and red clover because it yielded more heavily (15 tons/acre). It was also a good cover crop for undersowing into. However, the animals preferrred grass silage and in his simplified rotation he no longer bothers to grow the arable mixture.

Rape could be got in quickly after the arable silage. The silage aftermath was rotovated, the seed spun in, harrowed, and rolled once. The aim was not to produce a large crop but to keep the ground covered over the winter, help to smother germinating weeds, and provide a bite for the stock.

Kale is strip-grazed up to the end of January.

Fodder beet. An attempt was made to grow fodder beet using pelleted seed but this was found to be inadvisable as the pelleted seed germinated only slowly and, without the aid of herbicides, the weeds got ahead.

Cereals. Spring barley yields 26-30 cwt per acre. Winter barley is avoided as suppression of weeds over the longer period is regarded as more difficult. A few acres of winter wheat for milling are grown for local consumption, giving about 28 cwt/acre. Sheep are put on the wheat before the end of March to graze it lightly, help it tiller out, and catch a few weeds.

Provision of Plant Nutrients

About 350 tons of FYM are available each year from the cattle's winter quarters. This is taken round all the flatter land about once every 18 months at the rate of about seven ton/acre (4.5 t/acre/year). Muck only goes onto those fields which are to be cropped or conserved. Slurry from the pig unit is also put onto these cropping fields at the rate of 2,000 gals per acre on 20 acres (equivalent to 500 gals/acre/year). No other fertilisers or manures are applied. If Mr C felt a field was really deficient in P,K, lime or any other mineral element, he would ameliorate it, but has not done so, so far.

On the steeper, unmucked land, Mr C will occasionally use some basic slag or rock phosphate.

Weed Control

On the whole, cultivations and smother crops control the weeds but any local dock or thistle problem is spot treated with a knap-sack sprayer. With the exception of one thistle field, the corn is not very dirty. Any thistles in the grassland are cut with a hook whilst walking around. Not a single one is allowed to seed.

The most difficult problem on the farm for Mr C is timing the drilling or sowing of crops in order to beat initial competition from weeds.

Pests and Disease on Crops

There are no problems with pests or plant disease.

Undressed seed is used when available.

Livestock

As on most organic farms, the main difference in livestock management compared with orthodox farming is that the forage and some (when dairying) or all (beef and sheep) of the cereal feed is organically grown.

Dairy cows. Thirty-three Friesian milking cows and about 45 followers, including those being fattened for beef, were carried in 1978. Stocking rate was similar to that on conventional farms at 1.99 Grazing Livestock Units per forage hectare. "Extra acres" of barley had to be bought in to meet approximately 80% of the herd's cereal requirement. It was mixed with 1½ cwt of molassine "Nutrimol" per ton of barley, plus some minerals, and made into cake cubes on the farm to reduce cost. A protein supplement was not needed as the forage or silage contained sufficient. Each cow received about 22 cwt a year for a 1150 gallon lactation over 13½ months (1020 gals/year) at 3.7 to 3.8 to 4.1% butterfat.

There was no need to keep many followers as replacements because the cows remained in the herd for up to 12 lactations. They were calved at three years old to give a big carcase when they were eventually sold. Male and surplus female calves were reared and sold fat.

In winter the cows, and beef cattle, are housed in kennels which are roofed over but otherwise fairly open. The kennel beds are strawed; not enough would be available for a bedded yard. Slurry is pushed over into a pit of straw bales which soak up all liquid and give no run-off problem. The farmer does not compost this material as he considers it is not economically justified. The pit is open to the elements and one wonders what proportion of nutrients is lost.

Foot trouble is the only real veterinary problem he has but he treats this himself. Most of the vet bill was spent on the usual preventative measures.

Beef.. Thirty-five to forty calves are now bought-in in a year in early winter at 3-4 weeks old and given dried milk powder. Mr C tends to buy the lower priced calves so that in a bad year he does not stand to lose so much as someone who has invested in more expensive animals, while in a good year he is "O.K."

At the onset of winter, hay is taken out to the cattle in the fields, but when they are brought indoors, it is silage which is fed using a mechanical cutter and feeder. Some home-grown barley is also fed and kale is strip-grazed till January. The animals are sold fat at 27 to 30 months. As they are not fastidious eaters, there is no problem with control of the cocksfoot in the Clifton Park swards.

Sheep. The original plan was to carry 90 ewes and hoggs in addition to the hoggets. However, the sheep have proved difficult in a number of ways on a fairly small grassland acreage, and will gradually be culled to about 20 ewes to mop up behind the bullocks. Inadequate multistrand fencing, insufficient number of fresh paddocks, no sheep dog, too heavy or rich a sward, and some lack of empathy with sheep anyway did not help. The farmer now thinks that the place for sheep is not on a small lowland stock farm, but on the arable or larger grassland farms.

Markets

Apart from a very small quantity of potatoes and bread wheat sold locally at a perhaps slightly higher price, Mr C does not sell through special markets. He tends to think that Organic Farming should not be supported by premiums, and especially envisages difficulties over setting up an organic meat market.

Why does this farm work and what are the drawbacks

(a) *Management*. Almost by definition, a farm which works is under good management. The farmer has the system carefully thought out and in balance within itself: stocking is appropriate, manuring adequate and crop operations can be done at the right time. Like the other most successful organic farmers, he thinks he could probably farm anywhere organically.

(b) *Output*. Total net output per farm hectare is reasonably high (67% 1977-78, 106% 1979-80 of conventional) compared with several other organic farmers.

Forage production as reflected by the number of stock supported on the forage hectares is the same as that on other more conventional farms in the area, and higher than on many organic farms. Reasons for good grass and fodder crop production may include:

(1) fertility built up by heavy manuring in earlier years

(2) the deep-rooting clover-containing Clifton Park leys

(3) careful grazing control by strip-grazing of heavy stands, followed by unrestricted grazing with a less selective class of stock

(4) the rate of farm yard manure and slurry applied (equivalent to 4½ t/acre/year plus 450 gallons pig slurry) plus bought-in concentrates when dairying (60 tons) seems to be sufficient to maintain this level of productivity on this type of land

(5) the land is free-draining, so poaching difficulties are less constraining on management

(6) the grass is rested from at least February onwards, and to a lesser degree over the rest of the winter as well.

Cereal production. The low yields of cereals emphasise the advisability of concentrating on the good grass-growing ability of the farm, and of enhancing the value of the low cereal yield by feeding it through stock rather than selling it direct. The farmer thinks he used to get about 28 cwt per acre of barley in the 1970's before he went organic.

Incidentally, it has been noticed that seed-bed preparation has become easier.

(c) *Costs*. Variable costs are low.

Crop and fodder variable costs were about one-fifth of those on conventional farms, while animal variable costs (when dairying) were about two-thirds.

Total fixed costs, if put in at their notional values, are higher than on conventional farms because of a high machinery component. However, in practice the farmer is good at maintaining his equipment so some of the cost due to depreciation is overestimated. Furthermore, the high machinery investment buffers him against increases in labour costs.

The farm provides a comfortable income, and is now in a pretty secure and independent position - one of the main goals of the farmer. Slurry from a pig-fattening unit, however, is still used at a rate of about 2,000 gals/acre on 20 acres per year. The nutrient content of this (70 units N, 36 units P_2O_5 and 48 units K_2O per acre) could possibly be crucial for enabling a spring headstart to some fields for grazing or conservation, and hence affect the operation of the rest of the system.

The only difficulty the farmer finds that he has with Organic Farming is timing the drilling or sowing of crops to beat the weeds.

B.2.1.2 A large upland marginal farm (238 ha)

This farm is a low-input farm run on highly disciplined lines, relying more and more on organic methods alone since 1974. A rotation of 5-6 years' pasture, winter cereal, roots and a spring cereal is being developed out of about 170 acres of former permanent pasture. Green manures are being used between main crops. The other 400-odd acres are improved by lime, slag, subsoiling and grazing control. The farmer points out that, to farm organically with success, the farm must have the right equipment and labour to do jobs at the right time. Timing is crucial for Organic Farming.

The main inputs are lime, slag or Gafsa, Alginor (a liquid seaweed product) and some protein and mineral supplement. Chilean nitrate may be added. Herbicides still have to be used to some extent to supplement mechanical cleaning.

The farmer expects the system to make as much per ha as, or more than, conventional farms in the neighbourhood. At the moment output is upwards of 900 lambs, wool, 150 draft ewes, 75 suckled calves six months old or some carried through to fat. All the oats, barley, swedes and turnips are fed through the stock which are outwintered with hay and silage.

The farm lies at 800-1000 feet above sea-level in the north of England. Soils range from peaty, to sandy, to better loamy soils, all fairly acid, over some sort of gleyed clay, somewhat impermeable. Drainage problems are being tackled by subsoiling along the contours, and worm or fissure drainage channels stabilized, apparently, by Alginor.

Weather is the greatest problem associated with the farm, exposed as it is to wind, snow and frosts, and catchy summer weather.

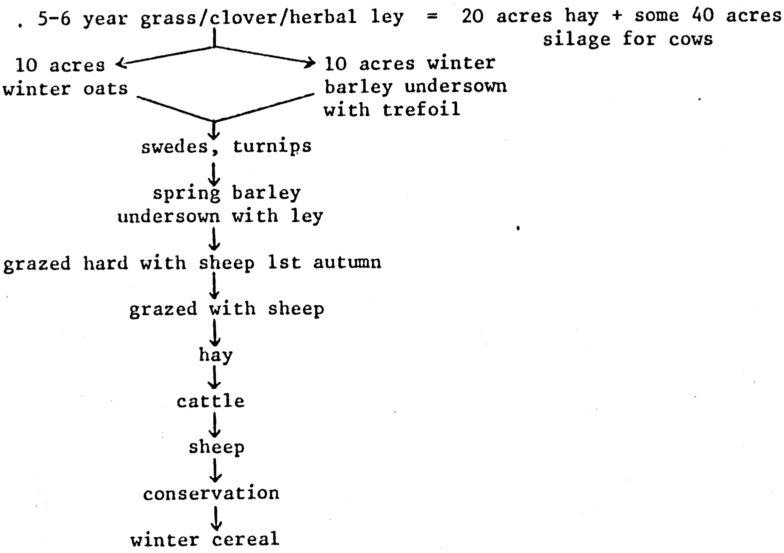
The farmer, influenced by his organically-gardening brother and by local advice, tried managing his permanent pasture, barley and swedes without soluble fertilisers. He was impressed by the results, particularly by the comparative keeping quality of the turnips. Thereafter he moved away from his former conventional farming and got in touch with advisers from organic movements. On the whole, however, he relies largely on his own experimentation to develop suitable methods.

The farmer is now convinced that organic husbandry is the right way to farm; and that the advice and propaganda put out by experts, advisers and representatives is ill-conceived, stupid and wrong. It is virtually a rebellion against them by a highly capable business-like and innovative farmer.

The cost and mode of action of simple soluble fertilisers is disliked. Their role is replaced by more slow-acting minerals (Gafsa) and slag, together with ploughed-in green manures. The farmer is, however, considering using Chilean nitrate to increase the conservation crops. As mentioned earlier, careful design of the system, sufficient equipment, and disciplined labour and timing are his most important tools, and critical to the success of an organic system.

Rotation

Depending on an individual field's idiosyncrasies:



Year 1 1st cereal crop after grass

Oats are grown because they do well at the rather acid pH the grass falls to after six years. Since only 10 acres are required for stock feed, the other 10 are put into barley. Both are winter crops for a number of reasons: higher yield; earlier harvesting before autumn dews set in; spring work-load lightened at lambing; and avoidance of constraints on seed-bed preparation by poor spring weather.

No herbicides are used on this crop.

Year 1-2 In 1979 the farmer was experimenting with sowing *trefoil* under the barley, so that it could be ploughed in as a green manure after the following winter for the roots, which need a good start.

Year 2-3 *Roots*

Roots like a high pH and also a quick start - his neighbours usually provide this by soluble nitrogen fertilisers, but this gives a poor keeping quality.

To favour a quick start, then,

(a) Gafsa (7½ cwt/acre) or slag (10 cwt/acre) is applied the previous autumn

(b) Lime (1 ton per acre) is applied in spring

(c) Seed is sown under prime conditions, all other tasks dropped when the time comes and the seed put in The farmer aims to sow as soon after May 18th as possible.

Year 3 *Spring cereal crop*

The spring cereal crop is easy to manage after roots, having had a good weed cleaning, a tilth worked up, and dunging by the grazing sheep.

The next ley is undersown later, when weeds have been controlled (see Weed Control) and the land warmed up: a good germination is then obtained.

Years 4-9 or 10

About 100 to 120 acres of medium term leys, five to six years long, have been, or are being put into the rotation. The seeds mixture consists of Ryegrasses, Timothies, 1 lb cocksfoot, 5 lb clover and 4 lb herbs. It is hoped the herbs will help counteract a cobalt deficiency found up here.

The grassland is used in rotation for sheep grazing, cattle grazing, and conservation. Fields are cut for hay once, at the most twice, in five years.

Permanent Grass

About 400 acres of permanent grass remain in rig and furrow formation, still retained although other drainage has been put in, because they provide a good deal of contentment to the stock and they do not dry out in the July trough. One field in particular is productive, palatable, non-poaching, and suffers little to no droughting. It would be difficult to replace these grasses, once ploughed.

The permanent pastures must be given a chance in spring to grow away, and then they will do well later. Cattle are turned on in mid to late May.

Nutrient Input

Nutrient input from off the farm is very low at about one ton per acre of lime plus 10 cwt per acre of slag (or 7½ cwt of Gafsa) put on before the root crop of 20 acres. Five cwt/acre of Alginor is put on in the autumn of the first year of the ley. Some Chilean nitrate may be applied to the conservation fields, these yielding about two tons of hay to the acre, with which the farmer is disappointed although for an organic hay crop it is a good yield.

Slag and lime are also used for improving the permanent pastures, and Alginor applied after subsoiling as mentioned later.

The first cereal crop grows out of a long ley; the roots are grown after trefoil has been ploughed in and lime and slag added; and the second cereal crop benefits from the dunging of the animals as they grazed the roots. The farmer sees the provision of sufficient nitrogen as a definite problem.

The farmer uses a vibrating subsoiler to aerate the soil, an important practice on his farm. He has tried applying Alginor after subsoiling and is pleased with the results. He thinks that earthworms take it down their tunnels, and that it also gets into cracks and helps keep these channels open. Use of Alginor is to become a regular practice now.

Weed Control

The farmer has had to use herbicides but tries to do without them.

First cereal crop after ploughing in the long ley has no need of herbicides. Since trefoil is, or may be, sown underneath, it is not possible to do stubble cultivations afterwards to help combat weeds.

Root crop: all of the mechanical cleaning must be done at this stage. The roots are grown on ridges for ease of row- and side-hoeing.

Second cereal crop (spring cereal) is lightly harrowed when 3" high, then again, and - if necessary - herbicides used. It is only after this that the next ley is sown, because the herbs within it are damaged by the spray - though a more expensive one is chosen to avoid damage to the clover.

Pests

Turnip root fly occurs, as do aphids on swedes. The aphids are successfully left to the ladybirds.

Disease

If there is any, the farmer ignores it.

Seed

The farmer intends to keep back his own, undressed.

Livestock

The farm is not heavily stocked. Everything is currently out-wintered, though a shed may be erected to yard and fatten some of his own calves, followed by indoor lambing, and then used for grain handling.

Six to seven hundred ewes are kept plus 75 sucklers and some of last year's calves retained for fattening. Draft Scottish Blackfaces are bought in to cross with a Blue-faced Leicester. The resulting Mule cross is crossed with Suffolk to give fat lambs.

As the ewes lamb, fields without sheep the year before are stocked to half-full during early grass growth, then topped up as more lambs are born and grass production accelerates. Some of the fields are then shut up in early May for conservation.

Clean grass is then provided for the lambs by a succession of aftermaths so that the only time they need worming is at weaning. Thus 20 acres of silage is cut at the end of June, 20 acres of hay in the first week of July, and another 20 acres for silage in August.

Stock on permanent pasture have to be drenched for worms. The farmer is prepared to worm very frequently to clean a field but otherwise keeps it to a minimum. Antibiotics are used for veterinary purposes. The sheep dip used is Youngs Phenol carbolic dip, done twice.

Cobalt, Iron and Copper are deficient on this land. Cobalt, iron and a little copper are given as a drench, while all ewes are injected with copper sulphate before lambing. Cobalt and phosphate minerals are also available in troughs.

As the cropping gets fully established the farmer will only need to buy in protein supplement and even this may be reduced if the silage proves high enough in quality. He expects the organically grown food may go further as in the Haughley experiment.

Swede grazing starts in January. Sheep are given oats before the swedes otherwise they overeat. They are allowed on to the swedes for half-an-hour at first, increasing to half-a-day later.

The cattle are to be given the silage and barley.

Markets

Livestock only is sold, all through the usual channels. In 1979 about 900 lambs were sold (plus 100 kept for replacements), wool, 150 draft ewes, and 75 suckled calves about 6 months old, 3-4 cwt in weight. More calves are to be kept back for feeding further, and the sheep flock gradually increased.

Performance

This has not been ascertained, but the quality of management of the farmer suggests that the organic system will be made very competitive with traditional, conventionally-supported farming in the district.

Barley has averaged a yield of 4.2 T/hectare (34 cwt/acre) out of a ploughed-in ley at about 800 ft and with no fertilisers. Hay is around 5:5 T/ha (2¼ tons/acre), which the farmer thinks too low.

B.2.1.3 A dairying and other livestock farm (97 ha)

This farm has been fully organic since 1948. Two-to seven-year leys alternate with a forage crop, grazed *in situ*, followed by one or two years in cereals. The principle enterprise is a dairy herd, formerly with a small herd of beef cattle and now with some sheep. All the crops are fed to the stock so output is entirely milk and livestock. A small amount of animal feed and hay are brought in to supplement that grown on the farm, but apart from very occasional use of lime and slag there is no other nutrient input, and never has been. Net output per hectare was about 65% of standard in 1977-8. Net farm income was relatively low but, as the land is now owned outright, a good living is obtained from it.

There are two types of reasons for farming organically. Firstly, fertilisers are avoided because they are thought to produce food for which animals and humans are not adapted. The destructive and toxic nature of pesticides and herbicides is much disliked as causing harm to other life in addition to their target. Secondly, apart from objections to use of specific materials, the method of farming is also carried out for more management-type reasons: to cut down on biological stress by not driving anything too hard for higher production and generating problems; to cut down risk in the farm business by low investment in variable inputs; and by both means to cut down stress on the farmer himself.

This is one of the most self-contained of the organic farms, and meets all the goals the farmers seek. Its success perhaps derives from scrupulous attention to the nourishment and well-being of the stock, from balancing livestock numbers with what the land can grow in a moderate year, and from rotation.

The farm is run with a business-like attitude; it has to pay and the farmers seek to obtain as high a rate of return to the system as they can. Cereal yields are about 30-34 cwt per acre and performance per cow is well above average for the breed. With a low stocking rate, returns per hectare of land are substantially lower than average - though up to the farmer's expectations. Financially they are in a stable, low-risk position because variable costs are small, the family can provide quite a lot of the labour, there is no heavy borrowing, and the land - though rented - is owned within the family.

The farmers say they experience no difficulty with the farming. To them this is the whole point, to farm in a way that does not create stress within the system and therefore does not create problems. The most important return is "satisfaction from knowing that the way we grow our crops and the way we rear and treat our animals is good for the family"; they are able to lead the kind of lifestyle they would wish.

Crop Rotation

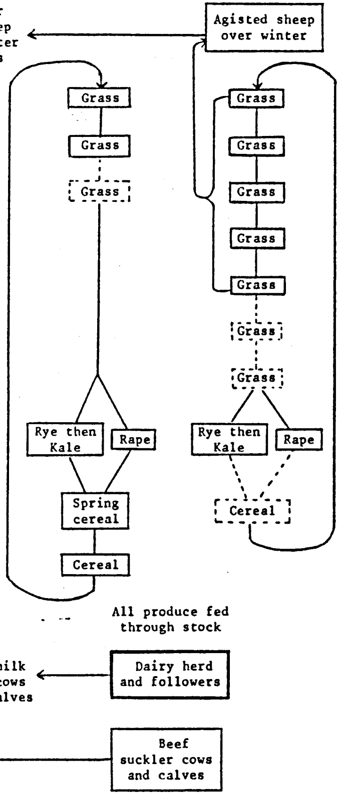
The farm has a western-seaboard type of climate and is exposed. It bridges two types of land: 64% of it lies on thin steep land and the remainder on good reclaimed bogland. Soil is a silty loam. About 23% of the land is down to cereals, 67% to leys, and 11% to fodder crops. Two rotations are used according to the type of land. They are shown in figure B.1, together with inputs, weed, pest and disease control. The predominantly grass and fodder crop rotation is used on the steeper land which, in a dry year, produces only a poor cereal crop. The fuller rotation of 2-3 years' cereal is used on the reclaimed bog.

The two rotations are basically the same but differ in the number of grass and cereal crops grown. Basically, grass is ploughed up, put into a fodder crop or two which are grazed behind electric fences, and then put either straight back into grass, or into one or more cereal crops first. The resown grass is used for conservation and grazing in the first two years and then for grazing only.

Since grassland production is lower than on conventional farms with fertilisers, and begins to fall off as poorer grasses invade, the farmers compensate for this by:

(a) Making quality hay rather than going for quantity. The grass is cut just after heading when still highly digestible; rather over half of it is barn-dried to make particularly high quality and the rest is field-cured. In 1977 about 115^+ tons were obtained off 26 hectares (4.4t/ha, 1.8 t/acre).

OUTPUT — CROP/ENTERPRISE DAIRY, BEEF, HOME-GROWN FEED SYSTEM — INPUTS



Total output sold	Recycled internally	Bought-in manures	Bought-in feed	Bought-in stock	Weed control
Keep for 220 sheep over winter months		rarely - lime used at 2 ton/ac approx every 12 years - slag 8 cwt/ac less than once every 12 years			Docks by hand in seed bed
-	Much white clover in swards				
-					
none sold	FYM approx. one fifth of farm each year at 6.9 ton/acre				Kale grown on ridges - inter-row cultivation. Rye cross-sown in 2 directions to smother. Preparation of seed bed, plus early sowing dates critical to give crop good competitive start. Winter cereal grazed.
160,000 litres milk 6 culled cows 18 dairy calves			10-11 tons dairy concentrates 8 tons sugar beet pulp 1 ton seaweed Molasses 0-10 tons hay	Only occasional purchases of breeding stock	
23 stores					

Figure B.1

(b) Reseeding pastures when they start to go down in production. About 25 acres are reseeded every year with vigorous varieties to provide quick spring growth plus bulk for hay.

(c) An abundance of white clover in summer. The stock are adapted to this, and do not bloat.

Rape is sown in July after the hay has come off. By this time of the year, the farmer can afford to sacrifice a grass field because the aftermath of the other hay fields has become available for grazing.

Rye is sown in the autumn either after a cereal or ploughed up grassland. It is an important aid to the grassland management because it provides an early bite, getting over the problem of slow grass growth in spring without nitrogen fertiliser. Meanwhile clover and grass in the other fields get a better start. Rye also enables kale to follow without needing to plough up another grass field.

Kale is occasionally used to break the grass, but as just mentioned it usually follows the rye so that it does not interrupt the supply of grass at conservation time. The rye is finished by May, ploughed, and put into kale in June. The kale is then grazed in winter and put back to grass in spring, or into a spring cereal crop.

Spring barley or spring oats are sown after the fodder crop has been grazed off. They are followed by winter oats or a small area of winter wheat on the better land. Oats is preferred to barley as a feed for the cattle. According to the contractors, cereal yields are above average for this area at 30^+ cwts per acre.

Weed Control

Weeds do occur and are tolerated to some extent. They are not regarded as a problem.

For the cereals, early sowing dates and good seed-bed preparation are regarded as critical so as to get the seedlings off to a good start. Germinating weed seeds can then be competed with more successfully, and at the same time higher yields are promoted. The farmers aim to get spring cereals sown by the fourth week in March, just as the soil is beginning to warm up and weed seeds germinate. Winter cereals are established as early as possible in September to withstand winter conditions. Weeds are lower in the winter cereals than in the spring.

The kale and rape get quite a lot of Fat Hen and Charlock, possibly affecting the yield of rape. The kale, however, is sown on ridges which are cultivated between, so weeds have less effect.

Rye is cross-sown at half-rate each way to smother the bare ground better. Again sowing date is critical; the farmers aim to get the seed in not later than the first week in September.

Grass is sown either in spring (April) or at the end of the summer (August). There is more of a weed problem in the spring-sown grass from annual weeds, but these are knocked out fairly quickly by mowing at the end of June. Tillering is encouraged at the same time.

If the grass is sown later in the year after a cereal, the seed must be sown by the end of August to get it established. A little weed grows over the winter, largely perennial. However tillering and weed control is again encouraged by a light grazing in about early November.

Daisies spread in the long-established fields sometimes, perhaps indicating a lime deficiency.

Docks that are seen are pulled out by hand during all cultivations prior to sowing. Couch occurs very little on the farm. If cultivations are done in hot weather, tines are used to lift the weeds up to the surface, where they dry out.

Crop Pests and Diseases

Nothing is done about these. Crows are the main problem, for which an increased seeding rate is used. Any seed that the farmers buy tends to be bought dressed as it is a lot cheaper than undressed in this area.

The farmers say there is no significant insect damage but they do get Cabbage White caterpillars on the rape. There is occasional fungal disease but only causing small losses.

Nutrients for Crop Growth

Farm yard manure from covered yards has been spread on about one-fifth of the farm every year at the rate of 6-9 t/acre. With more inwintering this will now increase substantially.

The manure generally goes onto grass at times that tie in with other operations. FYM is always spread before ploughing up a piece of grass for rape or kale.

Lime and slag are spread about once every 12 years or longer at two t/acre and eight cwt/acre respectively.

The only other forms of nutrients coming back onto the farm are about 0.2 t/hectare of cattle feed, plus one ton of seaweed meal and a little hay.

Livestock

The farm has been carrying 48 dairy cows plus followers and a small beef suckler herd. It is now changing to about 60 milking cows and followers, less beef and 40 or more breeding ewes. About 220 sheep are agisted over the winter. Stocking rate is nearly 1.1 GLU/ha, about 60% of standard.

Since the main cash crop is the dairy herd, the whole system is designed to provide feed for the cows throughout the year. The cows are given sort form of green food every day: rape is strip-grazed from mid-October to the end of December; kale from January to early March; and rye from then until mid-April. Four grass fields will have been kept clear of stock all winter, so that they are available to follow the rye whilst other fields are shut up for conservation until June.

The milking herd is now inwintered in bedded yards since numbers became too high to impose on the grassland. High quality barn-dried hay is essential to the winter-feeding programme for the dairy cows, as it keeps dependence on extra bought-in concentrates down. The concentrates are rolled oats, a little barley and - in winter - some high-fat dairy nuts and sugar beet pulp. Three-quarters or more of this is home-grown. Seaweed meal is fed for minerals.

The dry cows, young stock, and any beef animals are outwintered. They are fed field-cured hay, straw and some concentrates. Two hundred and twenty sheep are agisted on the 120 acres or so of grassland that is not being kept for spring grazing.

Inputs, Outputs and Markets

Inputs to the farm are low. The main inputs are 10-25% of the cereal and concentrates used, about 10% of the hay, plus seed and fuel. A little seaweed meal is brought in for the cattle instead of minerals, and very occasionally lime and slag are spread.

In 1977-80, 160, 000 litres of milk were produced, 23 beef stores, six dairy cows and 18 dairy calves, plus grazing keep for 220 agisted sheep. Net output came to 64% of standard, with no fertilisers or bought-in manures.

The dairy herd is now being increased, beef reduced, and a small flock of breeding ewes carried. Output can be expected to increase, possibly with a greater use of bought-in feed.

Milk is sold to the MMB, with a premium for quality. Stock goes through the local markets.

B.2.2.1 A cereals, beef and sheep farm (126 ha)

This farm is a fairly large mixed organic farm following a four-year grass, four-year arable, rotation. There is some dependence on an outside source of pig slurry and, in some years, on semi-organic manures and sewage sludge. Almost nothing is brought on to the farm in the form of animal feed. Very occasional use is made of herbicides. The farm is tenanted and financially viable, Management and Investment Income being above the average for comparable but conventional farms.

The farm extends over 126 hectares of rolling land in the north-east Midlands. Soil is basically sand with clay patches. The association of two very different soils within the same field, interacting with weather conditions, leads to husbandry and drainage problems.

The farmer was brought up in farming and went into partnership with his family who farmed traditionally but used modern chemical inputs. However, in biology classes at school he developed an organic outlook which he put into practice in his garden and, in later years, became able to put into practice on the farm when he took over the tenancy in 1972. He rents it from his father at a commercial rate and has had the same pressures of hefty rent increases as other people have in recent years.

Mr F dislikes using herbicides because they are, by nature, poisons; and he considers that the use of a lot of highly soluble NPK leads to an imbalance in the nutrition of the plant, which leads to other problems. "Health depends on the food provided". One of the factors encouraging him to put organic methods into practice on his farm was a bad copper problem in the later 1960's due to a high nitrogen usage. It had a particularly bad effect on the sheep.

The farm was converted to organic by putting one 30-acre field at a time, each year, into grass. At the end of four years it was dressed with 15 tons/acre of FYM, ploughed up and sown to wheat. The rest of the rotation followed. Sixty-two acres of permanent pasture has also been ploughed up and put into the rotation. The conversion has taken eight years, from 1972 to 1979. Herbicides were discontinued after the rotation had been going for a bit, but weeds still pose problems sometimes and the farmer is still looking for the right mechanical way of dealing with these. Mr F has obtained most of his information on farming organically from books.

Rotation

The rotation has, up until 1980, been four years grass, two years winter cereals (wheat, then oats), one year swedes and kale and turnips for the sheep, and one year spring cereal (wheat) undersown back to grass. However, with £100 per acre fixed costs in 1980, the farm cannot afford to have land tied up for a whole year in sheep roots. They have now been replaced by another cereal crop, winter barley. The barley is harvested in July and followed, if possible, by a catch crop of stubble turnips for the sheep, before putting in the spring crop of wheat. It may prove necessary to bring in more nutrients to the system, and possibly to alter the relative positions of the cereal crops.

Winter wheat is the first crop to be grown out of grass, being the most valuable. A bread-making variety is grown - Widgeon or Flinor - and sold at a 21% premium through Organic Farmers and Growers. Up until now, FYM has been applied at this stage of the rotation, at the rate of 15 tons per acre over 30 acres. Yield obtained is around 30 cwt cleaned and sold. Surplus winter wheat straw, surplus over that needed for bedding, may get chopped, providing it is dry.

Winter oats is put in after the wheat, winter rather than spring oats being aimed for because of the tremendous difference in bushel weight between the two. Spring oats usually yields 28-30 cwt per acre while winter oats gives 30-35 cwt. At the moment, nothing is added in the way of crop nutrients and it is important to get the crop in early to give it a good start. In the future the farmer may look to a little nitrogen fertiliser in an organic or 'naturally-occuring' form (Humber semi-organic manures or Chilean nitrate). The oats are sold at a 21% premium through Organic Farmers and Growers, but the premium would be reduced if Chilean nitrate were applied.

Swedes and kale have then followed, grown in alternating strips as winter fodder for the sheep. The droppings of the sheep contributed to the supply of available crop nutrients for the final cereal crop.

However, the third arable crop is now *winter barley*. Farm Yard manure is going to be applied here instead of earlier in the rotation for the winter wheat. The quantity available will probably be smaller with the change in the beef enterprise. Since the barley is going to be fed to the stock, not sold with a premium, it will be given a spring boost with Chilean nitrate. After harvest, the barley straw will probably be chopped up - if conditions are right - and phosphates added at the rate of 3½-4 cwt acre to help the breakdown. Either rock phosphate or Europhos or super-phosphate will be spread, even if no straw is left behind, because it benefits the stubble turnips following, and then the wheat. Winter barley is preferred to spring because it allows the catch crop of stubble turnips to be put in earlier. Barley, when grown, has given about 30 cwt per acre.

Stubble turnips will be put in if time and weather permit, and used for fattening lambs.

Spring wheat is the last crop in the arable sequence and is sold for bread-making through Organic Farmers and Growers.. Yield is generally 30 cwt per acre but 39 cwt cleaned and sold was obtained in 1980. It is undersown with the four-year grass ley.

Grass. Leys have been based on Timothys, Fescues, a little Ryegrass and white clover. Now deep-rooting herbal leys are used, including a new variety of Cocksfoot called Cambria that is easy to manage. Cambria remains soft and palatable as the season progresses, so the usual problems with Cocksfoot of rejection and build-up of coarse, dense clumps do not arise. The variety is not yet widely available because there are problems multiplying it up. Chicory has caused trouble at mowing - the farm makes hay, not silage - and will have to be reduced in quantity. The seeds mixtures used are:

On heavy land

1.5	kg S24 perennial ryegrass
2	kg S321 perennial ryegrass
4	kg Cambrian Cocksfoot
1.5	kg Pecora Timothy
1	kg Milkanova white clover
1	kg Mixed herbs (chicory, ribgrass and sheeps parsley)
11	kg/acre @ £17.25 (1979)

On light land

2	kg S24 ryegrass
3.5	kg Rossa Meadow Fescue
3.5	kg Cambria Cocksfoot
0.5	kg Erecta Timothy
0.75	kg Milkanova white clover
0.75	kg Huia white clover
1	kg Mixed herbs
12	kg/acre @ £17.55 (1979)

Grassland productivity is comparable with conventional according to the MLC sheep recording scheme. Just over two tons of hay are taken off per acre (100 bales; 5 tonnes/hectare), as well as grazing. Slurry generally goes on about twice in four years at the rate of 2000 gallons per acre. This slurry comes in free from a neighbouring pig farm two miles away. Chickweed problems have followed pig and duck slurry application, so it is put onto grass rather than arable land. The nearer the slurry application is to the crop, the worse the weed problem.

The other nutrient input to the grassland is nitrogen fixed by the clover. The farm aims at 40% of clover in the sward. So far bloat has not occurred, even with the bought-in calves recently introduced to the system.

Provision of Plant Nutrients

1. The fixing of nitrogen by swards containing up to 40% of white clover.

2. The use of deep-rooting grasses and herbs, ploughed in after four years.

3. The application of composted FYM once during the eight-year rotation, onto the arable section at 15 tons per acre x 30

acres. The rate may be reduced in the future as less FYM is generated on the farm.

The farm-yard manure is made into compost without involving very much more time and labour than would be needed to clean it out anyway. The manure is tipped out of the back of a cart into a long heap about 4-5 ft high - the height of the tipper. Two long rows are laid out in this way, adjacent to one another. Two weeks later, following some rain to provide moisture, the two sides of the heap are lifted towards the centre with a fore-mounted loader, to make one row. The heap then reheats and is left for 4-5 months.

The sheds are cleaned out on wet days in May, taking 10 days in all to clear and lay out the long heaps. It then only takes a day to turn them in towards the centre two weeks later. In September the rotted manure is spread on the ground before a cereal crop. Spreading takes about three days, doing 10 acres a day. Contractors may be used, for instance it cost £300 in 1979 for 30 acres.

4. Two thousand gallons per week of pig slurry are delivered free to the farm from two miles away, and spread on the grassland at the rate of 2,000 gallons per acre. A total of 100,000 gallons are delivered. Occasionally, free duck slurry is also obtained. The problem with chickweed seeds has already been mentioned.

5. Dewmus - dried, heat-treated, sewage sludge from Yorkshire - has now been discontinued because of the transport cost. A 20-ton grain lorry will only carry eight tons of Dewmus.

6. Humber semi-organic manures have been used occasionally when there has not been enough FYM and slurry. A little has been put on first-year grass, and some on the fourth year of the arable sequence.

7. Chilean nitrate may be used in early spring to suit the modern varieties of cereal: "25-30 units N may be reasonable on a high-organic-content farm".

8. The sheep strip-grazing the fodder crops may refurbish some fertility.

9. Basic slag (five cwt/acre) and lime (two tons/acre) are spread once every eight years.

10. The straw of the wheat and the barley is sometimes chopped, if it is dry enough, and 3½-4 cwt of rock phosphate, slag, or superphosphate added.

11. Occasionally, SM3 and Maxicrop - both liquid seaweed products are sprayed on to improve the quality of the grain. They contain nutrients, trace elements and cytokinins (plant hormones).

Weed Control

Weed control poses the most difficult organic husbandry problem on this farm. Couch is the most difficult; it builds up on the light sandy land when the soil lies wet. Autumn cultivations are used to drag it up, normal practice in this area. The farmer thinks that at some time it may prove necessary to use Roundup on two-to-three acre patches within a field, where sand has lain wet.

A very small amount of cultivation is also done within standing crops using an old-fashioned Fergie weeder, but the crops have got to be drilled carefully. When the weeder that is being copied in this country for Organic Farmers and Growers comes into production, the farmer will probably buy one of these.

Half-strength MCPA, diluted with water, has been used on occasion in the past.

Redshank (willow-weed) also occurs in fields in between the sand and clay. Fathen grows on the sand sometimes and, as organic matter builds up, chickweed is going to increase. It is already being brought in with the slurry but at least it has to compete with an established sward.

Pest Control

Pests are not a problem, even when the neighbour has had aphids. Possible reasons may be the proximity of a wood, harbouring predators; that the land is not in the direct path of the wind carrying the aphids; and that the plants are, for some reason, physically more resistant.

Fungal diseases are not looked for, but he is not aware of any problem.

Seed

First generation seed is dressed, but usually he gets undressed seed from Organic Farmers and Growers, or saves his own.

Livestock

The farm carries both sheep and cattle. Changes have recently taken place in their management - with the sheep because of the switch from roots to winter barley, and with the cattle because sucklers are no longer as profitable as they used to be in 1972 when the system was set up. Management of the stock is much the same as on conventional farms with the major exception being that they are fed on organically-grown produce. Only a small quantity of soya-bean is bought in for protein, and high Magnesium minerals. The stock are sold through the usual orthodox channels (Select Livestock Producers) without any premium attached.

Sheep. 245 ewes, 50 one-year-old replacements, six or seven rams and the lambs sold fat - have been run on about 24 acres of grass, 30 acres of turnips and six acres of kale and swedes, outdoors all the year round. Now numbers are being increased and the sheep inwintered from 1st February to lambing in late March. By lambing in late March it is hoped to get the lambs off fat from grass only, now that the root year has been done away with. The farmer likes to give fishmeal to the ewes just before lambing.

The home-bred flock of Cluns and Clun crosses have been added to by bought-in Mules. Ewes are tupped with a Suffolk and in 1979 gave a lambing percentage of 160 from 195 ewes and 48 gimmers.

Most of the sheeps' vet bill of about £1.22 per ewe-plus-lambs goes on Covexin and lambing. £1.22 is the same as the average on conventional farms. One of the biggest problems is pulpy kidney, even on the organic system. The flock is run on a clean-pasture sequence to keep down worms. The sheep are run on one half of the grassland one year, the cattle on the other half. The following year the stock are switched over. Ewes are drenched 48 hours after lambing, the lambs get drenched two or three times: in June, at weaning, and perhaps one time in between. Antibiotics, as with the cattle, are used under the vet's recommendation.

Cattle. The 50-strong Angus x Lincoln Red suckler herd, viable in 1972, has had to be fattened out and sold over 1979 and 1980, to be replaced by beef-rearing from bought-in Hereford x Friesian calves.

Typically, 50 fat cattle used to be turned out a year. The sucklers consistently had a calving index of 365 days, and lived for about 10 years. Fertility has never been a problem on this farm, before or after going organic. Staggers, an occasional problem throughout the year, has not changed either, neither with going organic nor with feeding magnesium.

Now calves are bought in at 10 weeks old and are to be sold fat at 18 months. They will be fed on home-grown barley and hay in the winter. It is anticipated that the farm will carry 100 calves aged 3-18 months, 75 being bought in per year.

So far bloat has not occurred in the bought-in stock. Perhaps the main or only drawback of this new enterprise will be the borrowing charges if any calves are bought in at an awkward time of the year.

Why does this farm work?

(a) One senses that it is under sensitive, good management, with the farmer thoroughly at home with what is going on, able to balance changes in one enterprise with changes in another according to conditions.

(b) the rather lower cereal yields than average are compensated for by a 20% premium so the gross monetary output per acre is, on the whole, within the range of similar, but conventional farms in the area.

At the moment a premium is essential if borrowing charges are to be met. With changes in input prices, and perhaps increasing inherent fertility as the grass goes round a few more times, the need for a premium may alter.

(c) Grassland productivity is high compared with other organic farms, reflected in a stocking rate as heavy as that on the better arable, sheep and beef farms in the area. Perhaps this increases the cycling of nutrients, and therefore their availability. Livestock output per hectare is comparable to that on conventional farms with no special outlet premium, or possibly a little lower.

(d) Variable costs are low, about 48% of that on conventional farms, but fixed costs are more similar (81%).

(e) Only the equivalent of two men work the 312 acres.

Main Problems

1. Mixture of two very different soils
2. Weather
3. Weed control

It is the variance of the soils here, and the weather interacting that cause the problems.

4. Fixed costs, including borrowing charges, going up at a faster rate than produce prices.
5. The introduction of a fourth year of cereals to replace the sheep roots may require more input of nutrients from outside.

B.2.2.2 A dairy farm with beef, poultry, potatoes and vegetables (151 ha)

This is a substantially organic farm which has converted from a more traditional conventional system over the past five years. A rotation of short to medium-term leys, cereals and fodder crops is supported by a moderate to high input of bought-in materials: poultry litter, Humber semi-organic manures, nitro-chalk and some herbicide. Everything gets extra nitrogen in some form or another. Permanent grass is to be established on outlying land. Calf-food and soya-bean meal are brought in to supplement the home-grown stock feed. The farm is now paying its way well, having weathered losses for a number of years with the help of other income. Crop yields per hectare are comparable to those on conventional farms. Dairy yields are to be improved by a change of breed and a higher use of concentrates.

The farmland covers over 150 hectares of good flat low-lying grade A1 land in the south of England. Soil is deep and silty, with high ground-water in part, but it has been known to dry out in summer. There are no inherent difficulties to the farm. About one-fifth of it is rented, the rest is owned.

The owner came into contact with people concerned about the food people eat. News reports were coming in at the same time of troubles with Aldrin and DDT, and he became conscious of the dangers that sprays can pose. In 1974, fertilisers and sprays on the farm were stopped overnight with poor results. So instead these materials were cut down gradually according to the individual needs of a field, while the structure and nutrient content of the soil has been built up with large quantities of muck, some of it imported from elsewhere.

The place of grass on the farm has had to be re-thought out so that it contributes effectively to a system which no longer has recourse to conventional inputs. The cropping is still in a process of adjustment, particularly the outlying fields which the dairy herd cannot use effectively.

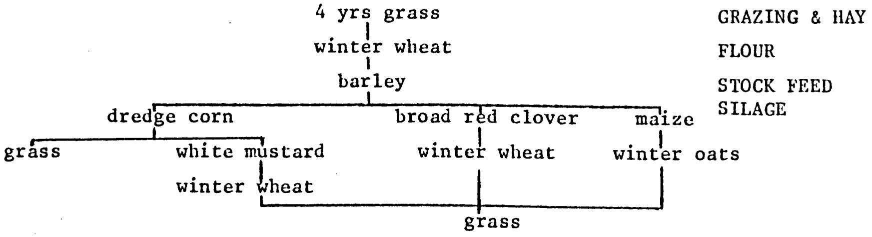
All farm staff have been on courses to learn about the new approach.

The farmers feel they are fulfilling their objective to produce food for stock and people that is naturally grown. They regard this as their "profit". The farm also produces a net farm income per hectare above average for the (small sample) of farms in the area carrying the same enterprises, but it would be a lot lower if they did not sell the wheat as flour.

Cropping Plan

The farm is to be run on two systems. The greater part, nearer the buildings, follows a ley-arable rotation and carries a dairy herd. Land further away is tidal, wet, and grows grass well; it is to be put down to permanent pasture for beef from the dairy herd.

The rotation is roughly four years of grass followed by three or four years arable according to the crops grown and the amount of manure put on:



- plus a few acres of kale and potatoes.

Grass

Up till recently a Cockle Park mix has been used, with Chicory, Sheeps Parsley, Burnet and Yarrow added. The inclusion of herbs caused the farmer to stop his regular practice (which had always been important to him) of topping and chain-harrowing directly behind the cows; it was necessary to let the herbs flower to keep them in the sward.

Cocksfoot used to be avoided because of its management difficulties and the need for topping. However, more recently, a Clifton Park mix of Italian Ryegrass, three Perennial Ryegrasses, two Cocksfoots, three Timothys, Red and White Clover, and herbs has been put down with good results. It does not yield as well as a straight Ryegrass mixture but it is believed to be of better value for the stock on account of its variety and the minerals in the herbs.

As an insurance policy against drought, five acres of a Cocksfoot plus New Zealand white clover five-year ley has also just been put in.

Wheat

Wheat is grown:

(a) after grass

(b) after dredge corn followed by a heavy dressing (up to 50 tons) of FYM

(c) after Red Clover

About two cwt/acre of Humber No.4 or No.12 is used on the wheat; yields are two tons per acre (4.9 T/ha).

Last year all the wheat land had to be sprayed with a pre-emergence spray against black grass. However, this land has not yet been through the whole rotation and it hoped that with land down to four years of grass the problem will be removed.

The farm is looking for a wheat of good milling quality. It has been using Maris Widgeon but now the ground is getting too good for it, it gets laid, and it also suffers the drawback of being winter soft. They find Bouquet is good under their system and this year are trying Bounty.

The wheat has been stone-ground and sold as flour for four years now. It is sold off gradually all the year round, but ideally the farm would like to sell some off in bulk after harvest to help with their cash flow. As it stands, the maize, dredge corn and hay are harvested in summer and fed in winter, with no immediate cash return to reduce borrowing charges; while the barley and wheat get used or sold steadily throughout the year.

The outlet for the flour is through health-food shops and the farm shop. A transport firm deliver it.

Barley

Winter barley is grown in preference to spring barley whenever possible (a) for the yield and (b) for its earlier harvesting date, enabling the next crop to be sown quickly. A two-sided variety is grown rather than a six-sided as it has a fuller grain which is better for the stock - less spiky. Yield is two tons per acre, using 1½ cwt/acre of Humber fertiliser in spring.

In planning the farm, it has been reckoned up to now that 70 acres of barley are needed to provide the 140 tons for the stock. It seems likely, however, that when the outlying land is put back to permanent pasture, there will be a need to import some cereal and concentrate food.

Oats

A small amount (10-20 acres) is grown for variety and to provide a soft grain to feed the calves. Yield again is around two ton/acre, with 1½ cwt/acre of Humber semi-organic manure.

Dredge-corn

Fourteen lbs wheat, oats and barley, plus 15 lbs tares per acre are sown in autumn, following an early harvest of barley. The dredge-corn is cut in the second week of May when the barley is just coming into ear, and made into arable silage. Forty acres are needed. Dredge-corn is made in preference to grass silage because of the greater range of species involved.

After cutting, the field is either sown directly to grass or dunged heavily and put into white mustard. The white mustard gets ploughed in by the autumn and is followed by winter wheat.

Red Clover

Broad-leaved Red Clover has been brought in to the rotation as a further way of preparing the ground for wheat, because there is insufficient dung to dress all the land that has been in dredge-corn. The clover itself is cut for silage and again for hay in August, and the aftermath ploughed in.

Maize

Maize is a cleaning crop generally before oats since a pre-emergence spray is used on it against wild oats, which makes it a good preparation for the oats. The maize (about 25 acres) is made into silage.

Kale

Ten acres are grown close to the dairy for strip-grazing by the dairy cows up to Christmas.

Building up and Maintaining Soil Fertility

Own resources

1. Ploughing in the four-year ley.

2. Nitrogen-fixation by white clover in the four-year ley.

3. Nitrogen-fixation by the red clover crop. The aftermath is used as a green manure.

4. Recycling of straw through:

    (a) cattle bedding (barley and oat straw). An intensive effort is being made to build up the fertility of the fields by applying 40-60 tons per acre of FYM on arable land.

    (b) chopping wheat straw and turning in. Care is taken to press it into the ground because otherwise an airlock is formed which leads to poor germination. Experimental strips with slag applied showed no extra benefit.

5. 400 chickens are run behind the cattle in summer.

Bought-in organic wastes

The farmer is prepared to buy in unlimited quantities of manure and still considers he is not getting enough:

6. Deep-litter poultry manure. After a visit to another organic farm, the farmer realised that he had to bring in nitrogen. About 12 tons per week (624 tons/year) is brought in from about four miles away at a cost of about £1.25 per ton (1979). The deep litter is considered essential at the moment.

    Some of it is mixed with FYM, the rest goes on the grass at the beginning of the winter at the rate of about six ton/acre. If put on any later, the cattle would not eat the grass.

7. Spent mushroom compost is brought in from two miles away - 100 loads in 1979 at £5/load, but sometimes up to 250 loads are bought.

    Slurry from the dairy is soaked into the mushroom compost, which absorbs it like blotting paper. Chalk in the compost helps to keep up soil pH.

Bought-in fertilisers

8. Semi-organic manures. The farmer is a great advocate of Humber manures. One-and-a-half, occasionally two, cwt per acre are applied to all the cereals including the dredgecorn, but it is no longer used on grass because of the expense.

9. Nitrochalk has now been substituted for Humber manures on that grassland for which there is not enough poultry manure; it costs only half as much as the Humber manures. Two cwt of Nitrochalk (50 units N) are applied on this land after the first grazing if it needs it, to ensure a quick regrowth. The first grazing itself is always adequate.

The farmer made a comparison of his different methods of manuring the pasture, using 12 of the one acre paddocks, three for each treatment.

Treatment:	Nothing applied	Chicken manure at 6 ton/acre (138 units N)	Nitrochalk at 2 cwt/ac (50 units N)	Humber semi-organic fertiliser (24 units N)
Results:				
1st grazing	Ate down bare	Avoided	Ate not quite so well	Ate very well
2nd grazing	Not much there	Ate better. As the season went on, this grass did the cows better and produced more.	Ate quite well, still a bit rejected.	Ate very well

Under the present system of using Nitrochalk and deep-litter poultry manure, the grassland, kale and silage crops supported the grazing of 1.88 Grazing Livestock Units per hectare in 1979, including about 80 tons of hay off the 116 grass acres (equivalent to 15 cwt per acre).

All crops and forage crops receive extra nitrogen in some form or another.

Weeds

Herbicides have to be used sometimes. At the moment, black-grass is becoming a problem in certain fields which have been too far from the dairy to put down to a pasture break. A pre-emergence spray has been used extensively on this. A bastard fallow is going to be used to clean the land.

Maize also needs to have a pre-emergence spray on it.

Otherwise sprays are seldom used; half-rate MCPA would be used to suppress weed growth where a lot had germinated. Weeds in the winter cereals are harrowed out in spring. Potatoes are rolled and harrowed.

Redshank in the clover was made into silage before it could seed. Bad couch in one field was successfully cleared by a bastard fallow during the whole of one summer.

The farmer thinks they should purchase a secondary cleaner for the combine to deal with weed seeds, with either another bin or a grinder to grind up the seeds. Milk thistles block the combine sieves.

Pests

On one occasion two bad wheat fields were sprayed for aphids and two cows went blind. Now the farm will not spray even if they risk losing some of the crop. Neighbours spray regularly. On this farm, ladybirds make their appearance about one week after the aphids, so the farmer prefers to live with any pests that arise.

Wire-worm damage was experienced on two fields of winter wheat this year (1980). Ploughing in mustard helps to prevent this, as does rolling then sowing of a spring rather than a winter crop on land known to be infested.

Seed

Seed is dressed, even the home-grown cereal seed that is saved once a variety has been found to be acceptable.

Livestock

The dairy herd consists of 119 pedigree Ayshires plus 10 heifers-in-calf for replacements. Cows reach an average age of 8-9 years, some 12, so there is only a 9% replacement rate. The herd is now being crossed out with Friesians to bring in a better calf price. The poorer 50% of the Ayshires are being put to Hereford and Limousin: the Hereford white face suits the local market and the Limousin matures earlier. The better cows are crossed with Freisian and the bull calves reared for beef, together with the other crosses. Cattle are never bought in.

The dairy cows run on about 68 acres of grazing divided into one-acre paddocks. Two paddocks are provided a day because of the damage that treading can cause (there is a high water table). The stock are brought in early in the autumn for the same reason.

Up to now the cows have been given a home-mixed concentrate ration of home-grown barley and purchased soya meal, each cow getting just over one ton a year and giving 760 to 900 gallons of milk at 4.2% butterfat and 8.8% SNF. The ration is now going to be supplemented with some bought-in dairy cake to raise yields. In winter they get maize, red clover and dredge-corn silages, plus hay.

Calves get a high-fat milk substitute once a day and then go on to hay and bought-in calf weaner nuts and cake, plus some home-grown oats.

Phosphate deficiency is a problem with the cattle (though clover grows well) and high phosphate minerals are supplied.

Calcified seaweed has not proved useful here. In the past, Irish-calcified seaweed did not help, it may even have worsened a fertility problem, while the sharper Cornish or Brittany seaweed "irritated the calves" stomachs. Calcified seaweed on the pasture also had no effect on grass production, but it was only tried twice.

There is no longer a fertility problem. Standard veterinary products and procedures are used.

Markets

Milk and stock are sold through the conventional channels, though a very little meat goes into the farm shop.

The wheat is stone-ground on the farm and sold through a substantial number of wholefood and health-food shops, through their own farm shop, and to individual customers.

Potatoes, vegetables, eggs and some milk are sold through the farm shop.

The price obtained for the wheat is substantially increased because it is sold processed rather than whole. The potatoes receive a small premium of about 10% but they have to compete with the neighbour's.

Main Problems

High labour costs: Six-and-a-half people work the farm, rather than four. The muck requires a lot of handling, plus the wheat processing, vegetables and poultry take up time.

Weeds: The business cannot afford to lose weight off the crop.

B.3.1 Arable rotation with livestock (47 ha)

This farm has been almost entirely organic since 1949 apart from the occasional use of herbicides, partly in consideration for the neighbour who grows seed corn. Up until very recently, sheep have been closely interlinked with the largely arable system. The labour needed has become a problem, however, as the farmer grows older, and so they have now been sold. Wheat, oats, barley and hay are still grown but with fewer fodder break crops in the rotation. All but the barley is sold. This goes to fatten bought-in stores in straw-bedded yards. Corresponding to this high output of nutrients off the farm, there is a very high input of manures, treated sewage and rock phosphate or slag from outside sources.

The farm is owned, generally makes a small profit, and has been able to keep going for 30 years. The former system with the sheep seems one of particular interest, together with the farmer's fairly substantial use of treated sewage sludge (and pig slurry).

The farm is on a medium loam overlying chalk in the north-east of England. It is thought to be less susceptible to drought or to becoming too wet to work, compared to the neighbouring farms. Seed bed preparation seems to be easier.

The farmer was brought up in traditional rotational farming and came across the writings of the organic movement in the 1940's. When he returned from abroad and took over the family farm, he went in for an organic system straight away. The farmer is much less concerned with the level of profit he makes than with the production of food under conditions that are likely to promote 'balance, health and vigour' - both in the crops and animals themselves, and in the people who eat them.

Rotations

The rotation used until recently is shown in diagram B2. The six-year rotation alternated between one cereal crop and one forage or root crop. Two-and-a-half cash crops (wheat, oats and half a block in potatoes) were sold off a field every six years, one cereal crop (barley) was fed through the bought-in store cattle for fattening, and the remaining material grown was fed through sheep.

The presence of a sheep flock enabled more break crops to be incorporated and utilised in an otherwise cereal rotation. Yarded cattle enabled full use of straw byproducts and added value to the barley.

The rotation that is now being adopted is:

1. A one year ley of Ryegrasses and Red Clover well manured with pig slurry, is cut and sold for hay. The aftermath is grazed by the neighbour's sheep, then ploughed in for:

2. *Winter wheat.*

   After harvest, the wheat straw is chopped and sometimes

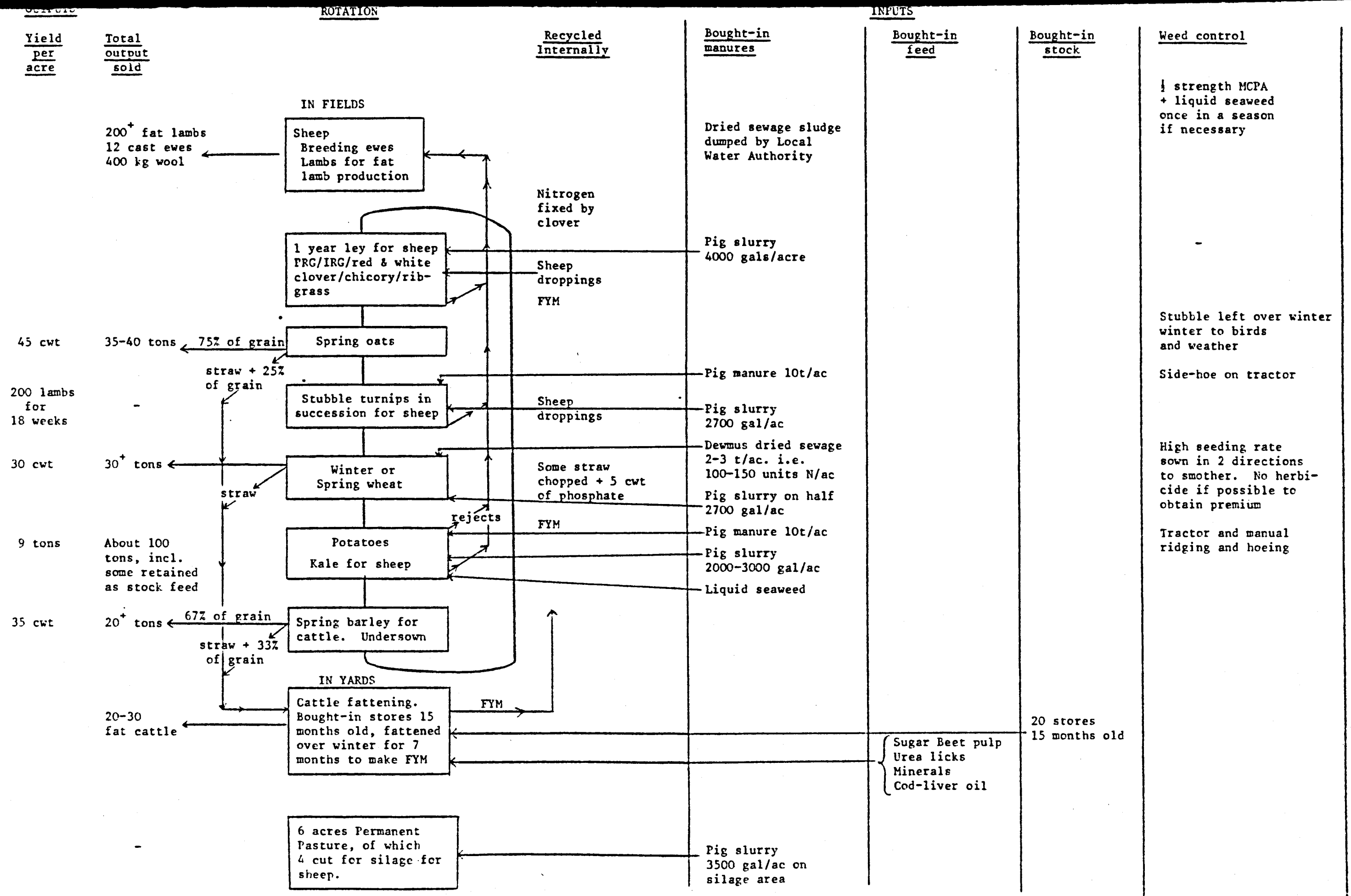

ROTATION
INPUTS
Yield per acre
Total output sold
Recycled Internally
Bought-in manures
Bought-in feed
Bought-in stock
Weed control
IN FIELDS
200+ fat lambs
12 cast ewes
400 kg wool
Sheep
Breeding ewes
Lambs for fat lamb production
Dried sewage sludge dumped by Local Water Authority
½ strength MCPA + liquid seaweed once in a season if necessary
Nitrogen fixed by clover
1 year ley for sheep PRG/IRG/red & white clover/chicory/rib-grass
Pig slurry 4000 gals/acre
Sheep droppings
FYM
-
45 cwt
35-40 tons
75% of grain
Spring oats
Stubble left over winter winter to birds and weather
straw + 25% of grain
Pig manure 10t/ac
Side-hoe on tractor
200 lambs for 18 weeks
-
Stubble turnips in succession for sheep
Sheep droppings
Pig slurry 2700 gal/ac
30 cwt
30+ tons
Winter or Spring wheat
straw
Dewmus dried sewage 2-3 t/ac. i.e. 100-150 units N/ac
Some straw chopped + 5 cwt of phosphate
Pig slurry on half 2700 gal/ac
High seeding rate sown in 2 directions to smother. No herbicide if possible to obtain premium
rejects
FYM
9 tons
About 100 tons, incl. some retained as stock feed
Potatoes
Kale for sheep
Pig manure 10t/ac
Pig slurry 2000-3000 gal/ac
Liquid seaweed
Tractor and manual ridging and hoeing
35 cwt
20+ tons
67% of grain
Spring barley for cattle. Undersown
straw + 33% of grain
IN YARDS
20-30 fat cattle
Cattle fattening. Bought-in stores 15 months old, fattened over winter for 7 months to make FYM
FYM
20 stores 15 months old
Sugar Beet pulp
Urea licks
Minerals
Cod-liver oil
-
6 acres Permanent Pasture, of which 4 cut for silage for sheep.
Pig slurry 3500 gal/ac on silage area

Figure B.2

basic slag or rock phosphate spread. The straw is rotovated very shallowly into the top two to three inches of soil.

3. *Spring oats.*

   After harvest the stubble will be left untouched till the New Year to give the birds and the weather a chance to clear the wild oats.

4. In spring it will be put into a green manure fallow such as mustard, once or twice, and in between times cultivated to bring up the couch.

5. Winter wheat.

6. Spring barley, undersown with the Red Clover/Ryegrass one-year ley.

There will thus be a break-crop to the cereals every two years, instead of every other year. Rather more cattle will be yarded for fattening, and there will be no sheep.

Nutrient Inputs

1. *Pig slurry* and

2. *Pig muck* with straw, are imported from a nearby farm. The slurry is free for the carting: it takes one man plus a tractor about 30 minutes per load, each load consisting of about 900 gallons. As much as 180,000 gallons or more are collected per year and spread at 2,000 to 4,000 gallons per acre.

   The pig muck is paid for and spread at 10 tons to the acre. It cost £1 per ton in 1977-8 for 298 tons.

3. *Dewmus* dried heat-treated sewage is sometimes put on before wheat. In 1979 it cost about £11.50 per ton and £3-£4 for delivery. Two tons are spread per acre to provide about 100 units N at a cost of £30-£35 per acre. Three tons are spread on fields low in organic matter.

4. The *Local Water Authority* dumps residential dried, pressed, *sewage sludge* free. One year the farmer put about six tons per acre on 20 acres.

5. Occasionally all organic waste supplies fail to materialise - e.g. an outbreak of SVD in pigs, breakdown of the sewage plant - in which case the farmer has to buy in *Humber Manures*.

6. *Basic slag or rock phosphate* are applied to chopped straw after harvest at the rate of five cwt/acre. This is to become regular practice now.

7. *Red Clover* in the one-year ley, before wheat.

8. *Green manure* (mustard) ploughed in before the second wheat crop.

9. *Liquid seaweed* (SM3 and Maxicrop) - though these are primarily used as a dilutant to MCPA herbicides rather than as sources of nutrients.

Weed Control

As far as possible the farmer relies on rotation, on mechanical cultivations, cross-sowing, fallowing and hand-roguing. However, partly because he has to keep tight control over wild-oats because his neighbour grows seed corn, and partly because plenty of other weeds still occur, he sometimes has to use herbicides.

He particularly tries to avoid herbicides on the wheat so that it can be sold at full premium. The seed is cross-sown in 4½" rows with the angle between the two directions somewhat acute, so increasing the area of ground smothered by the crop. Sowing rate seems to be particularly critical: part of a field sown in the autumn at 12½ stone/acre yielded a thick clean crop, while the other part sown the same day under ideal drilling conditions at 11½ stone/acre was thinner and red with poppies.

When a crop is sprayed with MCPA, it is used at one-half or even one-quarter strength, diluted by liquid seaweed. The combination seems to work just as well as full-strength MCPA on its own, and has been practised for five years now.

Bastard (i.e. short-term) fallowing and cultivations are used to bring up couch. Flexiharrows are used first, then a spike-rotovator, then a chisel plough to get at deeper bits, and then a flexiharrow again to collect bits onto the surface. The process is repeated once or twice at intervals of three weeks.

Mechanical weeding is also done on the potatoes and stubble turnips. One year nearly £700 had to be spent hand-roguing wild oats in potatoes and other crops - an unusual event but in a poor potato year it further increased the loss made on the high investment.

Weed control and sufficient labour for the whole sheep rotation are the biggest problems on this farm.

Pests

There is never sufficient trouble to contemplate spraying, even when the neighbour's cereals are infested.

A bit of fungus disease occurs - rust and mildew - but "never sufficient to take action", and he would be very loathe to do so. All seed sown is undressed, through an arrangement with the local merchant.

The farmer tries to minimise potato blight by choice of variety, Desirée being fairly resistant.

Stock

Virtually all of the feed for the sheep was organically home-grown, occasionally supplemented by extra protein and feed blocks, or liquid urea. Silage was made on a few acres of permanent pasture.

The bought-in cattle on the other hand were fed on home-grown barley and straw plus bought-in by-products - sugar beet pulp, ensiled brewers' grains, stockfeed potatoes and urea licks for the straw.

The ewes were considered to be healthier because they were fed organically as opposed to heavily nitrogened grass. Vet visits were for lambing difficulties, occasional ewe mastitis, and transit disease in the bullocks. The usual vaccinations, dips and medicines were used when necessary, and cod-liver oil, sea-weed meal and minerals fed.

Markets

The cereals and potatoes (now given up) are almost all sold through Organic Farmers and Growers at a premium according to whether herbicides have had to be used or not. There was no premium available for the sheep, and the cattle would not qualify as they are only bought in at 15 months.

Performance

Some premium seems to be essential to the viability of the farm, not to compensate for lower productivity - for this seems to be comparable to the average for the area - but because labour and to some extent machinery costs per hectare were very high. This is not surprising on a relatively small farm with many enterprises, and where much time and effort has to be put into both handling the bought-in manures, and into managing the sheep.

The success or failure of the potato crop also had a very big effect on the farm's financial position in any one year. This high risk crop has been dropped.

B.4.1 Organic cropping under glass (0.57 ha)

On this holding, 0.47 hectares of tomatoes and 0.1 hectares of cucumbers have been grown successfully under glass and in polythene tunnels by organic methods alone since 1976. Before that, the growers worked their business conventionally but were unhappy with the continual dependence on fungicides and insecticides. They felt there must be a way to grow crops such that they did not require the use of chemicides posing dangers to the consumer and operator. It was only after a visit to organic holdings in Europe with the aid of a Winston Churchill Scholarship that they were able to obtain sufficient information to change to an organic system.

A yield of about 96 tons/acre (237 t/ha) of tomatoes is obtained, and 133,360 cucumbers/acre (330,000 per ha).

The monetary returns from the business are well up within the range of returns published for specialist glasshouse nurseries within their area. It is not possible to be more analytical about the comparison because the figures published are an amalgam of different specialities, and are based on only a small number of holdings. In specialist glasshouse growing, the agricultural materials comprise only a very small proportion of total costs; heating, machinery and labour are the major items of expenditure. This particular organic holding is subject to the same major costs as conventional growers, using as it does all the irrigation, heating, ventilation and propagation technology available to them.

A very different approach to culturing the plants is, however, equally able to meet these high overhead costs. The local ADAS people are interested in his system and are monitoring nutrient and salt levels in the soil regularly. According to their analyses, both soluble salts (the"P.C. rating") and potash are theoretically too low but they do not show up in the expected disease symptoms.

Tomatoes

Preparation of ground

Plants are pulled up in November.

At the moment the old soil is ploughed up and steam-sterilized each year. The grower dislikes doing this as it kills off beneficial as well as harmful organisms. He is now attempting to reduce the frequency of sterilising by a trial of grafting new plants onto existing disease-resistant root-stock.

The buildings are washed out with a proprietary agent, again an alternative (to formaldehyde) is being sought because it is unpleasant to work with.

Around 40-50 tons per acre of well-rotted compost is then brought in. The compost has been prepared over the previous year from about 100 tons of FYM, some extra straw, and the tomato leaf waste but no stem. He uses cow manure mainly, and some horse, but no poultry as this is too acid and may contain high levels of zinc and copper from feeding stuffs. The materials are spread out in a long heap by muck spreader, in a shredded, loose, aerated form. Aeration holes are made down through the length of the heap using a stake. The heap rots down to about 50 tons of compost.

Raising of plants

Tomato seed is sown at the beginning of January and germinated under banks of fluorescent lights giving a 12-hour day length. The seedlings are pricked out into peat blocks. Both the seed compost and block compost have to be bought in, including the fertiliser usually combined in them. He has been unable to produce his own potting compost, but the peat firm are prepared in future to leave their usual additives out.

In late February the seedlings go into their final positions, served by heating pipes and an automatic watering system which, together with automatic ventilation, stop the houses getting too humid.

In 1979 the ground was mulched with straw to keep it cool and encourage microbial activity and surface roots. It may be that more nitrogen in the form of blood may be needed to counterbalance the nitrogen used up in the straw breakdown.

Feeding

Apart from the compost, the plants occasionally receive dressings of blood, bone and fishmeal. Alginor (a liquid seaweed product) is also used, and hoof-and-horn. A little goes into the compost heap as an activator.

The foliar feed Siapton (amino acids and peptides extracted from slaughterhouse waste) is used in disease control as explained below.

Overhead water spraying is done to help the fruit set.

Disease prevention and control

As the bottom leaves die back, they are picked off to allow freer circulation of air, so that humidity does not build up - an important measure in preventing disease. The old bottom trusses are also picked off as otherwise these bottom ones tend to die back into the stem - again a Botrytis risk through introducing lesions into the stem.

Corky Root Rot appeared in 1979 on a few plants. Instead of spraying the whole house as would be the normal procedure, they decided not to panic but to treat the individual plants. The affected plants were doused with Siapton foliar feed and a copper solution watered in. Damp peat was packed around the base to encourage the formation of new roots. The normal irrigation nozzles were moved further away to stop any build-up of waterlogged conditions under which the disease thrives. New roots did grow into the peat, every treated diseased plant survived, while the first 20 which had been untreated were lost, and the disease did not spread. It is not known whether the disease would have disappeared anyway.

Botrytis occures occasionally, generally after careless or accidental damage when handling the plants. The fungus can then invade the lesions. The grower paints a Botrytis patch with creosote. He says there is no real way of controlling Botrytis with sprays either. More of the disease occurs in those two parts of the house where the plants are weaker, the weaker growth perhaps being due to an underlying drainage problem, or a difference in soil type.

Pests

In 1979 he did not get whitefly although other growers in the area did. If he were to get it, he would introduce its parasite.

Cucumbers

Cucumbers are grown in raised beds of manure and soil, mulched over with straw. They occupy the polythene tunnels as they are better able to withstand the condensation and humidity which occurs in them. Red spider is controlled by its predator.

Rotation

The grower would like to rotate crops but so far has not found lucrative enough ones to replace tomatoes. A high-value crop is essential to cover the overhead costs already associated with tomato growing. He is experimenting with green peppers. Early potatoes are too late to allow the house to be used productively for the rest of the year.

Marketing

The produce is graded and packed with an eye-catching attractive "brand image". The majority (two thirds) of it goes to the wholesale market where it obtains a premium for quality, but not for being organically-grown. One-third of it distributed by their own van direct to shops, including health-food shops, and a little to the local village shop. The grower is now building up a reputation - people say that his tomatoes keep better and have a good flavour compared with other people's, even though they grow the same varieties.

The growers regard marketing as one of their major problems because so much (about 100%) is added by the middle men.

Management

Management is of a very high standard: the growers are basically perfectionists and artists who want to do the job the best way it can be done, both the cultural and the business and marketing sides. They now have 20 years horticultural experience behind them.

Yields are high (96 t/acre) though not as great as some growers can achieve (120-130 t/acre) using a more expensive input of conventional materials. Nevertheless, net farm income and return on investment seem very competitive despite what may possibly be a considerably greater wages bill.

The system would seem to be well worth official encouragement. It seems unlikely that relevant research would be carried out by supply firms as they stand to gain little or no commercial benefit from it.

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