NESC REPORT NO. 34

ALTERNATIVE GROWTH RATES IN AGRICULTURE

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Alternative Growth Rates in Irish Agriculture

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PART I:

THE COUNCIL'S COMMENTS ON "ALTERNATIVE GROWTH RATES IN IRISH AGRICULTURE"

I. Introduction[1]

1. In February 1975, the Council published[2] projections of the growth in population and the labour force up to 1986. In a subsequent report,[3] some of the implications of the projections for employment and living standards were examined. If employment is to be provided in Ireland for the projected expansion in the labour force, then considerable growth is required in output, productivity and investment in the agricultural, industrial and services sectors. In order to assess the growth prospects at a sectoral level, the Council decided to begin by examining the potential for development in agriculture.

2. After consultations with farming organisations, expert advice was sought from Mr. L. Folkesson, Professor of Agricultural Marketing and Policy, the Agricultural College of Sweden, Uppsala; Mr. J. F. van Riemsdijk, Professor of Farm Management, Wageningen University of Agriculture, The Netherlands; Mr. R. Savary, until recently Secretary General of the International Federation of Agricultural Producers, Paris; and Dr. S. J. Sheehy, Department of Applied Agricultural Economics, University College, Dublin. These experts met on a number of occasions and suggested a programme of work which was approved by the Council.

[1]Following discussions in the Economic Policy Committee at its meeting on 9 December 1976, and by the Council at its meetings on 17 February 1977 and 21 April 1977, successive drafts of the Council's comments on "Alternative Growth Rates in Irish Agriculture" were prepared by Tom Ferris in the Council's Secretariat.

[2]*Population and Employment Projections: 1971-86*, NESC, No. 5, February 1975.

[3]*Jobs and Living Standards: Projections and Implications*, NESC, No. 7, June 1975.

3. This Report is the third stage in the study of the potential for growth in the agricultural sector.[4] It attempts to quantify some of the important implications of alternative rates of growth in agriculture. It was prepared by Dr. John A. Murphy, Dr. John J. O'Connell and Dr. Seamus J. Sheehy, Department of Applied Agricultural Economics, University College, Dublin.

4. The consultants' study is published in full in Part II of this report. The Council would welcome comments from farming organisations and other interested parties on the implications of the consultants' analyses for the choice of policies and measures to accelerate the growth in Irish agricultural output. The Council plans to complete during 1977 a general report on the potential for development in Irish agriculture and the strategies and policies by which this potential might best be realised.

[4]The first two stages of the study, which have been completed by the Council, are *A Comparative Study of Output, Value-Added and Growth in Irish and Dutch Agriculture*, No. 24, December 1976, and *New Farm Operators, 1971 to 1975*, No. 27, April 1977

II. The Present Study

(a) Background

5. This report is concerned with quantifying some of the important implications of alternative rates of growth in Irish agriculture, in particular the implications for employment and the Balance of Payments. The basic question posed by the consultants is: "if agriculture grew in certain ways up to 1985, what would some of the important consequences be?"

6. The growth rates chosen by the consultants are not forecasts of what will happen by 1985. Instead, they show what growth is required in the different sub-sectors of agriculture if the overall agricultural growth rates—the "low" and the "high"—were to be realised. To that extent the study is purely a technical exercise and no judgement is implied as to the likelihood (or otherwise) of the growth rates selected being achieved. The consultants point out "no effort is made to specify the economic relationships that would be consistent with the different alternatives."

7. The "high" growth rate chosen by the consultants is not an impossible target for the agricultural sector. It is a rate which if achieved *over the eleven year period of the study* would be a most uncommon international achievement. Over a *short period*, at least, such a rate has been approached, as was pointed out by the Council in a recent report[5]—the growth in the agricultural sector in Ireland during the period 1971–75 actually exceeded 5% per annum on average. However, this figure reflects special factors at work in 1975, and is not strictly comparable with the projected growth rate of 5½%, which is based on specified assumptions (see Part II). On the basis of comparisons with other European countries, it can be shown, however, that there is a lot of leeway to be made up—in terms of both output and productivity. In *Jobs and Living Standards: Projections and Impli-*

[5]*A Comparative Study of Output, Value-Added and Growth in Irish and Dutch Agriculture* (NESC, No. 24, December 1976—page 10).

cations[6] it was estimated, for example, that productivity—as measured by the level of agricultural product per person at work—in the Irish agricultural sector in 1971 was less than half that of Benedelux.[7] More recent estimates suggest that the gap had not narrowed by 1974.

(b) Alternative Growth Projections

8. Two main alternatives are examined: a "low" growth path, corresponding to past trends, and a "high" growth path.[8] The technical performances required to achieve the alternative growth rates in Gross Agricultural Output (GAO) are presented in detail by the consultants. Particular emphasis is placed on on-farm and off-farm employment possibilities. In addition, the consultants examine the Balance of Payments implications of the alternative scenarios around 1985.

9. The consultants' analysis relates to a period of eleven years, from $\overline{1974}$ to $\overline{1985}$—a period sufficiently long to identify the implications of alternative expansion paths and yet short enough to permit realistic assumptions regarding market and technological developments.[9] As regards the availability of resources, the consultants assume that labour and capital are not constraining factors. Insofar as they do prove to be constraining factors, the employment estimates may have an upward bias to the extent that jobs created in agriculture may be partly (or entirely) offset by job losses in industries competing for scarce capital.

10. The consultants present in considerable detail the production patterns of the crop and livestock sectors of Irish agriculture.[10] Alternative production patterns are specified for the "low" and "high" growth paths examined. The "low" growth path points to an annual growth rate in Gross Agricultural Output of 3·0% between $\overline{1974}$ and $\overline{1985}$. By comparison, the "high" growth path would necessitate an annual growth rate of the order of 5½% in GAO, representing a doubling of gross output in thirteen years. In terms of Net Agricultural Output, the annual average growth rates are 2·0% ("low") and 3·7% ("high") respectively.[11] The "high" growth rate could be achieved by many different combinations of enterprises. The consultants selected two of the many possibilities, which would achieve a growth rate of around 5½% per annum. The difference between the two paths chosen is that one assumes no calf exports and the other assumes a certain level of calf exports, which would be replaced by additional cows and cereal production on the land released. In fact, the differences in the output mix between the two "high" growth scenarios were not large enough to necessitate detailed investigation of their separate employment consequences.

11. The projections for the "low" and "high" growth paths are summarised in Table A. The detailed assumptions on which the consultants' projections are based are set out in Part II of this report. On the basis of their assumptions, the consultants project, under the "low" growth path:

—a rise in acreage under feeding barley

—a decline in acreage under wheat, oats and potatoes

—a rise in milk and cattle output

—little change in pig and sheep output.

Under the "high" growth path, assuming no calf exports, the consultants project:

—an average annual increase of 100,000 cows

—an average annual increase of 30 gallons in milk yields

[6]NESC, No. 7, June 1975—page 25 (Table 3).

[7]Benedelux refers to Belgium, Luxembourg, Denmark and the Netherlands,

[8]The "high" growth rate is about 90% higher than past trends—a rate sufficiently high to require input/output volumes significantly different from trend output, while at the same time being feasible from the technical viewpoint.

[9] The notation $\overline{1974}$ and $\overline{1985}$ is used to denote the average of the three year periods 1973/74/75 and 1984/85/86 respectively.

[10]This involved preparing production estimates ($\overline{1985}$) for the alternative growth paths by projecting scale and intensity factors for each enterprise; converting to output by means of output: production ratios and finally aggregating the individual output components using $\overline{1974}$ unit values.

[11]Net Agricultural Output (NAO) is defined as Gross Agricultural Output *less* expenditure on seeds, feeding stuffs and fertilisers including lime. As these inputs account for approximately 60% of all the inputs of agriculture, changes in NAO are a useful guide to changes in the level of agricultural product. From a technical point of view, it should be noted that throughout their report, the consultants use *Gross Agricultural Output* to derive growth rates and not *Gross Agricultural Product.*

—an average annual increase of 6,000 sows

—an average annual increase of 30,000 acres in feeding barley

—an arrest of the decline in wheat acreage

—more intensive beef productions systems.

TABLE A: SUMMARY OF PROJECTIONS

Volume of Gross Agricultural Output: $\overline{1974}$-$\overline{1985}$

£m at $\overline{1974}$ prices

Projection	Sector	$\overline{1974}$	$\overline{1985}$	Average rate of growth
"Low" Growth rate	Livestock	596·2	837·3	+3·1%
	Crops	103·2	128·5	+2·0%
	Total GAO	699·4	965·8	+3·0%
"High" Growth rate[1]	Livestock	596·2	1104·7	+5·8%
	Crops	103·2	155·6	+3·8%
	Total GAO	699·4	1260·3	+5.5%

Note: The notation $\overline{1974}$ and $\overline{1985}$ is used to describe the average of the three year periods 1973/74/75 and 1984/85/86 respectively.

[1]This "high" growth rate assumes *no* calf exports. For the "high" growth path, which does assume calf exports, the consultants project a Gross Agricultural Output in $\overline{1985}$ of £1272·2m (at $\overline{1974}$ prices). This is marginally higher than the output figure of £1260·3m (at $\overline{1974}$ prices) under the "high" growth path without calf exports.

12. Under the alternative "high" growth path, the consultants examine the use to which surplus capacity might be put in $\overline{1985}$, if the export of calves is assumed. They conclude that calf exports need not depress output. Despite considerable apprehension in recent years at the initiation of live calf exports, the results of the consultants' study show that such a development would make little difference to

the agricultural economy if the land released by calf exports were suitably allocated to other enterprises. Indeed, the projections for $\overline{1985}$ point to a marginally higher volume of Gross Agricultural Output under this alternative "high" growth path.

(c) Employment/Productivity Projections

13. The consultants examined the likely employment implications for the alternative growth paths. They project a continued downward trend in on-farm employment. However, the annual rate of decline is projected at only 1·5% under the "high" and 2·1% under the "low" growth path. These rates of decline are less severe than those projected by Professor B. Walsh in *Population and Employment Projections: 1971–86.*[12] In this report, the consultants have estimated that 15,000 more people would be retained in farm employment in $\overline{1985}$ under the "high" growth path, than under the "low" growth path.

14. The other area examined was industries[13] where employment is directly influenced by changes in the output projected in the study. Each of the industries was studied on the basis of its past employment related to volume of agricultural production, and on the basis of surveys to provide information about expected developments over the next decade. The information gathered provided the basis for estimates of changes in productivity and employment. Direct employment projections were made for the industries selected on the basis of the "low" and "high" growth paths. The implications for employment of the two variations of the "high" growth path are not examined separately because of the negligible difference between their outputs by $\overline{1985}$.

[12]In NESC, No. 5, (February 1975), the annual rates of decline for the family farm labour force were between 3.2% and 3.5%.

[13]These are the industries whose scale is *substantially determined* by the level of agricultural production. Industries merely *associated* with agricultural inputs and outputs, but whose employment is not directly affected by the agricultural expansion envisaged in the projections, have not been included. The industries which have been considered are dairy processing, cattle and sheep processing, pig processing, animal feeds and fertiliser manufacture.

15. In addition to examining the employment effects of different volumes of throughput, data from their survey enabled the consultants to examine the employment effects in relation to the intensity of processing in the different industries. Under the combination of different assumptions regarding growth in agricultural output, intensity of processing and whether or not live cattle are exported, the consultants provide twelve different projections for employment in the industries associated with agriculture. The actual range of projected change in *direct* in-factory employment in the period 1974 to 1985 is from a minimum increase of 570 jobs to a maximum of 24,000 jobs under the most favourable assumptions. The minimum increase, namely the 570 jobs, would be associated with output under the "low" projection, 1975 processing intensity and a continuation of live cattle exports. The "maximum" projection, of 24,000 jobs, relates to the "high" growth projection with more intensive processing and with the cessation of live cattle exports. Even in the "high" growth case the effect on employment of moving from the 1975 intensity to a "high" intensity product mix is only about 10,000; most of this 10,000 comes from the milk sector, the impact on employment in the cattle, sheep and pig sectors being exceptionally low.

16. To the extent that *direct* employment in agriculture would be increased because of a faster growth in agricultural output and income, it is probable that employment in other sectors would also increase. It is not possible, however, to give any firm estimate of the number of these jobs. In their study, the consultants, in the absence of empirical evidence of the induced effect of changes in direct employment, apply for illustrative purposes an arbitrary multiplier of 2 to the *direct* employment projections. This means that for each new *direct*[14] job, an additional *indirect* and *induced* job is assumed to be maintained in other activities.

[14]*Direct employment* arises either on-farms or in factories directly related to the production of agricultural produce, with *indirect employment* arising in spin-off industries, such as land reclamation, packaging, etc., as a consequence of increased direct activity, and *induced employment* arising from expenditure of income of those in direct and indirect employment in agriculture.

(d) The Balance of Payment Effects

17. The consultants in estimating the impact on the Balance of Payments of the alternative growth strategies, first projected the domestic market requirements, and then derived the surplus available for export as a residual. Import requirements were then deducted to give the net Balance of Payments position. Using 1974 net trade as a yardstick, the consultants estimated a net trade gain of £165 million under the "low" growth model and £376 million under the "high" growth model.[17]

(e) Consultants' Conclusions

18. The contribution of agricultural growth to national employment has been shown to be heavily dependent on its rate of growth. On the basis of the growth rate over the past 15 years, the consultants' study indicates that agriculture would continue to lose jobs on farms even though the substantial improvement in the incomes of the on-farm workforce since 1971 has slowed the rate of decline. Further, the historic growth rate is estimated to yield very few new in-factory jobs to offset the loss of on-farm jobs, unless the intensity of processing improves considerably over its present level. A rapid rate of growth in agriculture—particularly if it could be augmented by more intensive processing—could, according to the consultants, make a significant contribution to national employment.

PART II

ALTERNATIVE GROWTH RATES IN IRISH AGRICULTURE

by

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PREFACE

The potential contribution of agriculture to economic growth has been widely debated over the years. There has been, however, relatively little research into quantifying that contribution. This report presents results of a study which aims at quantifying some of the important implications of alternative rates of growth in agriculture. The basic question asked is: "If agriculture grew in certain ways up to 1985, what would some of the important consequences be?"

A "low" growth rate corresponding to past trends is considered, and alternatively a "high" growth rate is assessed. Certain variations within the two growth rates are examined; in particular the effect on employment of cessation of live cattle exports is measured, and a high growth path involving export of calves is delineated.

Particular emphasis is given to the employment possibilities of the alternative growth rates. These are quantified as far as possible. Both on-farm and off-farm employment is considered and three levels of processing intensity are studied. The balance of payments effects by 1985 are also estimated.

The report is divided into five sections. Section I is the introduction; Section II contains the alternative growth projections for agriculture; Section III deals with the employment arising from the different growth rates; Section IV contains the balance of payments effects; and Section V consists of the summary.

Much of the basic analysis for Section II of the report was done by Seamus O'Donoghue as part of his M.Agr.Sc. programme. The authors wish to acknowledge his valuable contribution. The authors also wish to acknowledge the considerable help received from very busy people in the various industries surveyed.

SECTION I

CHAPTER 1

INTRODUCTION

The agricultural sector—defined in official statistics as the value added on all farms in the country—accounted for 18% of Gross National Product in 1975. Value added in industries the size of which is determined primarily by the level of output from agriculture[1] accounted for a further 6% of GNP. Therefore agriculture plus its dependent industries accounted for about the same portion of GNP as all other industry combined. It is obvious that the economic progress of this sector is of considerable importance to the progress of the nation.

Agriculture is not generally a dynamic growth sector. Over the fifteen-year period 1960 to 1975 the annual growth rate of Gross Agriculture Output was 2·8%; the annual growth rate of Industrial production over the same period was 6·1%.[2] This relationship between the growth rates of the two sectors is fairly typical across a variety of countries. Of 13 selected developed countries shown in Appendix Table 1.1, only on one occasion did any country exceed a growth rate of 4·0% in Gross Agricultural Output in any eleven-year period between 1954 and 1975; this occurred in the Netherlands in the period 1964 to 1975. The apparent inability of agriculture to grow rapidly over a prolonged period is related to two major constraints on its development.

[1]See definition in Chapter 7.

[2]Growth rates in this Report are derived by fitting an exponential curve to the appropriate series of data over time. [See 2.3 below]. They relate to *output* rather than to the more valid measure—*product*—because of the considerable difficulty of estimating all of the inputs necessary to arrive at *product*.

Firstly, the demand for food and the derived demand for farm services expands relatively slowly. This imposes a limit on the growth of agriculture in a closed economy. In such an economy, expansion at a more rapid rate than aggregate demand for food could only lead to growing surpluses. These in turn would be reflected in either lower market prices if agricultural markets are unsupported, or escalating exchequer expenditure if agricultural markets are supported. The growth in aggregate demand for food is related to population and real income developments and has been typically about 2% per annum in EEC countries over the past fifteen years.

The constraint on expansion of aggregate demand for food does not necessarily apply in an open economy. Irish agriculture within an EEC context could grow much more rapidly than the overall market. This could happen through greater market penetration, so that in effect Irish farmers would be displacing non-Irish farmers in supplying the EEC market. However, even in this favourable market situation there would be a second major constraint on rapid growth, namely, the biological nature of agricultural production.

The physiology of crops and animals is such that their production and reproduction is not as controllable as in the case of inert goods. They are subject to a great variety of environmental forces which impede rapid expansion. Two major forces of this kind are weather and disease. Related to these issues, the management factor is also a problem. Rapid agricultural growth requires rapid improvement in the managerial ability of farmers. But such rapid improvement is difficult when the production processes are complex. The relatively rigid social structure of family farming in Ireland further aggravates the management problem.[3]

Despite these constraints on rapid growth, it is widely believed that Irish agriculture could grow considerably faster than it has done in the past. Market opportunities are relatively favourable within the EEC, and so long as the principles of the Common Agricultural Policy remain intact such opportunities should continue to be favourable.

[3]*Farm Inheritance and Succession.* Macra na Feirme, Irish Farm Centre, Dublin, 1973. Also NESC, *New Farm Operators, 1971* to *1975*, Report No. 27, Stationery Office, Dublin. Prl. 5832, April 1977.

Therefore it is realistic in terms of market availability to consider the implications of rapid growth.

1.1 Alternative Growth Rates Studied

One of the main objectives of this study is to specify the technical performances that are necessary to achieve alternative growth rates. These are reported in Section II. Both "low" and "high" growth rates are specified, the low rate being related to past trends and the high growth rate being about 90% higher than past trends. The level of the high growth rate is in the region of 5·5% per annum in Gross Agricultural Output. This is an ambitious growth rate by past standards, representing a doubling of agricultural output in 13 years.

It was felt that the high growth rate should be sufficiently high to produce volumes of outputs and inputs that would be significantly different from the trend output; at the same time it should not be so high as to be clearly unfeasible even from a technical point of view. It may be compared with the growth rate of 6·0% specified in the Government Green Paper.[4] The 6·0% in the Green Paper relates to a different base period from that of the 5·5% in this study. When this is taken into account the Green Paper target becomes about 4% by comparison with the 5·5% of this study. Therefore the high growth target in this study is considerably higher than the Green Paper target. In addition, the 5·5% relates to an eleven-year period while the Green Paper relates to only four years.

These growth rates are projected over a period of 11 years—from the average of 1973/74/75 to the average of 1984/85/86. *The base and target periods are designated as* $\overline{1974}$ *and* $\overline{1985}$ *throughout the text.* The eleven-year period was deemed to be sufficiently long to see clearly the implications of alternative expansion paths but yet short enough that assumptions about market and technological dimensions could be realistically made.

The implications of alternative agricultural growth rates have not been studied much in the past. Both the FAO and Dr. Attwood made

[4]*Economic and Social Development, 1976-1980,* The Stationery Office, Dublin. Prl. 5758, September 1976.

projections for agriculture in the mid-sixties.[5,6] In 1972 a voluntary study group of the Irish Grassland and Animal Production Association published a five-year expansion plan for agriculture.[7] The plan was never officially adopted or pursued and proved to be well in excess of subsequent achievements in all commodity areas. The Irish Farmers' Association in 1974 examined the implications of doubling the livestock herd over a decade and published the results in a short booklet.[8]

The Second Programme for Economic Expansion, published in 1964, contained a comprehensive statement of targets, assumptions and policies in relation to agriculture.[9] It was stated that "the targets set for the various commodities are not a continuation of past trends but are estimates of the level of output which may reasonably be expected if the other assumptions made in the Programme regarding our international and trade relations, real income, etc. are fulfilled".[10] The components of the targets in terms of units of production and yields per unit were not published. Furthermore, the relationship of the projections to past trends was not specified in any detail.

This relationship with the past is important because it provides a standard with which the projections may be compared. It is well known that overall technical performance of Irish agriculture is low either by comparison with the best achievements within the industry or by comparison with other countries.[11] On this basis it is frequently claimed that the industry is operating only at a fraction of its potential and it is implied that it could grow rapidly. Such claims must

[5]FAO, *Agricultural Commodities—Projection for 1975 and 1985.* Vol. I, Rome, 1967.

[6]Attwood, E.A., "Future Prospects for Agriculture," Chapter 13 in *Irish Agriculture in a Changing World,* Oliver & Boyd, 1971.

[7]Irish Grassland and Animal Production Association, *An Expansion and Investment Plan for Irish Agriculture,* c/o Agriculture Institute, Belclare, Tuam, Co. Galway, 1972.

[8]Irish Farmers' Association, *Expansion of the Livestock Industry,* The Irish Farm Centre, Dublin, 12., 1974

[9]*Agriculture in the Second Programme for Economic Expansion,* Stationery Office, Dublin. Pr. 7697.

[10]Idem, page 59.

[11]NESC, *A Comparative Study of Output, Value-Added and Growth in Irish and Dutch Agriculture,* Report No. 24, Stationery Office, Dublin. Pr. 5651, Dec. 1976.

be assessed against past performance because, unless conditions change, the future is not likely to be very different from the past.

This Report quantifies in greater detail, than has heretofore been done, the specifications of alternative growth rates for agriculture and their relationship to past performance. Such detailed specifications are a necessary, though not sufficient, basis for planning. They are in themselves a purely technical exercise. They will provide the technical framework for the next Report which will attempt to specify the economic variables that will impinge on agricultural growth. In other words, this Report attempts to answer the question—"What would be the consequences if agriculture grew rapidly?". The next Report will assess the possibility of more rapid growth.

1.2 Employment Implications

The second main objective of this study is to assess the employment that would be likely to arise as a consequence of alternative growth rates in agriculture. The agricultural sector is not generally regarded as a significant source of employment. Experience supports this view because the total work-force on farms has fallen from 382,000 in 1960 to 244,000 in 1975. At the same time the work-force in dependent associated industries[12] (i.e., feed, fertiliser, dairy, cattle and sheep, and pig processing) increased from 14,600 to 23,700 or by only 9,100.

Despite the poor record in the past it must still be true that a high growth rate in agriculture would generate more employment than a low growth rate. Estimates of the extent of such employment have been quoted at various times. The Irish Grassland and Animal Production Association estimated that the expansion they envisaged could create 80,000 new jobs within five years.[13] The IFA claimed that a doubling of the livestock sector would create 102,000 new jobs over a decade.[14] In another publication it was stated that—"with increased throughput and greater sophistication, an increase of up to 20,000 jobs in the food processing industry could be envisaged".[15] However,

[12]See Chapter 7 for definition.

[13]Irish Grassland and Animal Production Association, op. cit. page 51.

[14]Irish Farmers' Association, op. cit. page 11.

[15]*The Irish Farmer and the European Community.* Irish Council of the European Movement, Occasional Paper III, 1972, p. 9.

neither the level of throughput, the level of sophistication, nor the year by which this 20,000 new jobs was to be achieved were specified.

In contrast to this figure the consensus of a recent conference held by the Agricultural Graduates Business Association was that the number of new jobs which could reasonably be expected in the food industry by 1980 would be 5,000 to 6,500.[16] This conference was composed largely of executives involved in the food processing and allied industries. Even though their estimate was based on subjective assessment, it must be treated with some respect since the estimators are closely involved in the industry.

Yet the expectations of many people with regard to the potential for employment in the agriculturally related industries remain high. Dr. Kieran Kennedy has stated that "the record of achievement to date suggests a comparative neglect of the country's natural advantages in, for instance, the processing of food and minerals. . .".[17]

Undoubtedly the performance of employment growth in food processing has been disappointing. However, it is not so obvious that this has been due to neglect. Indeed the Managing Director of the IDA has claimed that "agriculture is the prime such (natural) resource in Ireland at present and this has been the sector of Irish Industry in which we have concentrated most of our investment in recent years. Even with the massive investment of the past three years the job potential at full production in approved food projects has been about 2,500 per year in this period, a valuable but nevertheless small fraction of our needs".[18]

Thus it would appear that food processing which forms the major part of the agriculturally related industries sector has not been neglected. It is, however, capital intensive. Killeen estimated that the average investment per projected job in recent years was about

[16]Agricultural Graduates Business Association—*A View of the likely contribution of the Food Industry to Industrial Job Creation.* Statement issued in August, 1976.

[17]Kennedy, K.A. "Increasing Employment in Ireland". Paper read to the Statistical and Social Inquiry Society of Ireland, November, 1975, p. 13.

[18]Killeen, M.J."Increasing Employment in Ireland". Paper read to the Statistical and Social Inquiry Society of Ireland, November, 1975, page 19.

£10,000. Capital intensity allied to rapid technological changes have probably been more important than neglect in contributing to its poor employment performance.

The employment potential of agriculture is related to two main variables—the volume of production coming off farms and the intensity of processing of that production. Both of these variables are studied in this report. Both on-farm and off-farm employment is considered. The on-farm estimates are very difficult to arrive at and are more subjective than the in-factory estimates. The in-factory results are estimated from industry surveys, with time-series analysis employed to illustrate past performance.

Intensity of processing has been much discussed in recent years. While the definition of intensity has not usually been specified, it is used here to describe labour intensity. There is a widespread belief that considerable additional employment could be generated by greater diversification in food processing.[19] The data collected in the industry surveys enabled this question to be quantified for the first time. The employment implications of three alternative assumed levels of intensification are studied.

As well as the direct employment effects on farms and in factories, there are also indirect employment effects arising as a spin-off in industries such as packaging, which are not directly involved in food production, and there is induced employment arising from the expenditure of income earned by those in both direct and indirect employment.[20] The indirect and induced effects can only be arrived at by applying a somewhat arbitrary multiplier to the direct effects. The employment analysis is reported in Section III.

1.3 Balance of Payments Implications

The balance of payments effects of the alternative growth rates are also estimated in this study. The domestic market requirements are projected forward and the surplus available for export is derived as a

[19]Bank of Ireland Steering Group, *Creating Wealth from Farm Products,* Bank of Ireland Head Office, Dublin, 1977.

[20]Copeland, J.R. and Henry, E. W. *Irish Input-Output Multipliers, 1964 and 1968,* The Economic and Social Research Institute, Paper No. 82, 1975, pages 29–30.

residual. Import requirements are deducted to give the net balance of payments effects. The results are reported in Section IV.

1.4 Further Assumptions

It is recognised that a sectoral study such as this assumes ready availability of resources to enable the alternative growth rates to materialise. In the context of the resource environment in Ireland, labour is likely to be relatively freely available, though scarcities could arise in certain geographical areas or in certain specialised kinds of labour.

Capital, however, is not likely to be so readily available. No attempt has been made to quantify the capital requirements of the alternatives considered. Such quantification, in any case, would not be very useful in the absence of estimates of the overall availability of capital in the economy and the competing demands on it. To the extent that competition for capital would exist, the employment estimates are biased upwards. An additional job arising from agricultural expansion could be partly or entirely offset by a job loss or a job not created in an industry competing for scarce capital.

SECTION II

CHAPTER 2

OBJECTIVES AND GENERAL METHODOLOGY

The general objectives of this section are (a) to establish the production pattern that would exist in Irish agriculture in 1985 under the continuation of past trends, (b) to delineate alternative production patterns for 1985 that would be consistent with a "high" growth in agricultural output over the intervening period, and (c) to examine the likely requirements of seed, feed and fertiliser in each case. In subsequent discussion the production pattern delineated under (a) will be referred to as the "trend" model and those under (b) as the "high growth" models.

In working towards these objectives, particular attention is paid to the rate of change which must be achieved in the individual parameters, such as acreages and yields, that determine the overall rate of agricultural growth. It is hoped that such an approach will facilitate the evaluation by readers and other interested parties of the feasibility or otherwise of the various developments which underlie the growth rates put forward. It is the authors' belief that these detailed technical components of growth are necessary for rational debate on the initiatives required to achieve a high growth rate in Irish agriculture.

2.1 Selection of Growth Paths

In depicting the 1985 production patterns it has been necessary to make a number of assumptions, and the most difficult of these relate to the high growth models. The construction of a plan to yield a

specified growth rate involves selection from a large number of options. This is particularly so for a multiple enterprise industry such as Irish agriculture where high growth might be achieved through any one of a number of enterprises or through various combinations of enterprises. Furthermore, there are for each enterprise a number of ways through which a specific growth might be achieved. In practice, however, this large number of *possibilities* can be narrowed down to a small range of *realistic options*.

In reviewing the options available in the design of high growth models for this study it was decided that any selected model ought to be based principally on the development of the milk/beef sector which currently accounts for approximately two-thirds of Gross Agricultural Output. In spite of this narrowing of options a number of different alternatives still remain open. Chief among these would be growth paths deriving from (a) alternative views of the future movement in cereal acreages, and (b) alternative developments in the production and disposal of beef cattle and in particular the future role of calf exports.

Growth plans will also differ depending on the view taken with regard to the future of the pig enterprise. In the present study the limiting constraint on options has been derived from the general fixity of the land resource, while labour and capital have not been considered as constraining factors. To the extent that this is a valid approach, alternative rates of development in the pig enterprise do not affect the level and combinations of other enterprises. Consequently, for any of the models presented in later chapters the projections for the pig sector can be altered without changing the remaining components of the model, and the aggregate growth rate can thus be boosted or diminished without any counterbalancing effects in other enterprises.

2.2 Components of Output from each Enterprise

Each of the major products listed in the agricultural output tables of the Irish Statistical Bulletin has been projected separately. The output of each product has been derived from the following factors: (a) the scale of the underlying enterprise, (b) the intensity of production in that enterprise and (c) the proportion of production which is recorded as output.[1] Thus, for example, the projected *production* of wheat is based on a projected acreage (scale factor) multiplied by a projected yield per acre (intensity factor). This is then converted to *output* by means of a projected output : production ratio. For each product, therefore, there are three independent projections involved and the results of each are individually identified in the text.

In the trend model the projections are almost entirely based on past trends. In order to derive high growth models, however, it was necessary to alter substantially many of the scale factors and in particular the acreages of cereals and the number of cows. It was also necessary to alter the projected milk yield and stocking rate. The intensity factors and the output : production ratios for the high growth models are as a rule set at the same level as projected for the trend model.

2.3 Quantifying the Trends

As already stated the first objective of this section is to project the level and composition of agricultural output in $\overline{1985}$ on the basis of past trends. In general these trends were derived from data for the period 1960 to 1975. The decision as to what period to use was not an easy one to make.

The overall aim was to select a period which was likely to typify the future trend in agricultural production and output. Two periods emerged which appeared to merit consideration in this respect—from 1960 up to the present and from 1970 up to the present. The longer period offered a sufficiently wide timespan upon which to base reliable estimations of trend. Moreover, the year 1960 can be considered as roughly the beginning of a sustained and accelerated upward trend in agricultural output compared with the previous decade. Over the period 1950 to 1960 the volume of Gross Agricultural Output increased at the rate of 1·6% per anum. For the period 1960 to 1975 the growth rate amounted to 2·8% per annum.

[1]In the official statistics, Gross Agricultural Output is defined as that part of total agricultural production which is sold off farms, or which is consumed by persons on farms, during the year. Thus, it excludes produce used for further agricultural production on the farms on which it was produced or which was sold by one farmer to another. See any June issue of the *Irish Statistical Bulletin*.

It might alternatively be argued that the present decade represents a new stage of development in Irish agriculture. The early 1970s saw the advent of EEC membership and with it expectation of a favourable price structure and improved market access. This instilled a new optimism in Irish farming. Although some of the original expectations were shaken in the meantime, particularly in 1974, the general level of prices received by farmers has improved considerably under EEC membership both in absolute and real terms.

One would expect that this improvement in economic returns would be translated into accelerated growth in Gross Agricultural Output. The growth rate for the period 1970 to 1975 inclusive does show some improvement, amounting to 3·3% per annum compared to 2·8% for the period 1960 to 1975. However, it has been provisionally estimated that the volume of gross output in 1976 was approximately 4% below that of 1975.[2] Therefore the average growth for the period 1970 to 1976 inclusive has only been about 2·6% which is actually less than that of the period 1960 to 1975.

These figures show that in terms of growth in aggregate output there is little to choose between the two periods. However, from the point of view of establishing reliable trends in the individual components of output, particularly yields, it is very much preferable to use the longer period extending back to 1960. It is mainly for this reason that the majority of the projections put forward in the next chapter were based on the trends of the 1960 to 1975 period.[3] Occasionally, special adjustments have been made where there are definite indications that the longer-term trends have been superseded by more recent developments.

In general the trends were evaluated by fitting regression lines to the historical data. The equation form used in virtually all cases was that suggested by the time series graph of the data for that period. The choice lay mainly between:

(a) the exponential form, $Y=Ae^{rt}$, and (b) the linear form, $Y=a+bt$, where Y is the factor being trended, e.g., wheat acreage and t represents time. It should be noted that form (a) implies a constant percentage rate of change in Y[4] while (b) implies a constant absolute rate of change.

[2]*Economic Background to the Budget, 1977.* Stationery Office, Dublin.
[3]In certain cases where reliable data for 1976 were available these were included.

In some cases the selection of the equation form had a very significant bearing on the outcome. Thus, a linear equation when fitted to the wheat acreage data for 1960 to 1976 would suggest a downward trend of 11,330 acres per year giving a projection of just 14,500 acres of wheat in 1985 compared to 130,000 acres in 1976. On the other hand, an exponential trend when fitted to the same data would show an average decline of 5·3% per year resulting in a projected 78,000 acres in 1985. The situation is even more extreme in the case of oats and potatoes where a continuation of the linear trend would result in zero acreages by 1979 and 1984, respectively.

The exponential trends, on the other hand, give a projection of 42,000 acres of oats in 1985 and 60,000 acres of potatoes. In these examples the exponential trend depicts a constant percentage decline and therefore a diminishing absolute decline; this may in fact be a reasonable assumption on the grounds that these crops will eventually be confined to those areas which are particularly suited to them in terms of soil type or market access.

With much of the yield data the "goodness of fit" criterion did not offer a definite guide as to the appropriate choice of equation. In general the series used in this study have shown a significant upward trend over the past 15 years. This brought into focus the general question as to whether or not it is reasonable to expect such yields to sustain an exponential (compound) or even a linear growth pattern over a long period of time. Having considered the various factors underlying the past changes in each crop yield, the authors concluded that it was realistic to project them forward at least to 1985 in a linear fashion. It was, however, considered necessary to adopt alternative hypotheses for some of the yields in the livestock sector.

[4]The exponential equation is equivalent to a compound growth (or decline) formula where compounding takes place continuously at a rate of 100r per cent per year. The growth rates presented in the text are arrived at by adjusting the continuous values to obtain discrete annual values. A is the value of Y given by the equation when $t = o$.

The methodology used in projecting the output : production ratios was somewhat less systematic than that applied to the scale and intensity factors. The changes in past levels of these ratios were, however, generally used as a guide.

2.4 Base Period and Unit Values

In presenting the results for the trend and high growth models in Chapters 3 and 4 the projected output levels for 1985 are compared with the average output for 1974. The change in output is then converted to an annual average compound growth rate for the 11 year period 1974 to 1985. Since only volume changes are being examined, the outputs for both 1974 and 1985 are valued at the 1974 price levels. These were obtained for each product by dividing the volume of output for the 1973/74/75 period into its value.[5]

2.5 Summary

This chapter has outlined the broader questions of methodology which arose in the preparation of the trend and high growth models presented in Chapters 3 and 4. Only the more general issues have been discussed. The details will emerge in the presentation of the results in these chapters. The trend model is dealt with first so that it can act as a base against which to evaluate the special measures adopted in the high growth models in Chapter 4.

[5]See Appendix Table 2.1.

CHAPTER 3

GROSS AGRICULTURAL OUTPUT—THE TREND MODEL

The general construction of the trend model involves the projection of scale and intensity factors for each enterprise to give production estimates for 1985. These are then converted to output by means of a set of output : production ratios. The individual output components are then aggregated using the 1974 unit values. Finally, a growth rate for the volume of Gross Agricultural Output is calculated by reference to the volume of output in 1974.

(a) The Agricultural Crop Sector

As already stated output may be represented as:

$$O = A \times Y \times (O : P)$$

where O=output, A=area, Y=yield and O : P is the output : production ratio.

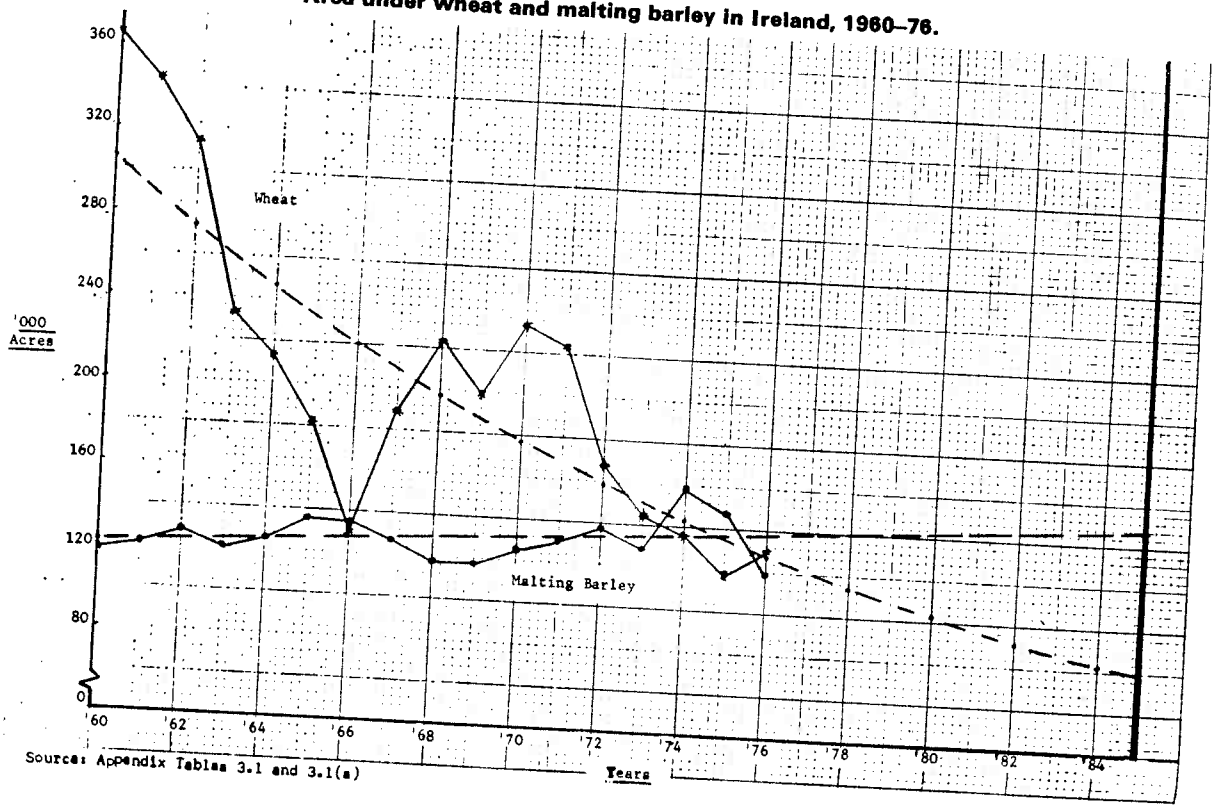
3.1 Acreages

The change in acreages under cereals, sugar beet and potatoes over the period 1960 to 1976 are shown in Figures 3.1a, 3.1b and 3.1c. In each case the trend equation which was selected for projection purposes is represented by the dotted line or curve. The actual equations are given in Appendix Table 3.1. The overall results of these trend projections and the corresponding acreages for 1974 are given below in Table 3.1.

As already stated there has been a downward trend in the acreages of wheat and oats, while malting barley has shown no significant trend. Thus the movement in total cereal acreage has in the past depended upon the degree to which the declines in wheat and oats were offset by the rising acreage of feeding barley. Up to the present the result has in general been a negative effect. However, if the area under feeding barley continued to increase in line with past trend,[1] the increase by 1985 would well outweigh the projected loss in wheat and oats giving a net gain of more than 60,000 acres under cereals. This result derives from the assumption that the rate of decline in wheat

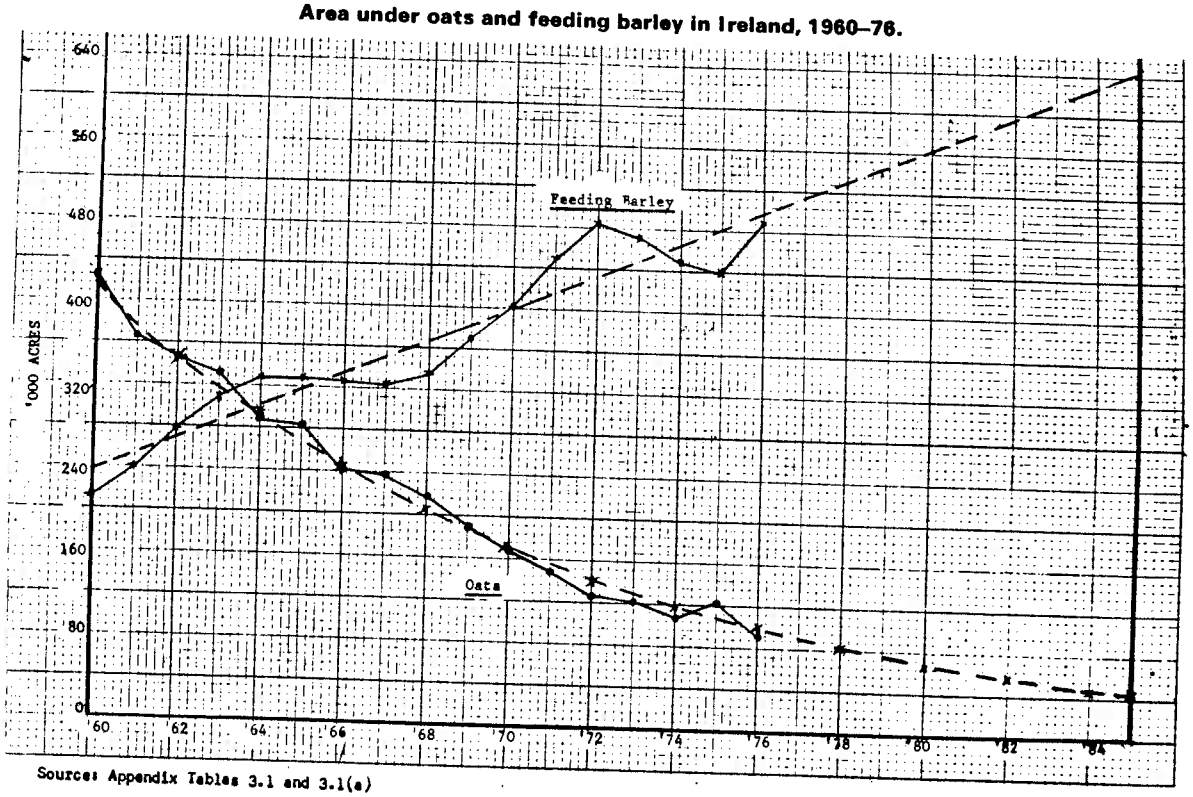
[1]The trend equation for feeding barley in Appendix Table 3.1 indicates an upward trend of 16,260 acres per year.

FIGURE 3.1a.
Area under wheat and malting barley in Ireland, 1960–76.



Source: Appendix Tables 3.1 and 3.1(a)

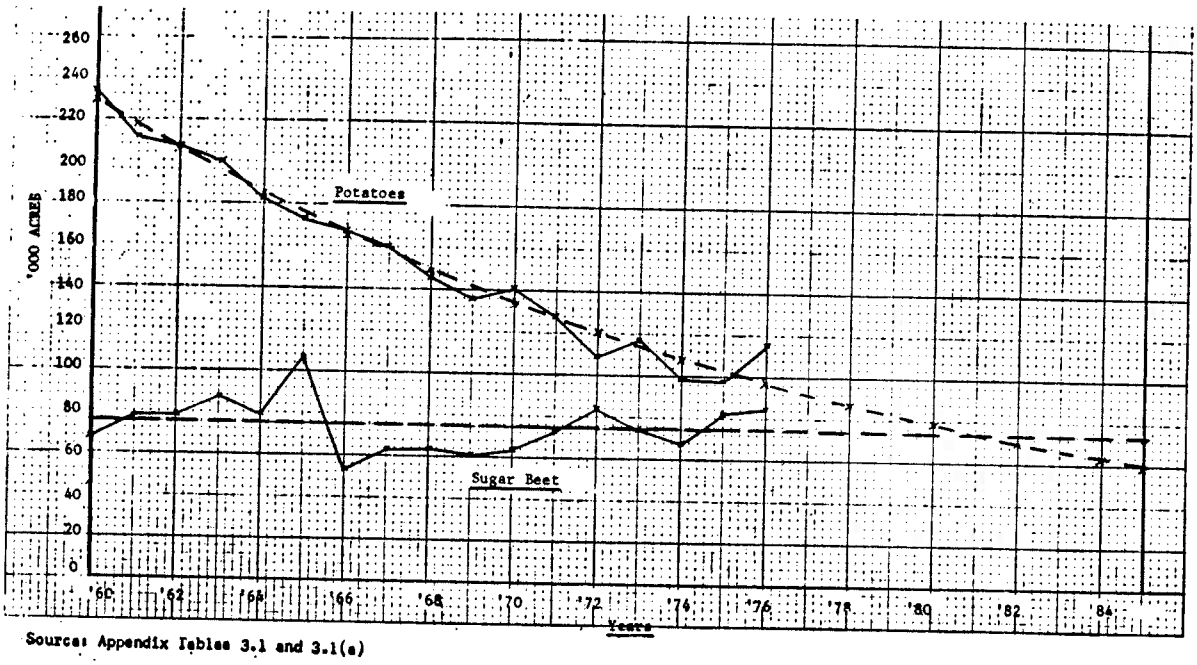
FIGURE 3.1b.
Area under oats and feeding barley in Ireland, 1960–76.



Source: Appendix Tables 3.1 and 3.1(a)

FIGURE 3.1c.

Area under potatoes and sugar beet in Ireland, 1960–76.



Source: Appendix Tables 3.1 and 3.1(a)

TABLE 3.1

Average acreages of cereals, potatoes and sugar beet in $\overline{1974}$ and projections for $\overline{1985}$ ('000)

Period	Wheat	Oats	Malting Barley	Feeding Barley	Total Cereals	Potatoes	Sugar-Beet	Other Tillage Crops	Total Tillage
$\overline{1974}$	133	118	145	453	849	105	73·5	130	1,158
$\overline{1985}$	80	40	145	645	910	60	70·0	90	1,130
Change	−53	−78	0	+192	+61	−55	−3·5	−40	−28
Change per annum, '000 acres[1]	−4·8	−7·1	0	+17·5	+5·6	−5·0	−0·3	−3·6	−2·5

[1]The total absolute change from $\overline{1974}$ (actual) to $\overline{1985}$ (projected) divided by 11.

Source: Irish Statistical Bulletin and Appendix Table 3.1. The projected values have been rounded to the nearest 5,000 acres.

and oats will diminish and that the feeding-barley acreage will continue to increase in a linear fashion.

The projected 1985 potato acreage is less than 60% of the 1974 acreage while the trend would suggest a slight long-term decline in the sugar beet acreage. The acreage of these two crops in 1985 would be 40-50,000 below that of 1974 which would partly offset the increase in cereal acreage.

The remaining tillage acreage is comprised mainly of fodder crops for livestock feeding and of horticultural crops. These amounted to approximately 250,000 acres in 1960 but declined to 130,000 acres in 1974. This decline has occurred almost entirely in the animal fodder crops while horticultural crops have remained at approximately 25,000 acres throughout the period. An extension of these long-term trends therefore suggests that by 1985 the area under "other tillage" will have dropped to approximately 90,000 acres, consisting of about 25,000 acres under horticultural crops and 65,000 acres used for animal feed crops.

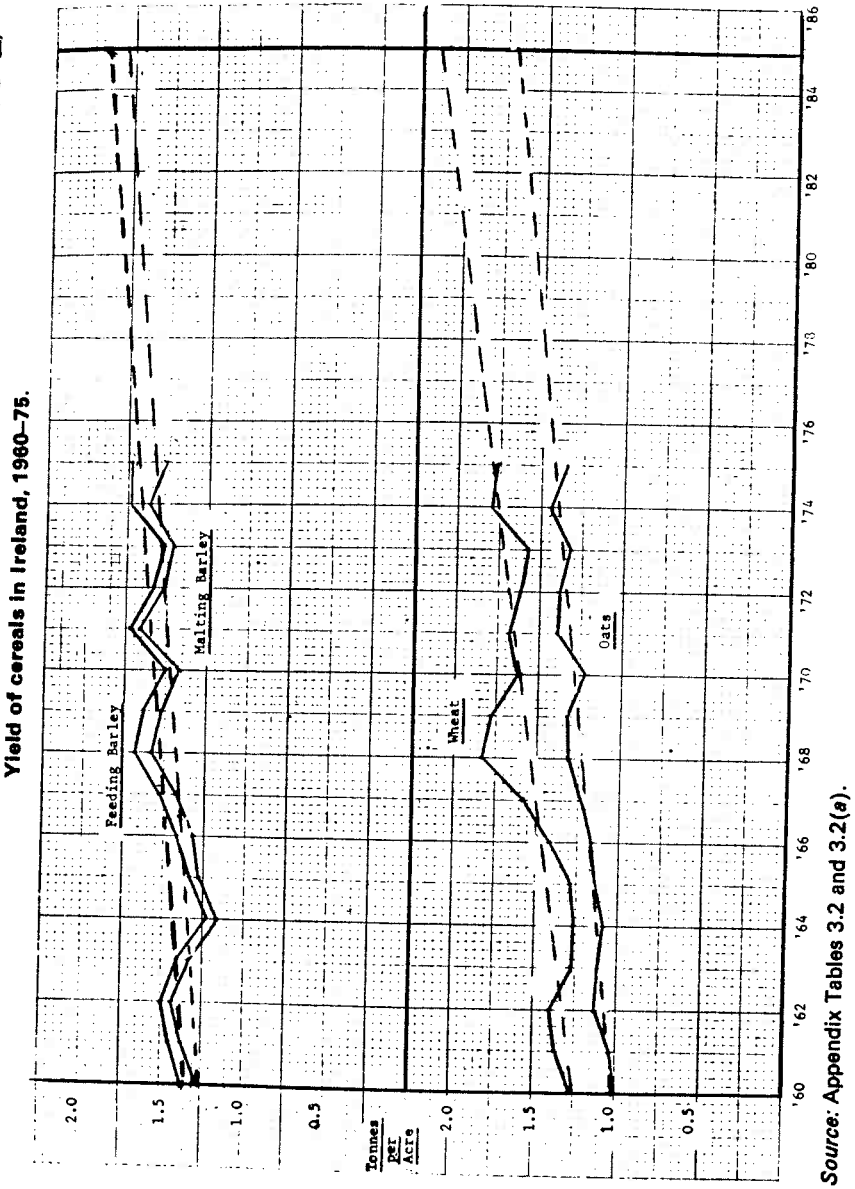
The total projected tillage acreages amount to approximately 1·130 million acres which is a decline of 2% on the 1974 level.

3.2 Yields

The long-term trends in crop yields can be gauged from the graphs presented in Figures 3.2a and 3.2b and the corresponding trend equations as given in Appendix Table 3.2. The average yields for cereals, potatoes and sugar beet in 1974 are given in Table 3.2, which also shows the yields that would be achieved in 1985 if the past trends were to continue.

In the case of cereals, the trend equations in Appendix Table 3.2 show average yield increases ranging from 20 to 35 kg per acre per year. The selection of an appropriate trend with which to project sugar beet yields posed some difficulties. The trend for 1960 to 1975 gave a projected yield of 20·5 tonnes per acre in 1985. While such yields are potentially feasible and are already being achieved by a substantial minority of growers,[2] it is doubtful if the *national* average could rise to that level by 1985. It can be seen from the graph in Fig. 3.2b that the strong upward trend obtained for the period 1960–'75 arises

[2]See C. Comerford, "Factors affecting Sugar Beet Yields", Biatas, Vol. XXX, No. 10, January 1977.



Yield of cereals in Ireland, 1960–75.

Source: Appendix Tables 3.2 and 3.2(*a*).

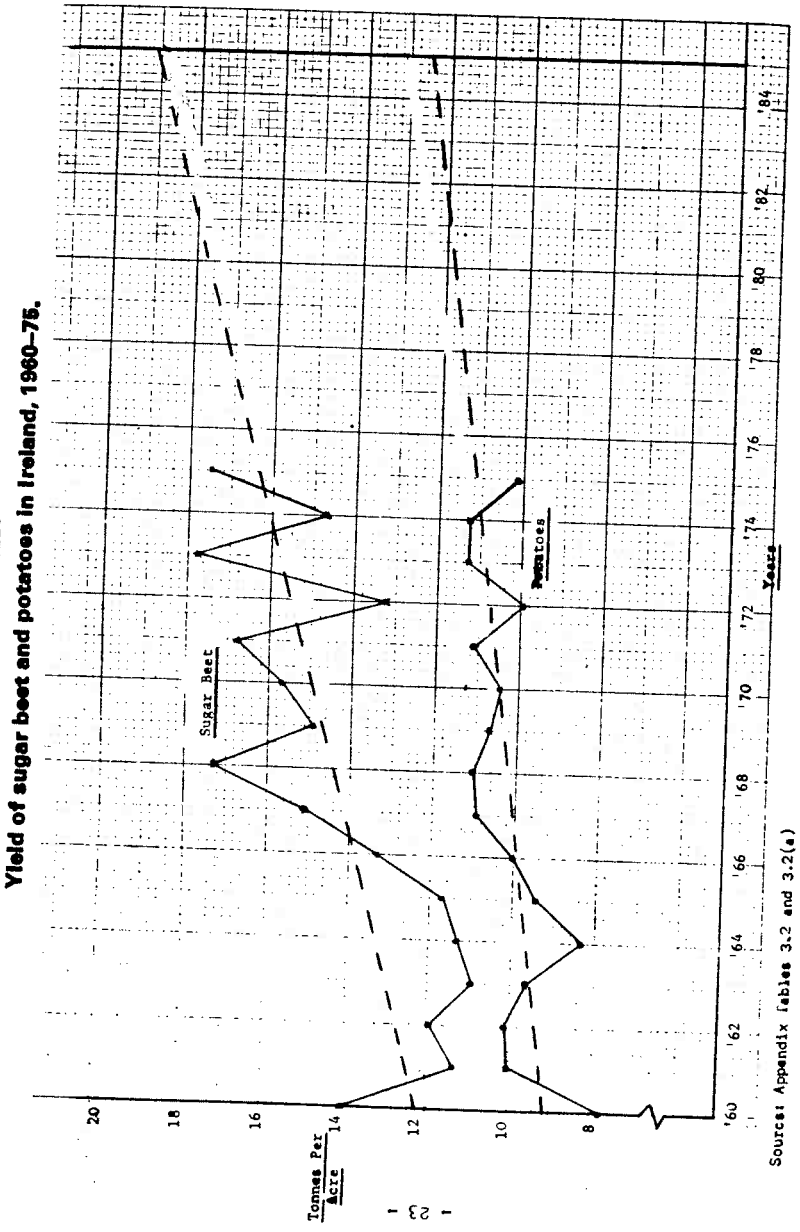


FIGURE 3.2b.
Yield of sugar beet and potatoes in Ireland, 1960–75.

TABLE 3.2

Average yield per acre of cereals, potatoes and sugar beet in 1974 and projections for 1985 (tonnes/ac)

Period	Wheat	Oats	Malting Barley	Feeding Barley	Potatoes	Sugar Beet
1974	1·71	1·37	1·55	1·66	10·9	16·6
1985	2·15	1·70	1·80	1·95	12·5	19·0
Change	+0·44	+0·33	+0·25	+0·29	+ 1·6	+ 2·4
Change per annum, Kg. [1]	+40·0	+30·0	+22·7	+26·4	+ 145	+ 220

Source: Irish Statistical Bulletin and Appendix Table 3.2.

[1]The total absolute change from 1974 (actual) to 1985 (projected) divided by 11.

mainly out of the rapid improvement from very low yields in 1961–'65 to over 17·0 tonnes per acre in 1968. It was felt that this sharp increase, which was in part due to changes in varieties,[3] gives an unduly high trend coefficient in an equation based on 1960 to 1975 data.

It was therefore decided that a more accurate long-term trend for beet yields would be obtained by using a series extending back to 1950. The resulting trend equation gave a projected yield of approximately 19·0 tonnes per acre in 1985 compared with an average of 16.5 tonnes in 1974. This was considered a more realistic projection for both the trend and high growth models. Even if this yield is still considered somewhat high it should be noted that the methodology used in pricing the 1985 output implies an average percentage sugar content equivalent to that which obtained in 1974.[4] Thus a similar 1985 projection for value of output might have been obtained from a lower yield projection combined with an increased sugar content coefficient.

3.3 Output: Production Ratios

The acreage and yield factors discussed above determine the level of crop production. It remains to consider for each crop the ratios of output to production that might be expected to prevail in 1985. These ratios for the years from 1960 onwards are given in Appendix Table 3.3.

[3]See J. Lee and L. J. O'Connor, "Sugar-beet yields in Ireland with special reference to Spatial Patterns", Irish Jour. of Agric. Research, Vol. 15, pp. 25–37, 1976.

[4]This follows from the use of the average 1974 price per tonne of sugar beet (roots) to value the 1985 tonnage.

The wheat ratio fluctuated considerably over the 1960 to 1975 period. It rose from a value of ·93 in 1960 to almost 1·00 in 1968 and 1969 and declined again to ·80 in 1973. Its average value for the entire period was ·92 and it was decided to use that value in deriving the 1985 output. The ratio for oats fluctuated within the range ·13 to ·24 in the period 1960 to 1975.[5] It reached its highest value in 1973. Although it has since declined sharply, it was decided to use a value of ·22 in the 1985 projections which is roughly in accordance with its long-term linear trend. The output : production ratio for barley (malting and feeding combined) has since 1961 generally been in the range ·66 to ·73. A linear trend for the entire 1960 to 1975 period gives a projected ratio of ·74 for 1985 and this is the figure used in subsequent estimations of the 1985 output figures for barley.

The output : production ratio for potatoes has in general fluctuated within the range ·25 to ·40. Again a linear trend projection was adopted for 1985 giving a value of 0·47. For sugar beet, output was taken as being equal to total production.

3.4 Projected Output of Crops in 1985

By combining the separate projections of acreage, yield and output : production ratios it is now possible to arrive at an output projection for each of the major tillage crops in 1985. This is done in Table 3.3.

The extreme right-hand column shows a projected increase of 71% in the tonnage of barley output by 1985 and a 9% increase in the tonnage of sugar beet. The increase in sugar beet arises solely from the higher yield adopted for 1985. The projected increase for barley, however, arises from a substantially higher acreage of feeding barley coupled with moderate increases in the yield and output : production ratios. The net impact of the various output changes shown in Table 3.3 can be assessed by applying constant 1974 prices to each product. This is done in Table 3.4.

[5]The generally low level of this ratio for oats arises to a considerable extent from the fact that in compiling the official statistics, oats sold to merchants and later repurchased by farmers for seed or as whole oats for feed is *not* included in agricultural output. See, for example, Irish Statistical Bulletin, June 1973, p. 96.

TABLE 3.3

Projection of output for each of the major tillage crops in 1985 and comparison with 1974

Crop	1985			1974		Change	
	Acreage '000	Yield tonne/ac	O:P ratio	Output '000 tonnes	Output '000 tonnes	'000 tonnes	per cent
Wheat	80	2·15	·92	158	194	− 36·0	−18·6
Oats	40	1·70	·22	15	30	− 15·0	−50·0
Malting Barley	145	1·80	·74	1,124	656	+468·0	+71·3
Feeding Barley	645	1·95					
Sugar Beet	70	19·0	1·00	1,330	1,222	+108·0	+ 9·0
Potatoes	60	12·5	·47	353	424	− 71·0	−16·8

Sources: Tables 3.1 and 3.2 and Appendix Table 2.1.

TABLE 3.4

The projected growth rate in the volume of agricultural crops 1974 to 1985.

Crop	Unit Value £/tonne	Value of output (£m)		Average annual rate of change
		1974	1985	
Wheat	56·8	11·0	9·0	−1·8%
Oats	44·9	1·4	0·7	−6·1%
Malting Barley	58·4	34·0	57·2[1]	+4·8%
Feeding Barley	49·4			
Sugar Beet	12·7	15·5	16·9	+0·8%
Potatoes	38·4	16·3	13·6	−1·6%
Other[2]	—	25·0	31·1	+2·0%
Total		103·2	128·5	+2·0%

Sources: Appendix Table 2.1 and Table 3.3.

[1]70% of malting barley is valued as such. The remainder is valued as feeding barley. This is in line with the pattern of disposal in the past.

[2]This is the value of crops other than those listed here which are included in the official agricultural output statistics. It is comprised mainly of horticultural crops. In the above table it is given the same growth rate as the average for the listed crops which is 2·0% per annum.

The various crop projections when aggregated show an annual average growth rate of 2·0% per annum for the agricultural crop sector over the eleven-year period 1974 to 1985. This compares with a growth rate of 1·9% over the period 1960 to 1975.

(b) The Livestock Sector

The general methodology which represents output as to the product of a scale, intensity and output : production ratio also serves as a useful approach by which to make projections of output in the livestock sector. Consequently the results in this part will also be presented in that context as far as possible.

3.5 Milk Output

Cow numbers: Cow numbers represent the scale factor for milk production and output. The numbers for the years 1960 to 1976 are given in Column (2) of Appendix Table 3.4 and graphed in Figure 3.3. The linear trend fitted to these data indicates an average increase of about 55,000 cows per year over that period.[6] When projected forward to 1985 this gives a population of 2·60 million cows.

Milk Yield: In attempting to analyse the trend in milk yields, difficulties were encountered in obtaining a continuous comparable series for the period under review. An official series was published by the Central Statistics Office for the years up to and including 1969 but not for subsequent years. The most reliable estimates for intervening years are those relating to creamery and liquid milk herds in the An Foras Talúntais Farm Management Survey, 1972–1976.

These Survey data are not comparable, however, with the pre-1969 CSO yield data, since they relate to a narrower range of cows.[7] It was possible, nevertheless, to use them to construct a yield index for the period 1969 to 1976—the values for 1969 to 1972 being derived from Department of Agriculture information on milk supplies per cow in creamery herds in those years. This index was then used to up-date the CSO series. The results are given in Appendix Table 3.4 and graphed in Figure 3.3.

[6]As shown in the trend equation for "Total Cows" in Appendix Table 3.1.

[7]The CSO data relate to all cows except those kept primarily for suckling. It therefore includes those cows kept primarily to supply milk for direct home consumption and for bucket feeding of calves in addition to the creamery and liquid milk cows.

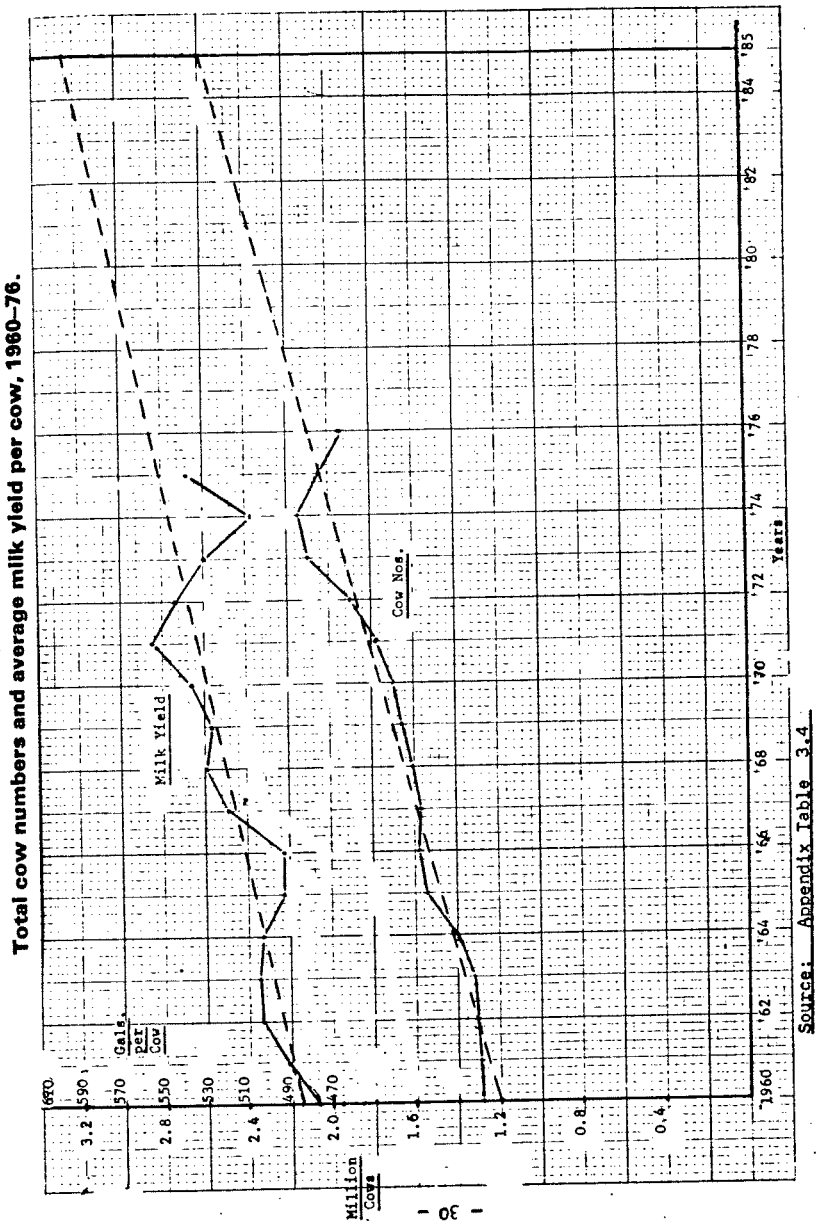


FIGURE 3.3.
Total cow numbers and average milk yield per cow, 1960–76.

The evidence shows that yields rose only very slowly throughout the 1960s and early 1970s. The trend over the entire period amounted to only 4·2 gallons per year,[8] which when projected forward gives a yield of about 595 gallons per cow in 1985. However, it is quite apparent in this instance that the long-term trend does not accurately foreshadow the future changes. It will be noted from Appendix Table 3.4 that the average yield increased by approximately 30 gallons in 1975 and 40 gallons in 1976. It is likely that a certain proportion of these increases were due to unusually good winter forage resulting from favourable weather conditions in recent summers. Nevertheless, there is also evidence of increased meal feeding in these years, particularly in 1976.[9] For this reason it was felt that a projected average increase of about 20 gallons per year for the eleven-year period 1974 to 1985 would be a more likely outcome than the long-term trend projection of 4·2 gallons per year over that period.

While the yield figures given in Appendix Table 3.4 adequately reflect past trends, they are unsatisfactory in so far as they are not published for the years since 1969. It was felt that it would be desirable to construct the 1985 milk projections of this study in terms of data on yields and cow numbers which are currently being published and which are likely to be continued in the future. The most obvious choice in this respect is the series on average cow yields recently initiated by the Statistical Office of the European Communities (SOEC).

The SOEC series, which commenced in 1974, represents average milk yield as "milk production" from "dairy cows" divided by the number of "dairy cows" in December of the previous year.[10] It gives a yield of 528 gallons per cow in 1974 and 588 gallons in 1975. With an annual increase in the region of 20 gallons per year, this would

[8]As shown by the trend equation which is given in Appendix Table 3.2.

[9]Private communication with B. Kearney, An Foras Talúntais.

[10]"Dairy cows" are defined as cows kept primarily to produce milk for sale or for human consumption. Total "milk production" from these cows is equivalent to the output of milk as published in the Irish Statistical Bulletin, plus an allowance for that fed to calves which is estimated at 3% of output—about 17 gallons per dairy cow in 1974.

reach 800 gallons per cow by 1985. Assuming "dairy cows" will comprise about two-thirds[11] of the projected 2·60 million cow herd, the 1985 projection for milk output is as shown in the following table.

TABLE 3.5

Projection of milk output in 1985 and comparison with 1974

	Cow Numbers ('000)		Yield per Cow (gallons)	Output[1] (million gallons)
	Total Cows	Dairy Cows		
1974	2,094	1,350[2]	565[2]	740
1985	2,600	1,734	800	1,358
Absolute change	+506	+374	+240	+618
Per cent change	+24·2%	+27·5%	+42·9%	+83·5%

Source: 1974 from Appendix Table 3.4 and 1976 Yearbook of Agricultural Statistics, SOEC. Projections for 1985 as described in the text.

[1]In calculating output the number of dairy cows is multiplied by the average yield shown here less 17 gallons per cow fed to calves in both 1974 and 1985.

[2]In deriving the 1974 averages the authors estimated that there were approximately 1.315 million dairy cows in Ireland in December 1972, giving an average yield of about 580 gallons in 1973.

The figures in the extreme right-hand column show that milk output is projected to increase by over 80 per cent by 1985. This arises mainly from the increase projected for yields and to a lesser extent from the extra cow numbers. It will be assumed subsequently that 150 million gallons of the 1985 output will be consumed by persons as liquid milk thus leaving 1,208 million gallons for creamery intake.

3.6 Cattle Output

The projection of cattle output can be derived directly from the 1985 cow numbers. The connecting link arises from the identity: opening inventory + births − mortalities = closing inventory − sales i.e. output (including inventory change) = births − mortalities. The com-

[11]This is approximately the average ratio obtaining for the years 1974, 1975 and 1976.

ponents on the right-hand side are related to the size of the breeding herd and over the past 20 years output has in general ranged between 80% and 90% of cow numbers. The percentage for the years 1953 to 1975 are plotted in Fig 3.4. The values for 1962 to 1965 exceed 90% but it has been argued that these were abnormally high due to the operation of the Bovine Tuberculosis Scheme.[12] The trend equation fitted to the series excluding 1962 to 1965 is given in Appendix Table 3.2. It shows a slight upward trend resulting in a projected value of approximately 87·5% for 1985. When applied to the projected cow population of 2·60 million in 1985 this gives an output of 2.28 million head of cattle compared to an average of 1·76 million in 1974.

3.7 Output of Sheep and Wool

The long-term trend in ewe numbers in Ireland has been downward as can be seen from the appropriate graph in Figure 3.5. If projected forward according to the trend equation this would result in a national herd of just 1·6 million ewes in 1985[13] compared to 1·8 million in 1974. Simply projecting the trend forward in this case, however, is a highly speculative exercise due to the uncertainty with regard to future access to the French market. Free access to this market would provide a considerable boost to the Irish sheep enterprise which almost certainly would reverse the long-term decline in the breeding flock. It was nevertheless decided to adopt the trend position and fix the 1985 number for ewes at 1·6 million head.

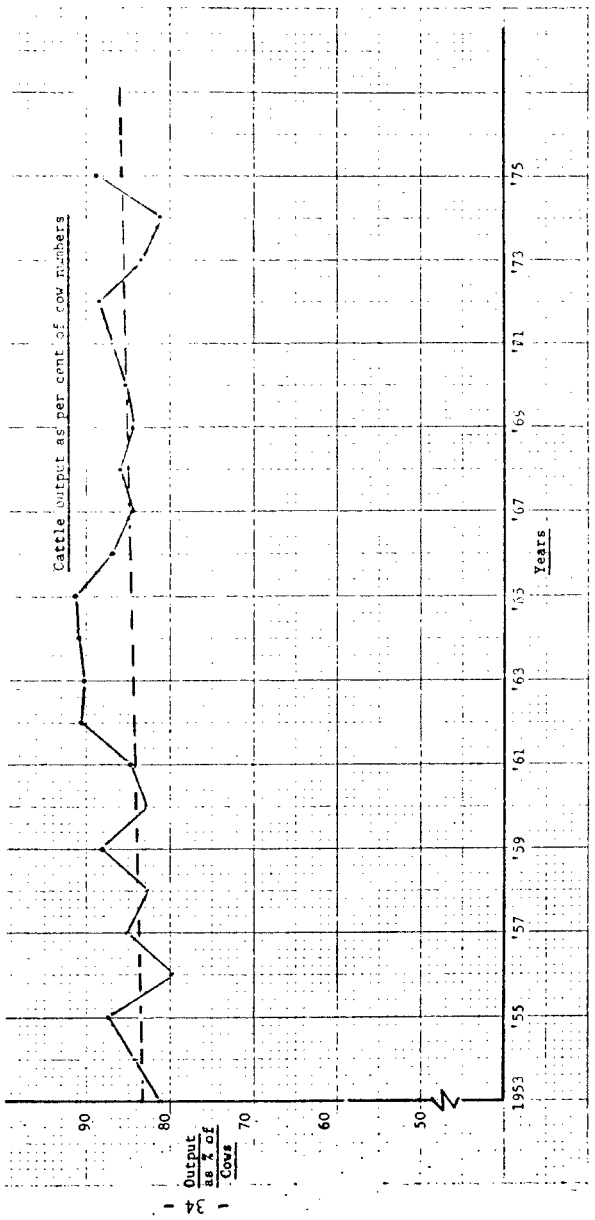
The relationship between sheep output and ewe numbers has been improving over the years as may be seen from Figure 3.5 and the trend equation given in Appendix Table 3.2. Consequently an output of 95 sheep per 100 ewes is projected for 1985 as against 90 in 1974. The output of wool was 8·7 lb per ewe in 1974 and the same figure was adopted for 1985.

[12]See O'Connor, R., "Projections of Irish Cattle and Milk Output under EEC Conditions", *The Economic and Social Review*, Vol. 3, No. 3, 1972.

[13]See Appendix Table 3.1.

FIGURE 3.4

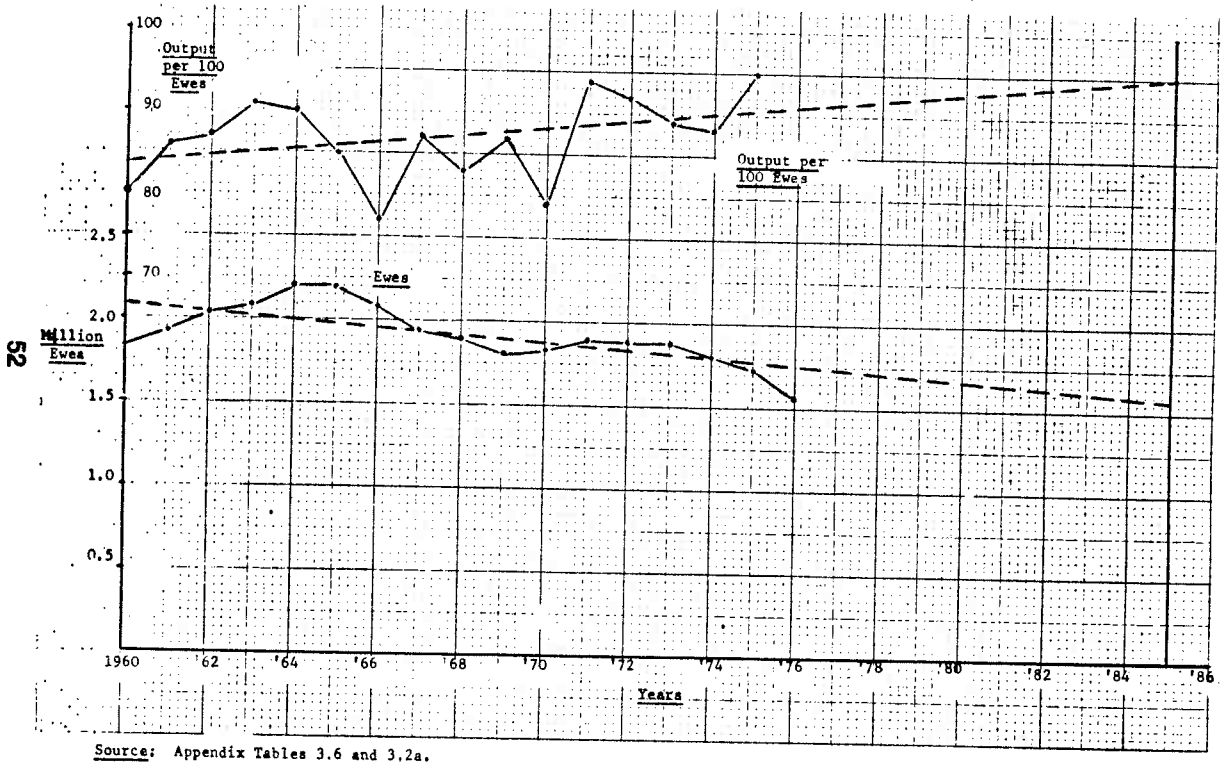
Cattle output as a percentage of cow numbers, 1953–75



Source: Appendix Tables 3.5 and 3.2a

FIGURE 3.5

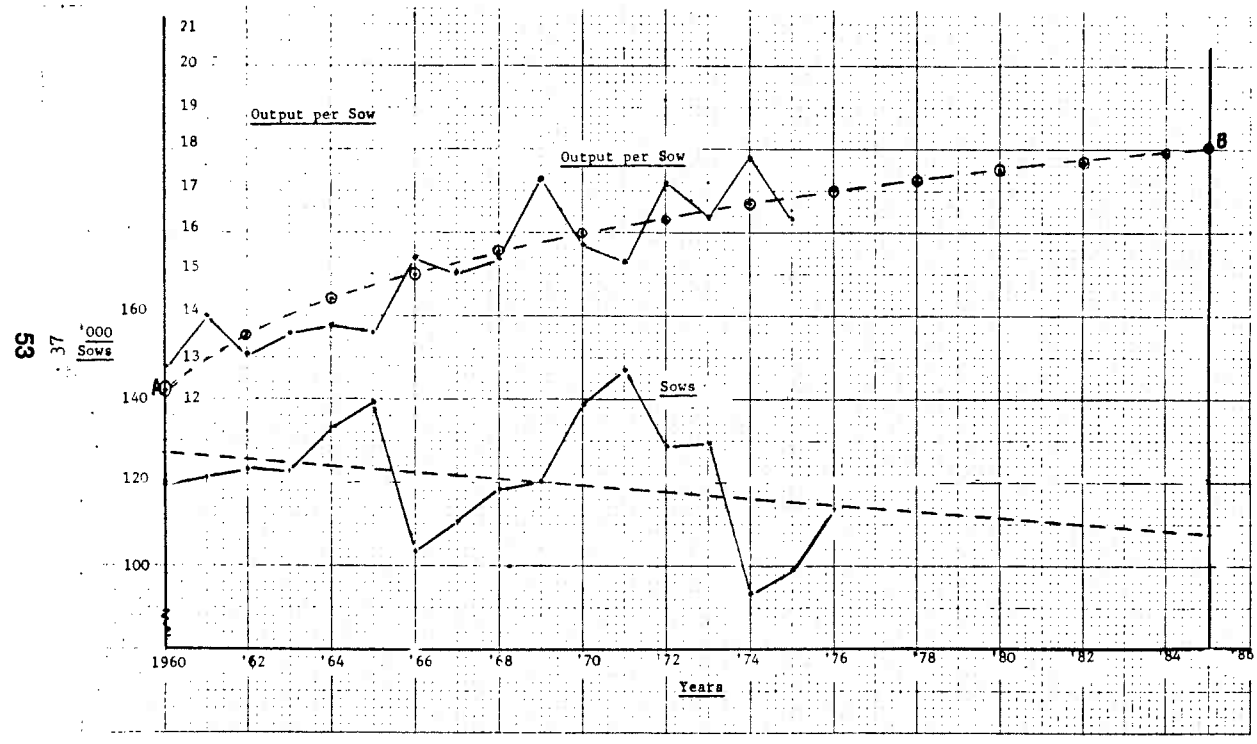
Number of ewes, 1960–76 and output of sheep and lambs per 100 ewes, 1960–75



Source: Appendix Tables 3.6 and 3.2a.

FIGURE 3.6

Number of sows, 1960–76 and pig output per sow, 1960–75



Source: Appendix Tables 3.7 and 3.2a.

3.8 Pig Output

The changes in the breeding herd over the period 1960 to 1976 are shown in Figure 3.6. The trend equation given in Appendix Table 3.1 indicates a long-term decline in numbers and it suggests a figure of 108,000 sows in 1985 which is marginally above the average for 1974. No attempt has been made in this study to superimpose a cycle upon the long-term trend. However the use of a three-year average target date, namely 1985, reduces the possible significance of this factor.

In the past the downward trend in the breeding herd has been compensated for by a substantial upward shift in the ratio of pig output to sow numbers. The linear trend equation for this ratio is shown in Appendix Table 3.2 and would suggest an average output of 20.3 pigs per sow in 1985. This would be a very substantial increase on the 1974 level of 16.8 pigs per sow and is hardly attainable by 1985. It was felt however, that a figure of about 18 pigs per sow could be reached by 1985.[14] Thus the projected pig output for 1985 in the trend model was set at 108,000 × 18·0 = 1·94 million pigs compared to an average of 1·8 million in 1974 (including inventory changes).

3.9 Output of Poultry, Eggs and Horses

Trend lines were fitted directly to the output data for each of these products. Linear trends were applied to the data for eggs and horses giving 1985 outputs of 4·40 million units of 10 dozen and 15,300 head respectively; both represent slight declines on the 1974 levels. For poultry all bird types were grouped together and a linear trend fitted giving an output of 41·3 million birds in 1985.

3.10 The Projected Total Output for the Livestock Sector

By applying 1974 prices to each product it is now possible to assess the overall changes projected for the livestock sector. This is done in Table 3.6. In terms of 1974 prices, the output of the livestock sector is projected to increase by £241 million or just over 40%. Of that

[14]This would be consistent with a slower rate of improvement in output per sow in the coming years due to biological constraints and might be represented by a trend equation such as Log Y = 2.3982 + 0.1499 Log t (t = 2 for 1960, r = .89) giving curve AB in Figure 3.6.

increase approximately 94 per cent derives from the milk/beef sector. In total the projections amount to a 3·1% growth rate for the sector over the 11 year period 1974 to 1985 which is the same as the growth rate achieved in the period 1960 to 1975.

TABLE 3.6

The projected volume of output from the livestock sector in 1985 and the growth rate for 1974 to 1985.

Product	Unit value	Quantity 1985	Value of output (£m) at 1974 prices		Average annual rate of change
			1985	1974[2]	
Cattle and calves	£158.8/head[1]	2.28m	362.1	283.8	+2.2%
Sheep and lambs	£15.3/head	1.52m	23.3	22·2	+0·4%
Pigs	£34·5/head	1·94m	66·9	61·3	+0·8%
Poultry	£0·7/head	41·30m	28·9	17·7	+4.6%
Horses	£367·7/head	·015m	5·6	5·9	−0·5%
Milk: Liquid	£265·5/000 gal	150m gl	39·8	36·4	+0·8%
Other[3]	£243·7/000 gal	1,208·00 m gl	294·4	149·1	+6·4%
Wool	£22·0/100 lb	14·1m lb	3·1	3·5	−1·1%
Eggs	£2·80/120 eggs	4·40m × 120	12·3	15·7	−2·2%
Cattle hides	£2·24 each		0·3	0·2	+3·8%
Other	—		0·6	0·4	+3·8%
Total			837·3	596·2	+3·1%

Source: 1974 output and unit values: Appendix Table 2.1. Quantities for 1985: see text.

[1]The average value per head for cattle and calves was £156·9 in 1974 but this has been adjusted upwards for the 1985 projection to allow for zero exports of calves.

[2]Including the value of inventory changes.

[3]Including milk used in farmers' butter, buttermilk and separated milk.

(c) Projected Growth in Agricultural Output

In the previous paragraphs the authors' estimates of the trend developments in the crop and livestock sectors of Irish agriculture have been set down. By way of summary the overall results are shown below in Table 3.7.

TABLE 3.7

Projected volume of Gross Agricultural Output in 1985 and average annual growth rates, 1974 to 1985.

Sector	Value of output at 1974 prices		Per cent change	Average rate of growth
	1974	1985		
Livestock	596·2	837·3	+40%	3·1% p.a.
Crops	103·2	128·5	+25%	2·0% p.a.
Total	699·4	965·8	+38%	3·0% p.a.

When the projections for the two sectors are combined they show a 38% increase in the volume of Gross Agricultural Output by 1985. Valued at 1974 prices this would mean an increase of over £250 million in output. When expressed as a growth rate it amounts to an average increase of 3·0% per annum and if achieved would represent a marginal improvement on the growth rate achieved over the period 1960 to 1975.[15]

[15]During that period the volume of Gross Agricultural Output, including turf, increased at an average rate of 2.8% per annum. The output of turf however, had a downward trend over the period and if this item were removed from the Gross Agricultural Output index the resulting growth rate would be only marginally lower than that projected above for the period 1974 to 1985.

CHAPTER 4.

GROSS AGRICULTURAL OUTPUT—HIGH GROWTH MODELS

The objective of this chapter is to define alternative patterns for 1985 which would be consistent with a growth rate in Gross Agricultural Output over the period 1974 to 1985 amounting to between 5 and 6 per cent. In doing so, the authors present a number of sub-sector growth targets which in their view are realistic and technically feasible. The details of two alternative models are presented. They differ principally in the level of calf exports.

(a) High Growth Model I

By comparison with the trend model, the main features of this model are (*a*) an increase of 185,000 acres in cereals, (*b*) an increase in the stocking rate on grassland of the order of 14 per cent above the trend model, (*c*) an average milk yield of 900 gallons per cow, (*d*) disposal of cattle at a younger age (but no calf exports) and (*e*) a 4·5 per cent annual rate of increase in the breeding sow population.

4.1 The Crop Sector

In the trend model, the acreage of wheat was projected to decline from 133,000 acres in 1974 to 80,000 acres in 1985. However, for high growth Model I it was decided to postulate a stabilisation of its acreage at approximately the 1974 levels. It was also decided to increase the acreage of feeding barley to 775,000 acres. This compares with 645,000 acres in the trend model and an actual figure of 453,000 acres in 1974.

These are the only major crop changes postulated in Model I over and above those of the trend model. The acreages of potatoes and sugar beet as well as all the yields and output:production ratios are

held at the same levels. Some further volume growth in the "other crop" component is projected, and the acreage in this category has been increased to 100,000 acres compared to 90,000 acres in the trend model.

The complete set of changes postulated for the crop sector and the resulting growth rate are summarised below in Table 4.1.

TABLE 4.1.

Projections for the volume of agricultural crops in high growth Model I

Crop	1985		Value of output at 1974 prices		Annual rate of change
	Acreage ('000 ac)	Output ('000 tonne)	1985	1974	
Wheat	135	267	15·2	11·0	+3·0%
Oats	40	15·0	0·7	1·4	−6·1%
M. Barley	145	1,311	66·4[1]	34·0	+6·3%
F. Barley	775				
S. Beet	70	1,330	16·9	15·5	+0·8%
Potatoes	60	353	13·6	16·3	−1·6%
Other	100	—	42·8	25·0	+5·0%
Total	1,325		155·6	103·2	+3·8%

[1]In deriving this figure 70 per cent of the production of malting barley is valued as such and the remainder is valued as feeding barley. This is the same procedure as adopted in the trend model.

It can be seen that the changes made have raised the projected growth rate for the crop sector to 3·8% per annum compared to 2·0% in the trend model. The growth assumed in the "other crop" figures amounts to 5·0% per annum. It is envisaged that the major portion of that increase would come from the horticultural sector.

The total acreage of tillage is 1,325,000 acres and may be contrasted with the acreage in 1974 of 1,158,000 acres. Indeed the last time at which the acreage was above the projected level was in 1965 although it was close to it in 1970 and 1971.

4.2. The Livestock Sector

In high growth Model I a number of projections for grazing livestock populations were considered. The main criterion used in evaluating the feasibility of these was the national stocking rate implicit in them. The general framework put forward by Lee and Diamond in evaluating Irish grassland potential was adopted for this purpose.[1] They divided the area of land in agricultural use into lowland mineral soils and mountain soils and then estimated the grazing capacities of these soils.

In evaluating grazing capacities, the main pre-occupation must be with that of the lowland mineral soils since these carry about 95 per cent of the grazing livestock units (LU's) in the country. Lee and Diamond considered the average grazing capacity of these soils to be 0·8 and 1·0 LU's per acre under alternative level of nitrogen application.[2] Estimates of the stocking rate on lowland mineral soils for the years 1960 to 1975 are presented in Column (7) of Appendix Table 4.1. The rate of improvement has been approximately 2·1% per annum and if this were continued the lower grazing capacity figure suggested by Lee and Diamond would be reached by about 1990. The target selected in this study for both high growth models was ·80 LU per acre in 1985. Consequently these models involve "telescoping" approximately 15 years of improvement in stocking rates into 10 years. They also represent a considerably more rapid rate of improvement than that implicit in the trend model where the 1985 projections require a stocking rate of only ·72 LU per acre on lowland mineral soils.[3]

Having set the target stocking/rate and the tillage acreage, it was then possible to estimate the total number of livestock units that would be feasible in high growth Model I. The results are summarised in Table 4.2.

[1]John Lee and Sean Diamond. *The Potential of Irish Land for Livestock Production* Soil Survey Bulletin No. 26, An Foras Taluntais, June 1972.

[2]43lb N/ac and 206 lb N/ac. p. 28.

[3]See Appendix Table 4.3.

TABLE 4.2.

The projected livestock carrying capacity in 1985—Model I

	Lowland mineral soils	Mountain and hill soils
Number of "feed acres" available to livestock ..	9·4 m ac.	3·3 m ac.
Average stocking rate	0·80 LU/ac	0·20 LU/ac
Stock carrying capacity	7·5 m. LU.	0·7 m LU
Total carrying capacity	8·2 m. LU's	

Source: See Appendix Table 4.2 for the derivation of "feed acreage".

The projected livestock carrying capacity shows that a grazing livestock population of approximately 8·2 million LU's could be carried. This compares with a population of 7·2 million LU's projected in the trend model and an average of 5·9 million actually carried in 1974.[4] Thus, 8·2 million LU's served as a guide to the upper constraint for the livestock projections made in high growth Model I.

Sheep output: In 1974 the output of sheep and lambs, including inventory changes, amounted to 1·632 million head. A slight decrease was projected in the trend model arising out of the downward trend in ewe numbers. The future of the sheep trade will depend very much on the outcome of efforts to gain access to the French market and on the rate of progress in developing an EEC sheep policy. In both high growth models it is assumed that more favourable trading conditions will be obtained in this sector before the end of the decade at least. On this basis a projection of 2·50 million ewes is included for 1985 compared to 1·6 million in the trend model and 1·8 million in 1974. With a productivity of 95 sheep and lambs per 100 ewes, as in the trend model, this would provide an output of 2·375 million head per annum. It is estimated that the ewes and their followers would constitute about ·76 million LU's.[5] It is further assumed that 50 per cent of these will be carried on the mountain soils.

[4]See Appendix Tables 4.3 and 4.1 respectively.

Output of horses: This is projected at the same level as in the trend model, viz., 15,200 horses. This is the same level of output as in 1974 and consequently the inventory of horses for 1985 was taken to be the same as in 1974. These amounted to approximately 127,000 LU's all of which were assumed to be carried on lowland mineral soils.

Cattle Output: Having made projections for sheep and horses it is possible to deduce the maximum number of cattle that would be consistent with the overall stock carrying capacity projected for 1985. Thus we have:

	Lowland m LU's	Mountain m LU's
Total capacity ..	7·50	0·70
Less: sheep ..	·38	·38
horses ..	·13	—
	6·99	·32
Total cattle LU's ..	7·31	

It can be shown that this population of cattle livestock units is consistent with a cow population of approximately 3·20 million cows[6] under the main assumptions of high growth Model I which are: (*a*) no calves exported, and (*b*) 75 per cent of beef cattle fattened and sold at approximately 2 years of age. Applying the formula, cattle output=·875 cows, gives an estimated cattle output of 2·80 million head in high growth Model I compared to 2·34 million in the trend model. It will be assumed that these cattle will be of the same average weight and condition as in the trend model even though they are being made ready for final sale at an earlier age. This will have significance for the feed requirements estimated in Chapter 5.

[5]See Appendix Table 4.4 for details.
[6]See Appendix Table 4.4.

Milk output: The same methodology as in the trend model was used to derive the milk output from the projected 3·20 million cow population except that a yield of 900 gallons per cow was assumed rather than 800 gallons. The results are shown in Table 4.3.

TABLE 4.3

Projection of milk output in 1985 under high growth Model I and comparison with 1974

	Cow Numbers		Yield per cow	Output[1] (million gallons)
	Total cows ('000)	Dairy cows ('000)	(gallons)	
1974	2,094	1,350	565	740
1985	3,200	2,134	900	1,885
Absolute change	+1,106	+784	+335	+1,145
Per cent change	+53%	+58%	+59%	+155%

[1]See footnote 1. to Table 3.5.

It can be seen that the projected cow numbers and yields for this high growth model would raise the milk output to almost 1,900 million gallons in 1985 compared to 740 million gallons in 1974. Assuming 150 million gallons are consumed by persons as liquid milk, this high growth model entails a total creamery intake of appproximately 1,735 million gallons in 1985.

Pig Output: The target set for the pig enterprise in high growth Model I is a breeding herd of 175,000 sows by 1985. Assuming an output: sow ratio of 18·0 this would give an output of 3·15 million pigs which is 75% greater than the output figure for 1974 and 62% greater than that of the trend model.

Other products: The output of cattle hides and wool were related to cattle output and ewe numbers respectively in the same way as in the trend model. The output of eggs and poultry were fixed at the same levels as in the trend model.

4.3 Projected Total Output for the Livestock Sector

The changes which have been postulated in the livestock sector in order to raise the growth rate are summarised in Table 4.4.

TABLE 4.4.

Projected growth rate in output from the livestock sector in high growth Model I.

Product	Unit value	Quantity 1985	Value of output (£m) at 1974 prices 1985	1974	Average annual rate of change
Cattle	£158·8/hd.	2·80m	444·6	283·8	+4·2%
Sheep and lambs	£15·3/hd.	2·375m	36·3	22·2	+4·6%
Pigs	£34·5/hd.	3·15m	108·7	61·3	+5·3%
Poultry	£0·7/hd.	41·30m	28·9	17·7	+4·6%
Horses	£367·7/hd.	0·015m	5·6	5·9	−0·5%
Milk: Liquid	£265·5/000 gal.	150m gal.	39·8	36·4	+0·8%
Other	£243·7/000 gal.	1,735m gal.	422·8	149·1	+9·9%
Wool	£22·0/100 lb	22·0m lb.	4·8	3·5	+2·9%
Eggs	£2·8/120 eggs	4·40m × 120	12·3	15·7	−2·2%
Cattle hides	£2·24 each	—	0·3	0·2	+3·8%
Other		—	0·6	0·4	+3·8%
Total			1,104·7	596·2	+5·8%

Sources: Unit values and 1974 output; from Appendix Table 2.1.
Quantities for 1985 from text.

The overall growth rate amounts to 5·8% per annum for this sector. This compares with a projection of 3·1% in the trend model. From the figures it can be seen that the three main sources of

increased output are the cattle, milk and pig enterprises. The extra output of milk is the single most important contributing factor. In terms of 1974 prices it adds £277 million to the output of the livestock sector. This is over 50% of the total increase projected for that sector in the present model.

It should be noted again that the cattle disposal system postulated here involves no calf exports. It is, however, based on the assumption that approximately 75% of beef cattle are fattened at approximately 24 months of age. Compared to the traditional system, this has the effect of reducing the amount of land required to support the adult beef cattle population and consequently has allowed a greater number of cows. The 24 month-old beef cattle system postulated is that which has been developed at both Grange and the U.C.D. farm and does not involve lower slaughtering weights.[7]

4.4 Growth in the Volume of Gross Agricultural Output

When combined, the projections for the crop and the livestock sectors amount to a 5·5% growth rate for the period 1974 to 1985 as can be seen from Table 4.5.

TABLE 4.5.

The growth in volume of Gross Agricultural Output under high growth Model I.

Sector	Value of output at 1974 prices (£m)		Increase (£m)	Annual rate of change
	1974	1985		
Livestock	596·2	1,104·7	+508·5	+5·8%
Crops	103·2	155·6	+52·4	+3·8%
Total	699·4	1,260·3	+560·9	+5·5%

Source: Tables 4.1 and 4.4.

[7]Caffrey, P. and P.O. Brophy, "Beef Production from Spring-Born Calves Using an Intensive Grassland System", in *Journal of the Irish Grassland and Animal Production Association*, Vol. 10, 1975.

These figures for high growth Model I represent just one of the many combinations of individual enterprise targets which would yield a growth rate in excess of 5% per annum. The projections are in the authors' opinion well within the range of technical feasibility. The likelihood of their being achieved is another matter which will be assessed in the next Report. Specifically they include for the period 1974 to 1985:

(*a*) An average increase of 100,000 cows per year compared to the 1960 to 1976 trend of 56,000 extra cows per year.

(*b*) An average increase in milk yields in the region of 30 gallons per year compared to a trend increase of just over 4 gallons per year in 1960 to 1976.

(*c*) A 64% increase in the sow herd, i.e. an average increase of 6,000 sows per year, as against a long-term decline over the 1960 to 1976 period.

(*d*) An average annual increase of approximately 30,000 acres in feeding barley compared to the 1960 to 1976 trend of 16,000 extra acres per year.

(*e*) A halt in the decline in wheat acreage.

(*f*) A more intensive beef production system in which at least 75% of cattle would be fattened at 24 months of age.

(b) High Growth Model II

In the trend model and high growth Model I the cattle herd was projected along traditional patterns with regard to both its structure and disposal. Thus it was assumed that all beef animals were retained on Irish farms to a mature age before being sold for slaughter or for export as stores. Such a system contrasts with that practised in some other countries, notably the Netherlands, whereby a very high proportion of non-replacement stock are either slaughtered or exported as calves. This reduces the ratio of dry stock to cows which in turn affords the option of expanding the cow herd and increasing milk output. Alternatively, it could facilitate the substitution of tillage enterprises which may have higher output and valued-added than beef production.

The objective of the remainder of this chapter is to set down a high growth plan for Irish agriculture involving a significant level of calf exports and to assess the effect of such trading on the volume of Gross Agricultural Output. Interest in this question was first aroused in 1973 when Italian beef producers turned their attention to Ireland as a source of calf supplies. While exports were low in 1973 and 1974 they reached approximately 80,000 head in 1975 and 1976; this was between 4 and 5% of all calves produced in those years.

In high growth Model I an inventory of 3·20 million cows was projected for 1985. Assuming a yield of 94 calves per 100 cows these would produce 3·00 million calves.[8] For the purpose of the current analysis it is assumed that 300,000 of these are exported in the early weeks of life. The implications of this level of exports are assessed in high growth Model II.

Relative to high growth Model I, exporting 300,000 calves per annum gives rise to surplus capacity particularly in land. A continuing yearly trade on this scale would mean a reduction of 300,000 in the inventory of 0–1 year olds, about 290,000 head in the inventory of 1–2 year olds and approximately 80,000 head in the inventory of cattle over 2 years of age. In terms of livestock units this amounts to a reduction of 400,000 cattle LU's.[9] which, at an average stocking rate of ·8 LU per acre, would have required 500,000 acres of land to maintain.

Two extremes, therefore, can be postulated with regard to the output effects arising from calf exports:

(*a*) No expansion takes place in cattle or any other enterprise to take up the surplus resources.

(*b*) The surplus capacity is fully taken up.

In the former case the effect will be to reduce output by the amount which accrues from rearing 300,000 calves to maturity.

[8]This yield coupled with a 6% post-natal mortality rate gives an inventory of 0–1 yr olds in June equal to approximately 88·5% of cows. This is the relationship used in deriving the projected cattle inventories shown in Appendix Tables 4.3 and 4.4.

[9]See Appendix Table 4.4 for estimation of total cattle LU's (including cows) associated with a 3·20 million cow herd with (*a*) no calf exports and (*b*) 300,000 calves exported.

A more positive approach to the calf export question, however, would be to view the surplus capacity as an opportunity for further expansion in production. It can be shown that 175,000 extra cows with their followers managed as in Model I (i.e. 75% disposed of as 24 month-old beef cattle) could be kept on the 500,000 acres released.[10] However, since the export of calves represents a stock reduction mostly in store and fattening regions of the country it would perhaps be more realistic to postulate that part of the land released would be devoted to grain production. The subsequent analysis in this chapter, therefore, will be based on the following changes from high growth Model I in addition to the export of 300,000 calves: 25,000 extra acres under wheat, 75,000 extra acres under feeding barley, and 140,000 extra cows with followers reared to maturity as in high growth Model I.[11]

The effect of these changes on Gross Agricultural Output are shown overleaf in Table 4.6.

These figures show that calf exports need not depress output provided they do not give rise to a less intensive use of the national land area than would otherwise exist. In fact the figures in the bottom line of Table 4.6 show that it could even achieve a marginal increase in the volume of Gross Agricultural Output and its growth rate.[13]

A similar result to that shown in Table 4.6 would be obtained if it were assumed that *all* the surplus capacity were taken up by increased cow numbers and followers. In the event that none of the surplus capacity is utilised, however, a loss of approximately £35 million[12] would result and the growth rate would then amount to only 5·2%

[10]The calculations in Appendix Table 4.4 relating to high growth Model I give 2·294 cattle LU's for every cow. Thus, 175,000 extra cows and their followers would amount to approximately 400,000 LU's and at ·8 LU per acre account for 500,000 acres.

[11]See previous footnote for methodology. 140,000 cows × 2·294 LU = 321,000 LU's. At ·8 LU per acre these would require approximately 400,000 acres.

[12]It is perhaps worth noting that these results are not particularly sensitive to the price assumed for exported calves. A reduction of £10 per head in the price merely reduces the estimate of the output volume by £3 million and the estimate of the growth rate by 0·02%.

[13]Measured approximately by the difference in value between 300,000 calves and 300,000 adult cattle at 1974 prices.

TABLE 4.6.

Volume of Gross Agricultural Output in 1985 under high growth Model II (300,000 calves exported).

Sector	Quantity of Output	Value of output at 1974 prices (£m)		Average annual rate of change	Change from Model I
	1985	1985	1974		
Wheat	316,000 tonnes	17·9	11·0	+4·5%	+2·7m
M. & F. Barley	1,420,000 tonnes	71·8[1]	34·0	+7·0%	+£5·4m
Other Crops	—	74·0	58·2	+2·2%	0
Milk: Liquid	150m gl.	39·8	36·4	+0·8%	0
Other	1,817m gl.	442·8	149·1	+10·4%	+£20·0m
Calves	0·30m hd.	12·3[2]	1·2[2]	+23·6%	+£12·3m
Other cattle	2·62m hd.	416·1	282·6	+3·6%	−£28·5m
Other livestock and products	—	197·5	126·9	+4·2%	0
Total	—	1,272·2	699·4	+5·6%	+£11·9m

[1]Valued as in high growth Model I.

[2]Valued at £41 each which is approximately 26% of the 1974 mature cattle price. This percentage was arrived at by deducting 10% from the export prices of calves in 1974 and 1975 (*Trade Statistics of Ireland,* Dec. 1975) to obtain farm level prices and relating these to the average mature cattle prices implicit in the agricultural output statistics for those years. Calf exports were too low in 1973 to give a reliable relationship.

per annum for the period 1974 to 1985. Thus, the consequences of exporting calves is entirely dependent on the adjustment in land use which takes place as a consequence.

The above results as well as those for the trend model and high growth Model I are in terms of changes in Gross Output. It remains to examine the implications of these models in terms of Net Output. This is done in Chapter 5.

CHAPTER 5.

NET AGRICULTURAL OUTPUT

Net Agricultural Output is defined as Gross Agricultural Output less expenditure on seeds, feeding stuffs and fertilisers including lime. These inputs account for approximately 60% of all the inputs of agriculture. Consequently changes in Net Output are a useful guide to changes in the value-added of agriculture. In fact the change over time in the volume of Net Output as shown in Irish official statistics has been curiously almost identical with the change in the volume of Gross Agricultural Product or value-added in agriculture.[1] The purpose of this chapter is to estimate the volume of Net Agricultural Output which might derive from each of the Gross Output projections made in the previous chapters.

In constructing the Gross Output projections in Chapters 3 and 4 a number of constraining factors were applied. These were: the rate of growth in yields; the level of O:P values and in the case of the high growth models, a constraint imposed by the potential of Irish grassland.[2] In the case of Gross Output it was a relatively simple matter to ensure feasibility with respect to these constraints. It was not, however, nearly so easy to ensure feasibility in the Net Output projections.

The difficulties which arose in attempting to derive projections for Net Output which were consistent with Gross Output stemmed from a lack of precise knowledge regarding some of the input:output relationships in agriculture. This was found to be particularly so when deriving

[1]See, for example, comment in *A Comparative Study of Output, Value-Added and Growth in Irish and Dutch Agriculture,* NESC, No. 24, Dec. 1976. p 28.

[2]The constraint arising from grassland potential was not operative in the trend model due to the fact that the implied stocking rates were well within the limits of feasibility for 1985.

the fertiliser requirements necessary to sustain the projected crop yields and stocking rates and the meal inputs required to maintain the projected milk yields.

For each of the three inputs involved the approach used was to estimate the average requirement per acre or per animal and apply these to the acreage and livestock projections of the growth models. Where different rates of performance were involved, such as in milk yield or level of stocking, it was necessary to vary the input rates to take account of this. It was in such cases that the available information was found to be most inadequate.

5.1 Projecting the volume of seed inputs

In 1974 the value of seed purchased by farmers from merchants[2] averaged £8·7 million per annum. This was only 5% of the total bill for seeds, feed and fertilisers. Consequently it is not proposed to enter into detail about the projections under this heading. The per acre seed expenditures for each of the main crops were derived from a breakdown of total seed purchases by type of seed as provided by the Central Statistics Office. The results are summarised in Table 5.1 and applied to the 1985 acreage projections. Thus it should be noted that the implied seeding rates per acre have not been altered from the average 1974 levels in either of the models shown.

The bottom line of the table shows total estimated seed purchases under the trend model and high growth Model I in terms of 1974 prices. Virtually no change is projected for the trend model, mainly because of the small change in total tillage area. A 21% volume increase is projected for high growth Model I due to the higher cereal acreages involved.

The seed expenditures under "high" growth Model II have not been shown in Table 5.1. These are the same as for high growth Model I except for the requirements due to the extra 25,000 acres of wheat and 75,000 acres of barley. These bring the total seed bill for that model to £11·36 million at 1974 prices.

[2]These are the only purchases included in the seed input. Sales from one farmer to another are not included. In the cases of seed oats and seed potatoes purchased from merchants, only cleaning and retail charges are included.

TABLE 5.1

Projected expenditure on seeds for the trend model and high growth Model I. at constant 1974 prices.

Crop	1974 Seed Input			1985—Trend Model		1985—High Growth Model 1[1]	
	Acreage (000)	Seed Total £m	Purchases per acre £	Acreage (000)	Seed Purchases £m	Acreage (000)	Seed Purchases £m
Wheat	133	1·150	8·65	80	0·69	135	1·17
Barley	598	3·346	5·60	790	4·42	920	5·15
Oats	118	0·418	3·54	40	0·14	40	0·14
Sugar Beet	73·5	0·360	4·90	70	0·34	70	0·34
Potatoes	105	0·160	1·52	60	0·09	60	0·09
Other tillage	130	0·425	—	90	0·29[1]	100	0·33[1]
Pasture (Grass and clover seed)	—	2·850	—	—	2·79[2]	—	3·26[2]
Total		8·710			8·76		10·48

Source of data: Value of seed inputs 1974, Central Statistics Office, Dublin.

[1]The 1974 value scaled according to "other tillage" acreage.

[2]Scaled in proportion to total tillage acreage on the assumption that the area seeded is approximately proportional to the area under tillage. This assumes 1974 rotation systems are continued to 1985.

TABLE 5.2

Fertilizer rates on grassland, percentage of area fertilised and projections for 1985

		Percentage of Area Fertilised	Average Rate on Fertilised Area (lb/ac) N	P	K
Pasture:	1964	37·6	9·0	22·5	22·9
	1967	35·1	12·1	23·8	25·9
	1971/72	66·0	16·8	19·9	26·2
Projected:					
Trend	1985	90	45	15	30
H. Growth (I.and II)	1985	90	65	15	30
Silage:	1964	52·9	54·1	22·0	44·1
	1967	87·4	34·7	20·6	39·0
	1971/72	99·6	69·6	29·1	56·3
Projected:					
Trend	1985	100	100	30	130
H. Growth (I and II)	1985	100	125	30	130
Hay:	1964	50	10·7	21·1	28·8
	1967	66	14·4	19·1	29·9
	1971/72	87	22·4	23·7	37·7
Projected:					
Trend	1985	100	80	25	75
H. Growth (I and II)	1985	100	100	30	100
			Average Rate on Total Area		
Rough Grazing:	1967		0·04	0·5	0·02
	1971/72[1]		0·18	3·6	0·36
Projected:					
Trend	1985		0·1	1·0	0·1
H. Growth (I and II)	1985		0·1	1·0	0·1

[1]These rates for rough grazing are not comparable with the 1967 rates and were therefore discounted in the present study. (Private communication with W. Murphy, An Foras Talúntais. Johnstown Castle, Wexford).

Sources: Fertiliser Use Surveys 1964, 1967 and 1971–2. An Foras Talúntais.

5.2 Projecting fertiliser use

In 1974 the input of fertiliser (including lime) amounted to £55·3 million or almost one-third of the total bill for feed, seed and fertiliser. The main sources of information used in deriving the projections presented below were the Fertiliser Use Surveys, 1964, 1967 and 1971–'72 carried out by An Foras Talúntais.[4] No single method was adhered to in all cases but as a rough guide the increases in per acre rates as indicated by these three surveys were compounded forward to 1985 except where maximum recommended rates were exceeded by doing so.[5] In the high growth models the upper limits were in general set at the maintenance recommendations of An Foras Talúntais since it is assumed that under this model soil fertility would have been raised to a satisfactory level by 1985 and consequently only maintenance requirements would be needed.

By far the greater part of the fertiliser requirements in the 1985 models are for grassland. Data on past rates per acre in this sector and their projected levels are shown in Table 5.2 as well as the assumptions with regard to the percentage of area fertilised.[6] The latter were also based on data from the Fertiliser Use Surveys. Similar information with regard to the tillage sector is shown in Table 5.3 for 1985.

The total projected fertiliser input for the trend model is shown in Table 5.4. In terms of 1974 prices it amounts to £103 million. This is 86% above the 1974 level. The underlying calculations were considerably influenced by the assumption regarding the proportion of grassland from which either hay or silage is taken. This was considered to be dependent largely upon the projected stocking rate.[7] For the trend model 0·70 LU per acre was projected and an allowance of

[4]A paper by Brogan, J. C. "Fertiliser Needs in the Seventies", *Fertiliser Association of Ireland, No. 4,* July 1970 also provided useful guidelines.

[5]Some of these projections were subsequently altered on the basis of comments on an earlier draft of this report and as a result of discussions with J. C. Brogan and W. E. Murphy, An Foras Talúntais, Johnstown Castle, Wexford. Recommended rates were taken from the Fertiliser Manual, An Foras Talúntais, June, 1971.

[6]The figures in this table and in Tables 5.3, 5.4 and 5.5 refer to elemental N, P and K.

[7]Theoretically it should also be a function of the level of meal feeding.

TABLE 5.3

Fertiliser rates on cropland and percentage of area fertilised: Trend model and high growth models, 1985

Crop	Percentage of Area Fertilised	Average Rate on Fertilised Area (lb/ac)		
		N	D	K
Wheat	100	40	25	50
Oats	100	25	25	50
Feeding Barley	100	40	25	50
Malting Barley	100	25	25	50
Sugar Beet	100	100	100	300
Potatoes	100	100	100	200
Mangels, Swedes Rape, and Kale etc.	100	50	100	150
Fruit and Veg.	75—Trend 100 H.growth	80	80	220

Sources: Based on Fertiliser Use Surveys, 1964, 1967 and 1971–2. An Foras Talúntais.

approximately 0·4 acres of hay or silage per LU was considered adequate.[8]

A further issue in the fertiliser projections was the degree of recycling of farmyard manures and the effect of this on the purchases of artificial manures. The view was taken that the projections in Table 5.4 and also in Table 5.5 could be considered to be in excess of any nutrients returned to the soil through recycling. The primary reason for this conclusion was that the N, P and K rates assumed for 1985 in these tables were to a large extent derived by extrapolating the rates shown in the 1964, 1967 and 1971–72 fertiliser use surveys. The rates recorded in these surveys relate to artificial manures and therefore are in excess of any recycled nutrients in these years.

[8]Total LU's in the trend model = 7.17m.

TABLE 5.4.

Fertiliser Use in 1985 under the trend model.

Crop	Acreage	N	P	K
Tillage	'000 Acres	'000 tonnes		
Wheat	80	1·45	·91	1·81
Oats	40	·45	·45	·91
Malting Barley	145	1·64	1·64	3·28
Feeding Barley	645	11·70	7·31	14·65
Sugar Beet	70	3·17	3·17	9·52
Potatoes	60	2·72	2·72	5·44
Swedes etc.	60	1·36	2·72	4·08
Horticultural crops	30	·82	·82	2·24
	1,130	23·31	19·74	41·93
Grassland[1]				
Pasture	7,280	133·7	44·6	89·1
Silage	2,000	90·7	27·2	117·9
Hay	1,000	36·3	11·3	34·0
Rough Grazing	2,570	0·1	1·0	0·1
	12,850	260·8	84·1	241·1
Total for 1985		284·1	103·8	283·0
Purchases in 1974		131·7	75·5	133·1
1974 prices (approx)/tonne		£170	£265	£82·5
1985 volume at 1974 prices		£48·3m	£27·5m	£23·3m
1985 Lime		£3·8m		
Total 1985 Expenditure		£102·9m		
Total 1974 Expenditure		£55·3m		

[1]The grassland area is taken as 14·0m acres less 1·13m acres tillage (See Appendix Table 4.2) assume 20% is "rough grazing" (fertiliser Use Survey 1969).

Source: Tables 5.2 and 5.3. See text of Chapter 3 and this chapter for acreages. The 1974 prices are the authors' estimates.

TABLE 5.5.

Fertiliser use in 1985 under high growth Model I.

Crop	Acreage	N	P	K
Tillage	'000 acres	'000 tonnes		
Wheat	135	2·45	1·53	3·06
Oats	40	0·45	0·45	0·90
Malting Barley	145	1·64	1·64	3·28
Feeding Barley	775	14·06	8·79	17·57
Sugar Beet	70	3·17	3·17	9·52
Potatoes	60	2·72	2·72	5·44
Swedes etc.	70	1·59	3·17	4·77
Horticulture Crops	30	1·09	1·09	2·99
	1,325	27·17	22·56	47·53
Grassland[1]				
Pasture	5,890	156·2	36·1	72·2
Silage	3,400	192·7	46·3	200·6
Hay	750	34·0	10·2	34·0
Rough Grazing	2,635	0·1	1·2	0·1
	12,675	383·0	93·8	306·9
Total for 1985		410·2	116·4	354·4
1974 prices (approx)/tonne				
Value at 1974 prices		£69·7m	£30·8m	£29·2m
Lime		£5·0m		
Total 1985 Expenditure		£134·7m		

[1]The grassland area is taken as 14·0 m. acres less 1·325 m. acres tillage (See Appendix Table 4.2) assume 20 per cent rough grazing (Fertiliser Use Survey. 1969).

Source: Tables 5.2 and 5.3. See text of Chapter 4 and this chapter for acreages.

Furthermore it is the bellef of the authors that a very high proportion of the nutrients from farmyard manures have traditionally been recycled In Irish farming. Undoubtedly some losses—mainly N and K—

have occurred in the storage process especially where open dungsteads have been used. While improved storage facilities will bring future improvements in this regard, it was not considered to be of such proportions as to warrant a reduction in the projections of Table 5.3 for the trend model.

In the high growth models it is assumed that 75 per cent of dry cattle are managed in a 24 month old beef cattle system. Such animals will be housed for a higher proportion of their lives than in the traditional system and this would require the erection of suitable housing and slurry collection systems. This in turn would have the effect of reducing the loss of nutrients from farmyard manures. In addition high levels of meal feeding would be required for these cattle and for dairy cows in the high growth models[9] which would in effect amount to a substantial import of fertiliser to the national farm through the medium of concentrates. This also occurs to a lesser extent in the trend model through the increased meal feeding assumed for dairy cows.

In total the authors estimate that In the trend model for 1985 approximately 100,000 tonnes of both N and K and 20,000 tonnes of P would be available from housed animals for recycling.[10] The amounts for the high growth models would be 25–30 per cent higher. These compare with estimates of 75,000 tonnes of N and K and 15,000 tonnes of P in 1974. Thus if it is accepted that the proportion recycled in 1974 was already very high the likely increase in nutrients returned to the soil in the 1985 models does not appear to be a very significant factor in relation to the amounts of artificial N, P, and K projected in Tables 5.4 and 5.5.

Subject to these arguments regarding the significance of recycled farmyard manure the projected purchases of fertiliser required under high growth Model I are as shown in Table 5.5. In total they amount to £135 million at 1974 prices. This compares with £103 million for the trend model and £55 million in 1974. The most significant difference from the trend model is the greater nitrogen requirement. This follows from the higher stocking rate necessitating higher rates of fertilisation

[9]Estimated with the assistance of Dr. A. Morgan, Faculty of Agriculture. University College, Dublin.

[10]See Tables 5.6 and 5.7.

and also from the need to allocate a greater proportion of grassland to silage and hay. Since the stocking rate applied in this model was .80 LU per acre it was considered necessary to allow 0·5 acres of hay or silage per LU with the emphasis mainly on silage.[11]

In high growth Model II the average stocking rate is the same as in high growth Model I so that the same rates per acre on grassland are applicable. The only effect therefore of the changes between the two models is that arising out of the transfer of 100,000 acres from grassland to cereals. In the 1985 projections for high growth the average rates of N and K on grassland, excluding rough grazing, are higher than on cereals while P rates are just marginally lower. As a result there is a net saving. However, this was calculated to be only £0·35 million.

It is difficult to judge whether the above increases in fertiliser use are sufficient to maintain the stocking rates of ·70 and ·80 LU per acre in the trend and high growth models respectively. In Figure 5.1 estimates of the fertiliser usage on grassland (in 1974 prices) are plotted against the national stocking rate for the years 1960 to 1975. The points marked X represent the rates projected in this study. The curved line represents the relationship between fertiliser expenditure and stocking rate as shown by farms of different stocking rates in the Farm Management Survey of An Foras Talúntais.[12] It would appear to substantiate the relativities between the fertiliser projections for the trend and high growth models of the present study.

Figure 5.1 also suggests that the general level of the fertiliser projections in the present study may be compatible with realistic standards of grassland management. It is perhaps worth noting in this regard that Lee and Diamond, in a study of grassland potential budgeted an average rate of 43 lb N/ac for a stocking rate of ·8 LU/ac.[13] This is considerably below the N rates actually used by farmers and implies a heavy reliance on nitrogen-fixing clover which does not occur now even on highly stocked farms.

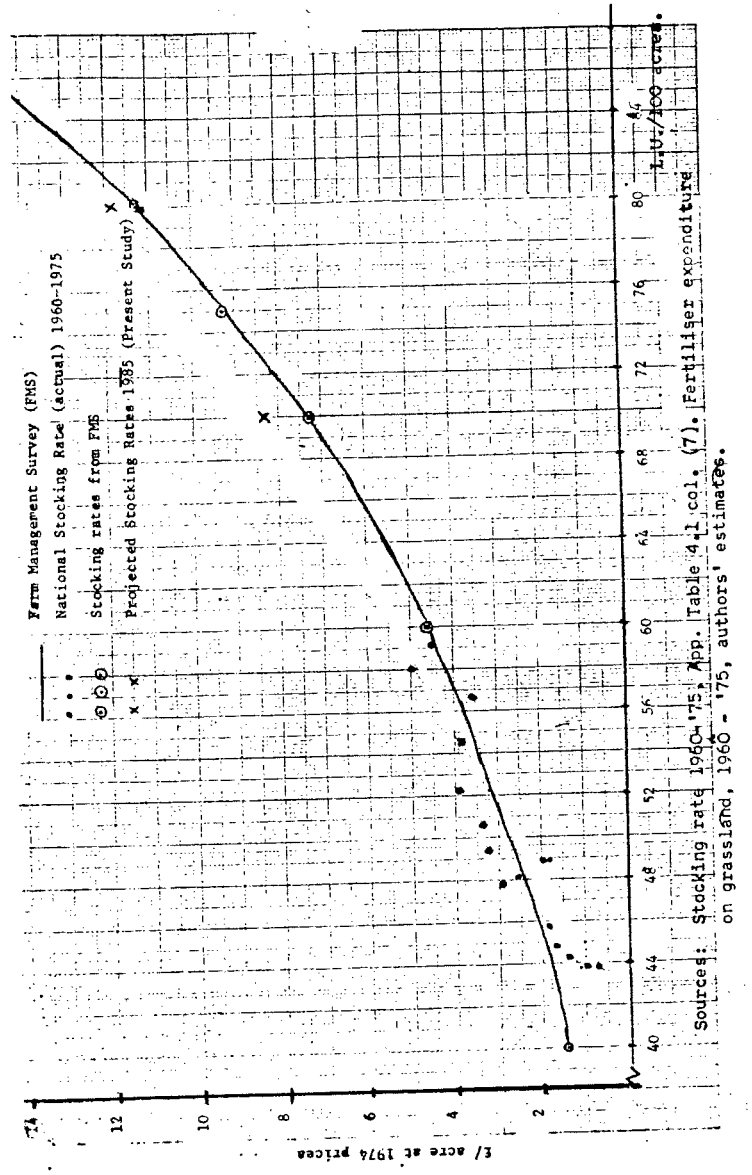
[11]Total LU's in high growth Model I = 8·23 m.

[12]See W. E. Murphy and J. C. Brogan, *"Review: The Use and Value of Fertiliser and Lime"*. Paper presented at An Foras Talúntais, Johnstown Castle. Sept. 1975. The expenditures have been converted to 1974 prices in Fig, 5.1.

[13]John Lee and Sean Diamond, *The Potential of Irish Land for Livestock Production*, Soil Survey Bulletin No. 26 An Foras Talúntais, 1972.

FIGURE 5.1

Relationship between fertilizer expenditure per acre of Grassland and Stocking Rate



5.3 The Input of Feeding Stuffs

The details of the estimation of the 1985 feed requirements are shown in Table 5.7 and the accompanying notes. The major decision in deriving these estimates related to the meal requirements of cows to produce a yield of 800 gals. and 900 gals. per annum in 1985 as opposed to 565 gals. in 1974 and the meal inputs for 24-month old beef cattle systems.

The final assumptions which were adopted in the case of dairy cows are summarised in Table 5.6.

TABLE 5.6.

Assumptions regarding meals fed to dairy cows yielding 800 gals. and 900 gals.

	1974 yield gal.	1974 feed cwt.	1985 models			
			Yield gals.	"Management factor"	Extra meal cwt.	Total meal cwt.
Trend model	565	4·9	800	+50 gals.	6·6	11·5
High growth models	565	4·9	900	+50 gals.	10·2	15·1

The figure for average meals fed in 1974 was obtained from survey data.[14] The management factor relates to assumptions made regarding the proportion of the increase in yields which could be assumed to derive from better cow husbandry such as improved veterinary care and/or culling, and especially from a better grass conservation programme for winter feeding. The latter is consistent with the higher silage areas assumed in working out the fertiliser requirements.

The extra meals are based on an input of 4·0 lbs of meal per extra gallon of milk achieved. This figure might appear conservative in view

[14] An Foras Talúntais, *Farm Management Survey*, 1973–'75.

of research carried out by An Foras Talúntais in recent years which indicated a response as low as a gallon of milk per 10 lbs of extra meal at higher feed levels.[15] It should be noted, however, that in the long-term improvement in yields envisaged in the present study the response to meals is coupled with some genetic improvement in the cow herd and earlier calving both of which may justify the figure of 4·0 lbs per extra gallon.

The estimated total meal requirements under the trend and high growth projections for livestock in 1985 are given in Table 5.7 along with similar estimates for 1974. They suggest that an additional 1·13 million tonnes of meal would be required for the trend projections and 2·78 million tonnes for the projections of high growth Model I. Increased numbers and levels of feeding in the cattle sector account for approximately 84 per cent of the extra feed in the former case and almost 82 per cent in the latter.

In high growth Model II with 300,000 calves exported at an early age, the meal requirements of the cattle sector are reduced by approximately 30,000 tonnes compared to the levels in high growth Model I.[16] In addition the extra 100,000 acres of wheat and barley in Model II could be expected to result in an additional 40,000 tonnes of grain retained for feed on the producing farms. In total therefore the estimated purchases of feed in Model II would be approximately £5·5 million less than the £327 million projected for high growth Model I in Table 5.7.

[15] See for example paper by T. M. Butler "Winter feeding of dairy cows" presented at Milk Production Seminar 1975, Fermoy.

[16] This allows for the increase of 140,000 cows and their followings.

TABLE 5.7.

Estimated Feed Requirement in Trend and High Growth Model I.

Enterprise	1974				1985—Trend Model				1985—High Growth Model I			
	Million Units	Feed/Unit cwt.	Total Quantity '000M.T.	Value of purchases £M.	Million Units	Feed/Unit cwt.	Total Quantity '000M.T.	Value of purchases £M.	Million Units	Feed/Unit cwt.	Total Quantity '000M.T	Value of purchases £M.
1 Dairy cows	1·350 cows	4·87	334	—	1,734 cows	11·5	1,013	—	2·134 cows	15·0	1,628	—
2 2-Yr. Old Beef	3·77 (L U 's)	3·0	575	—	4·73	3·5	841	—	2·00	10·0	1,016	—
3 All other cattle									3·10 (L U 's)	3·5	551	—
			909	40·0			1,854	113·2			3,193	217·0
4 Pigs	1·795 (output)	6·83	623	42·0	2·16 (output)	6·83	749	51·6	3·15 (output)	6·5	1,040	73·6
Poultry												
5 Eggs	5·65 ×120	6lb/doz	154	—	4·4 ×120	6lb/doz	120	—	4·7 ×120	6lb/doz	120	—
6 Broilers and Others	25·2	12lb each	137	—	41·3	12lb each	220	—	41·3	12lb each	220	—
7 Parent Stock	0·4	112lb each	20	—	0·6	112lb each	30	—	0·6	112lb each	30	—
			311	23·0			370	28·0			370	28·0
8 Sheep	0·58 (L U 's)	1·2	35	1·0	0·49 (L U 's)	1·3	32	0·8	0·76 (L U 's)	1·3	50	2·2
9 Horses	0·125 (L U 's)	5·0	32	2·0	0·125 (L U 's)	5·3	34	2·2	0·125 (L U 's)	5·3	34	2·2
10 Total			1,910	108			3,039	195·8			4,687	323·0
11 Adjustment for feedgrain retained on farms							(+25)	+1·9			(—51)	—4·0
12 Feed Purchases				£180				197·7				327·0

NOTES TO TABLE 5·7

(a) 1974 expenditure have been estimated by dividing total feed in each enterprise into purchased compounds and straights and unpurchased straights and applying approximate unit values to the first two.

(b) In the 1985 models all extra feed over the 1974 totals was assumed to be compounds and was thus valued at compound prices. This was then added to the 1974 value of purchases. The compound prices per tonne which were used were as follows: cows, cattle, sheep and horses—£77·5; pigs—£75·8: poultry—£83·6.

(c) The 1974 levels of meal feeding for cows and cattle are those shown in the *Farm Management Survey*, An Foras Talúntais, 1973–75.

(d) The 1974 levels of meal feeding for sheep were estimated and updated by the authors from data in the *Farm Management Survey 1966–69*, An Foras Talúntais.

(e) The poultry feed levels were estimated on the basis of standard feed requirements.

(f) Pig requirements in 1974: from B Kearney, *An Economic Study of Costs and Returns in Pig Production*, An Foras Talúntais, Dec. 1972. They imply a conversion rate of 3·9 lbs per lb liveweight output. This has been retained for 1985 in the trend model and lowered to 3·7 lbs in the high growth model.

(g) In line 11 of the table an adjustment has been made for the *changes* in feed wheat, oats and barley retained on farms over the 1974 levels. The values are at £77·5 per tonne since this increase (reduction) in feed-grain is assumed to reduce (increase) the compound purchases by an equal amount (approximately).

(h) In the 1985 high growth Model I, cattle L.U.'s other than for dairy cows were divided into "24 month old beef cattle" and "others" as follows:

Total output = 2·8 m hd
Less cull cows = 0·6 m hd

Output of dry cattle = 2·2 m hd
2 yr old beef (75%) = 1·65 m hd
At 1·2 L U per hd. = 2·00 m L.U.

5.4 Overall Growth in Net Agricultural Output

The projections for seed, fertiliser and feed are now combined in Table 5.8 and deducted from Gross Output.

TABLE 5.8.

The total change in Net Agricultural Output, 1974 to 1985 at constant 1974 prices.

Inputs	1974 £m	1985–trend £m	1985–high growth I £m
Seed	8·7	8·8	10·5
Fertiliser and lime	55·3	102·9	134·7
Feeding stuffs	108·0	197·7	327·0
Total	172·0	309·4	472·2
Change from 1974 (£m)	—	+137·4	+300·2
Rate of change	—	+5·5% p.a.	+9·6% p.a.
Gross Output[1]	699·4	965·8	1,260·3
less inputs	172·0	309·4	472·2
Net Output	527·4	656·4	788·1
Change from 1974 (£m)	—	+129·0	+260·7
Rate of change	—	+2·0%	+3·7% p.a.

[1]Excluding turf.

It can be seen that the trend model involves an annual increase of over 5% in the inputs under examination. This to some extent offsets the 3·0% growth in gross output in that model giving a growth rate of 2·0% per annum in the volume of Net Agricultural Output. For high growth Model I the projected input requirements show an annual increase of 9·6% and this transforms the target of 5·5% growth in Gross Output into a 3·7% growth rate for Net Agricultural Output.

It was shown in Chapter 4 that Gross Agricultural Output under high growth Model II would be £11·9 million higher than under Model I. This coupled with the net reduction of £5 million inputs projected in this chapter gives a Net Output figure approximately £17 million higher than in Model I amounting to an average growth rate of 3·9% per annum over the 11-year period.

As a final comment on the projections of this chapter it is worth noting from Table 5.8 that in the trend model net output amounts to 68% of gross output compared to 75% in 1974. The fact that the percentage has declined is in accordance with expectations. However, it is the authors' opinion that the 1974 percentage is abnormally high and that the 1985 trend projection may be correspondingly high.

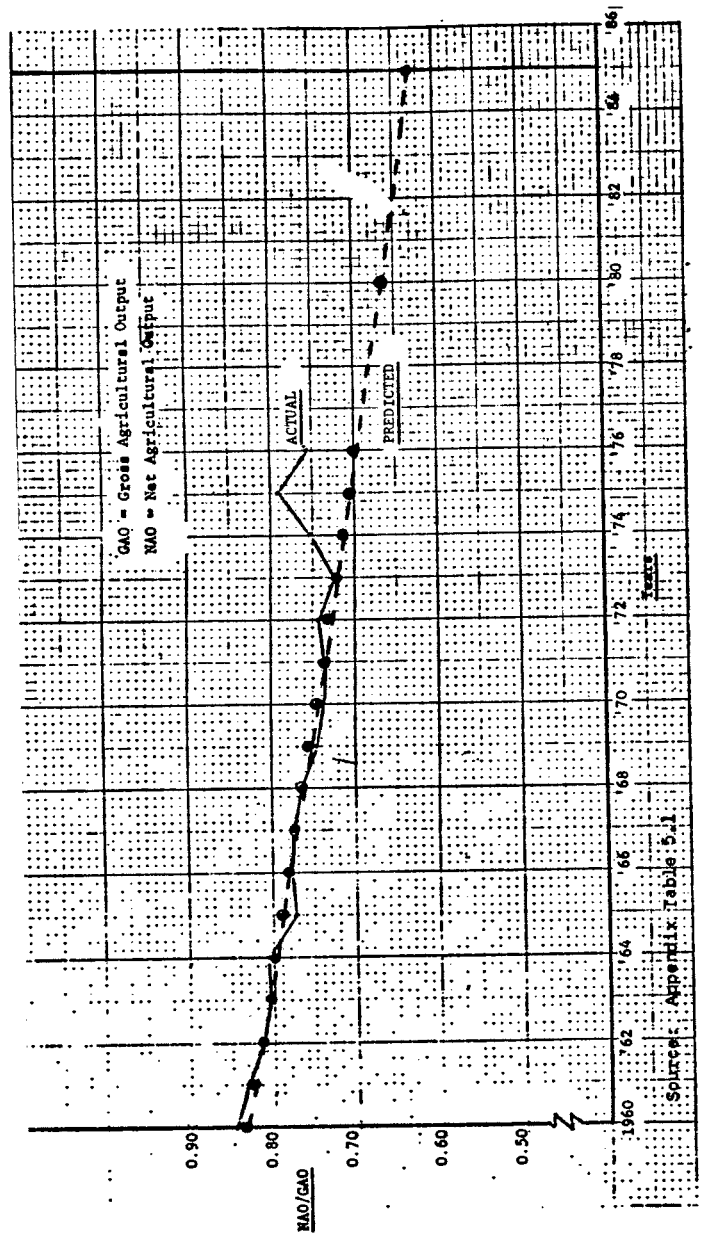
The Gross and Net Agricultural Output series at constant 1974 prices are shown in Appendix Table 5.1. Their ratios are shown in column (4) and graphed in Figure 5.2 where the abnormality of the relationships obtaining in 1974 and 1975 is clearly evident. The dotted curve shows the "normal" 1974–'75 relationship on the basis of the 1960–'73 trend. It suggests a normalised average ratio of ·71 for 1974. If projected forward to 1985 the ratio drops to ·63.

Since the actual ratios for 1960 to 1973 conform quite closely to those suggested by the graph, the above projection to 1985 would appear to be reliable if growth conditions similar to those of the 1960–'73 period were to continue. Since the rate of growth projected for Gross Agricultural Output under the trend model is not significantly different from that achieved over the 1960 to 1973 period it might be concluded that the ratio of Net to Gross output would be in the region of ·60 to ·65 by 1985, rather than ·68 as suggested in Table 5.8.

It might be expected that with the accelerated growth projected in high growth Model I the ratio of Net to Gross output would decline faster than over the period 1960 to 1973. Therefore the ratio of ·63 implicit in Table 5.8 may be unrealistically high. In spite of these observations, however, it was decided not to alter the input projections for either the trend or high growth Models as presented in this chapter. The reader should nevertheless be aware of the historical record when interpreting the results of this chapter.

FIGURE 5.2

Ratio of Net Agricultural Output to Gross Agricultural Output at Constant 1974 prices, 1960–'75



SECTION III

CHAPTER 6

ON-FARM EMPLOYMENT

One of the universal characteristics of economic development is a decline in on-farm employment. This arises because of a number of underlying causes. As stated in Chapter 1, the slow rate of increase in aggregate demand for food in a closed economy constrains agriculture to a slow growth rate relative to other sectors in the economy. Therefore, unless relative prices shift in favour of farmers to provide them with a terms of trade gain over time, their relative incomes would tend to decline. Relative prices do not generally shift in favour of farmers; instead relative incomes tend to be maintained by an outflow of labour. This outflow is facilitated by the progressive adoption on farms of mechanisation and other labour-saving techniques and by the ready availability of off-farm employment.[1]

The universal nature of these forces is illustrated by the data in Table 6.1 relating to selected OECD countries. The annual rates of decline in agricultural employment over the period covered range from 2·4% for Canada to 5·1% for Sweden. The rate of decline is not generally related to the stage of development of a country: it is just as rapid in highly industrialised countries like West Germany and the United Kingdom as in less developed countries such as Ireland and Italy.

The fundamental and universal nature of the forces causing on-farm employment to decline leads researchers generally to assume that such declines will continue.[2,3] Even though decline may continue, the

[1]Reynolds, L. G. "Agriculture in Development Theory: An Overview", in *Agriculture in Development Theory*, Yale University Press, 1975.

[2]NIEC, *Report on Full Employment*, Report No. 18., Stationery Office, Dublin, 1967 (Par. 105 and 106).

[3]NESC, *Population and Employment Projections: 1971–86*, Report No. 5, Stationery Office, 1975, Dublin. Prl. 4193, Appendix C.

rate of decline might change and in this way more or less on-farm jobs could result. In particular, if a slow-down in the rate of decline could be achieved, jobs would be retained on farms that would otherwise be lost. Such retained jobs, provided they are economically rewarding, are presumably as desirable as alternative industrial or service jobs that might be created.

TABLE 6.1.

Annual percentage decline in agricultural employment 1962/3/4 to 1973/4/5 and agricultural workers as a percentage of the total work-force in 1974 for selected countries

	Percentage Decline	Agricultural workers as percentage of workforce
Canada	2·4	6·3
U.S.A.	2·8	4·1
Denmark	3·3[1]	9·6
France	3·8	11·6
West Germany	4·6	7·3
Ireland	3·1	24·3
Italy	4·9	16·6
Netherlands	2·9	6·6
Sweden	5·1[2]	6·7
United Kingdom	3·8[3]	2·8

[1]1960 to 1973/4/5.
[2]1963/4/5 to 1973/4/5.
[3]1963/4/5 to 1972/3/4.

Source: Decline data from O.E.C.D., *Labour Statistics*, various issues. 1974 work-force data from O.E.C.D. *Observer*, No. 80, March/April, 1976.

In the context of the present study a passive attitude towards on-farm employment would not be logical. The possible impact of high growth as distinct from trend growth on the number of farm workers must be investigated. *A priori* there are two possible reasons why high growth might decelerate the decline of on-farm labour: firstly, the additional work involved in meeting the high growth targets would not necessarily be absorbed by higher productivity; secondly, high growth would generate higher relative incomes than trend growth and there is

clear evidence of a relationship between on-farm income levels and the rate of decline of the on-farm work-force.[4]

Attempts are made in this chapter to quantify the effect of high growth on on-farm employment. The approach adopted is first to select the most reasonable employment projections associated with the trend growth and then to attempt to adjust these for high growth. The results can only be taken as approximations since it is extremely difficult to find reliable measures of the relationships that are involved.

6.1 Problems of Measurement of On-farm Employment

Data relating to on-farm employment are derived from two sources in Ireland. The Census of Population is the primary source. It provides information in regard to principal occupation, the industry in which a person is engaged and the employment status of the entire labour force. From this is derived the numbers of farmers, relatives assisting on farms, agricultural labourers or hired workers, and other miscellaneous agricultural workers. A person who returns himself as one of these categories does not have to be full-time in agriculture: he merely has to claim that his principal occupation is in agriculture. There is therefore a grey area between full-time farm workers and non-farm workers which is delineated by the private decision of the respondent. In recent years the number of part-time farm workers has increased, but it is not known whether this has biased in any way the measured trend in the work-force.[5]

Similarly in relation to elderly people it is left to the respondents to declare whether they are retired or not. Eighteen per cent of the agricultural work-force in the 1971 census were aged 65 years or over and one wonders how many of these were in fact mainly retired.

The second source of data relating to on-farm employment is the June Agricultural Enumeration carried out each year. This information relates only to males whose principal occupation is in agriculture. The geographical coverage varies from year to year ranging from complete coverage of all holdings nearly every five years to as low as

[4]Walsh, B. "Economic and Demographic Adjustment of the Irish Agricultural Labour Force, 1961–1966", *Irish Journal of Agricultural Economics and Rural Sociology*. Volume 3, No. 2, 1971.

[5]NESC, *New Farm Operators, 1971 to 1975*. Report No. 27, Stationery Office, Dublin. Prl. 5832, 1977.

25% coverage in certain years. The data are therefore not equally reliable every year. They are used by the CSO to trend the farm work-force in inter-census periods rather than to establish the absolute size of the work-force.

6.2 NESC Projections of the Work-force

The family farm labour force, consisting of the two categories—farmers and relatives assisting—has been projected by Walsh in NESC Report No. 5 to the year 1986 which is very close to the target date of this study, 1985. The projection was done using the continuation rates in farming of the 1966 to 1971 inter-censal period. The validity of such projections rests on the assumption that the continuation rates of the base period are going to continue into the future. The 1966 to 1971 period was, however, an unusual one in relation to the farm work-force. As shown in Table 6.2 it was a period of accelerated outflow from farming and particularly for those under 18 years of age. The main reason for this was the education explosion following the introduction of free post-primary education and free transport in 1967. This radically altered the pattern of entry to farming, shifting the age of entry forward to correspond with the additional education being obtained. Whereas formerly most young people would enter farming directly after their primary education, now a considerable number pursue post-primary education, then possibly take up off-farm employment, and only return to farming—if at all—at such time as they either inherit or purchase land.[6]

TABLE 6.2.

Annual percentage rates of change of different categories of agricultural workers for intercensal periods.

	Farmers and Relatives				
	Under 18	18 and over	Labourers	Other	Total
1951–61	−3·3	−2·4	n.a.	n.a.	−2·7
1961–66	−4·9	−2·1	−5·0	+1·1	−2·6
1966–71	−15·6	−3·3	−7·7	+4·8	−4·0

Source: Censuses of Population, 1951, 1961, 1966 and 1971.

[6]NESC Report No. 27.

Walsh recognised these problems in his projections and dealt with them by assuming two alternative continuation rates for the 15–19 year age group; one was the 1966 to 1971 continuation rate and the second was a higher rate to allow for some additional return to farming after formal education had ceased. The two estimates of the 1986 family farm labour force resulting were 144·3 thousand and 137·0 thousand. These estimates are not very different from each other and the decline involved of either −3·0 or −3·4% per annum is not very different from the annual rate of decline actually recorded in that section of the labour force in the 1966 to 1971 period. In other words, Walsh's projections mean that the accelerated rate of out-flow of the family work force of 1966 to 1971 would continue to 1986. The actual decline since 1971 has been considerably less than this, at only −2·1% per annum, so the projection needs to be reviewed at this stage.

6.3 Alternative Projections for Trend Growth

Projections of the on-farm work-force may also be attempted through assumptions about productivity. (The most valid measure of productivity is value-added or Gross Agricultural Product per worker. The measure employed in this chapter, namely, Gross Agricultural Output per worker, overstates the true situation somewhat). Data are presented in Table 6.3 on the pattern of productivity changes since 1960. Rising productivity in agriculture has resulted from a combination of a declining work-force and an increasing volume of output. The change from year to year varies considerably mainly because output tends to fluctuate. The average annual rate of increase, however, between the years 1959/60/61 and 1973/74/75 was 6·0%.

Assuming a 6% annual rate of productivity increase over the 1974 to 1985 period would give an annual rate of decline in the work-force of −2·8% for the trend model which involves a growth rate of 3·0 per cent. This would have been a reasonable labour projection from the perspective that prevailed in pre-EEC Ireland.[7] However, there were major changes in some key factors affecting the on-farm work-force since 1972 and these must be taken into account. In particular,

[7]It is very close for example to the −2·9% annum decline used in the White Paper. *The Accession of Ireland to the European Communities*. The Stationery Office, Dublin, 1972. Prl. 2064, par. 5.37.

TABLE 6.3.

Productivity of the agricultural work-force, 1960 to 1975.

	Workers '000	GAO 1968 =100	Productivity annual % increase
1959	390	77·9	—
1960	382	80·4	5·4
1961	372	83·9	7·1
1962	363	86·4	5·5
1963	356	86·7	2·3
1964	346	90·0	6·8
1965	333	90·8	4·8
1966	326	90·6	1·9
1967	313	93·5	7·5
1968	302	100·0	10·8
1969	291	100·2	4·0
1970	276	103·1	8·5
1971	266	109·7	10·4
1972	260	113·8	6·1
1973	253	116·6	5·3
1974	247	116·2	2·1
1975	244	124·5	8·5

Source: Workers derived from series relating to "Agriculture, forestry and fishing" published in various issues of *The Trend of Employment and Unemployment.* GAO from *Irish Statistical Bulletin,* June, 1976.

there was a significant improvement in the relative income position of farm workers—both family and hired—compared with other workers and an associated deceleration of the decline in their numbers. These effects are quantified in Table 6.4. Males engaged, who are either under 18 years or are classified as temporary, are not included because they are minor parts of the total male work-force (amounting to less than 8% in recent years) and their movements tend to be erratic over the years.

The improvement in the relative income position of farmers from 1972 onwards is very evident. After fluctuating closely around an average ratio of 0·89 for the previous 13 years, the ratio jumped to 1·11 in 1972 and to 1·21 in 1973. While the ratio dropped in 1974, that drop proved to be transient as it recovered again in 1975.[8] The ratio has

[8]The new level of the ratio is being well maintained in 1976 and 1977.

averaged 1·10 in the four years 1972 to 1975 representing a shift in relative incomes in favour of farm workers of 23% compared with the position in the 'sixties.

TABLE 6.4.

Annual percentage rates of change in selected categories of males engaged in farm work and the relative income position of the farm work-force, 1959 to 1975

	Males, 18 years and over				Relative* Incomes
	Members of Family		Other Permanent		
	Nos. '000	Annual % change	Nos. '000	Annual % change	Farm/ Industrial
1959	281·8	—	48·1	—	0·91
1960	275·0	−2·4	47·1	−2·1	0·89
1961	280·3	+1·9	44·6	−5·3	0·91
1962	267·2	−4·7	41·1	−7·8	0·86
1963	264·5	−1·0	39·1	−4·9	0·84
1964	260·3	−1·6	36·6	−6·4	0·90
1965	249·7	−4·1	35·0	−4·4	0·92
1966	247·7	−0·8	32·5	−7·1	0·83
1967	241·9	−2·3	29·7	−8·6	0·87
1968	237·9	−1·6	28·2	−5·0	0·94
1969	233·4	−1·9	25·8	−8·5	0·90
1970	223·0	−4·5	23·9	−7·4	0·89
1971	218·2	−2·2	22·4	−6·3	0·90
1972	214·9	−1·5	21·4	−4·5	1·11
1973	210·7	−2·0	20·4	−4·7	1·21
1974	206·8	−1·8	19·2	−5·9	0·94
1975	204·8	−1·0	18·3	−4·7	1·12

Source: Males engaged from *Irish Statistical Bulletin* and C.S.O.

*The relative income is the average farm worker income divided by the average wage of all industrial workers net of income tax. The income of farm workers is the "income from self employment and other trading income" as published by the C.S.O. plus wages and salaries of hired workers divided by the work-force, as shown in Table 6.3. The wage of industrial workers is as published by the C.S.O. for all industrial workers in Transportable Goods Industries. It was adjusted for income tax up to 1973 using average rates derived from "The Income Sensitivity of the Personal Income Tax Base in Ireland, 1947 to 1972" by B. Dowling in the *Economic and Social Review,* Vol. 8, No. 2. For 1974 and 1975 estimates of equivalent average tax rates were used.

Associated with the improved economic position of farm workers there has been a slow-down in the out-flow of workers. The economic recession might possibly account for some of this slow-down, but that could not have been the case in 1972, 1973 and 1974. The annual rate of decline of family males from 1959/60/61 to 1969/70/71 was 2·1%; this dropped to 1·6% between 1972 and 1975, or to 1·8% if 1975 is omitted. The annual rate of decline of "other males—permanent" was 6·4% between 1959/60/61 and 1969/70/71; this dropped to 4·9% between 1972 and 1975, or to 5·0% if 1975 is omitted.

Efforts were made to quantify the relationship between relative incomes and the decline in the work-force using time series analysis on national data and cross-sectional analysis on county data. The relationships derived from time series analysis were not significant though they were of a magnitude consistent with the averages used above. The cross-county analysis gave significant relationships but of a magnitude too small to be credible, given the record since 1972.

In the absence of statistically significant relationships, projections have been made on a subjective basis. It is assumed that the improved post-1971 relative income position of farmers will be maintained with the trend growth projection and that its effects on the rate of decline of employment will be similar to that of 1972, 1973 and 1974. On this basis the family male work-force aged 18 and over (both farmers and relatives assisting) from the 1971 Census of Population is projected to $\overline{1985}$ at an annual rate of decline of 1·8%. Agricultural labourers in the Census have declined over the years at a rate virtually identical with the decline of "other males-permanent". Agricultural labourers are, therefore, projected at an annual rate of decline of 5·0% which is the recorded rate of decline in 1972, 1973 and 1974 for "other males-permanent".

These two categories constituted 86% of the work-force in agriculture in 1971. The remaining 14% is accounted for by:

(i) family female workers of 18 years and over,

(ii) family workers under 18 years, and

(iii) other miscellaneous workers such as farm managers, jobbing gardeners, agricultural contractors and clerical workers.

Some elements of this latter category are only marginally connected with farming. Nevertheless, to make the projected work-force comparable with the official statistics, this category is included in its entirety. No useful trend information other than intercensal data is available for these categories. They have therefore been projected on the basis of their intercensal movements, though the projection of the first two categories is also linked to movements in the total family work-force.

Family female workers of 18 years and over constituted in 1951 16·2% of all family workers, male and female, of the same age; this percentage had dropped to 13·2 in 1961 and to 10·5 in 1971. This constant percentage rate of decline was projected to $\overline{1985}$ giving 7·8% females in the family work-force in that year. The family work-force under 18 years of age has declined from 5·8% of the total family work-force in 1951 to 5·3% in 1961 and to 2·4% in 1971. It is projected to 0·8% of the family work-force in $\overline{1985}$. The number of miscellaneous workers has actually increased over the years. The annual rate of increase from 1961 to 1971 was 2·9% and this rate of increase has been used to project the $\overline{1985}$ number.

These projections are summarised in Table 6.5. They represent an annual rate of decline for both the family work-force and the entire farm work-force of over 2·1% per annum between 1971 and $\overline{1985}$. This is substantially less of a decline than projected in NESC Report No. 5; it involves a retention of 24·5 thousand more workers in family farming in $\overline{1985}$ than the NESC Report projected under its "high" assumptions.

Obviously the actual rate of decline that will materialise will be influenced by the degree of prosperity in farming and presumably by the availability of off-farm employment.[9] We believe, however, that the fall in the total work-force which is shown in Table 6.5 is a reasonable projection in the context of the assumptions of the trend model. This fall is equivalent to 2·1% per annum between $\overline{1974}$ and $\overline{1985}$.

[9]Analysis of the available data provided no credible evidence of a relationship between the availability of off-farm employment and the rate of decline of the farm work-force. Some evidence has been found by Walsh, *ibid*, of a relationship for hired workers.

TABLE 6.5.

Projections of on-farm employment for trend model, 1985.

	1971	Basis of projection	1985
Family males, 18 years and over	204,747	−1·8% per annum	158,800
Family females, 18 years and over	24,187	7·8% of total family, 18 years and over, in 1985	13,400
Family work-force, under 18 years	5,614	0·8% of total family work-force in 1985	1,400
Agricultural labourers	24,660	−5·0% per annum	12,000
Miscellaneous	7,108	+2·9% per annum	10,600
Total family	234,548		173,600
Total	266,316		196,200

6.4 Projections for High Growth Models

For the purposes of this study, the projection of the on-farm labour force associated with the trend model is only of secondary interest. The primary issue is the difference in the labour force that would arise from the high growth as distinct from the low growth models. Only the effects of high growth Model I are considered, as the differences betwen high growth Models I and II are not great enough to assess different on-farm employment effects.

The effect of high growth on on-farm employment depends of course on the relationship of growth rate to productivity. This in turn is presumably related to the extent of underemployment existing on farms—or more specifically on those farms that would accelerate their growth rates. It should also be related to the capital intensity of the additional growth. Unfortunately, neither Irish data nor international data provide any guidance here as may be seen from Table 6.6. The correlation between growth rates and the fall in employment

TABLE 6.6.

Relationship between rate of growth of Gross Agricultural Output and rate of decline of labour force.

	Ireland		International		
	3 year moving averages of annual % change,		Annual % change 1962/3/4 to 1973/4/5		
	Labour force decline	GAO		Labour force decline	GAO
1954–56	2·2	1·2	Canada	2·4	1·0
1955–57	2·9	2·4			
1956–58	2·8	−0·8	U.S.A.	2·8	1·9
1957–59	2·6	1·1			
1958–60	2·0	0·7	Denmark[1]	3·3	0·7
1959–61	2·3	4·7			
1960–62	2·4	3·5	France	3·8	2·2
1961–63	2·3	2·6			
1962–64	2·4	2·4	W. Germany	4·6	1·2
1963–65	2·8	1·7			
1964–66	2·9	1·5	Ireland	3·1	2·4
1965–67	3·3	1·3			
1966–68	3·2	3·3	Italy	4·9	2·0
1967–69	3·7	3·4			
1968–70	4·1	3·7	Netherlands	2·9	3·3
1969–71	4·1	3·2			
1970–72	3·7	4·3	Sweden[2]	5·1	1·1
1971–73	2·9	4·2			
1972–74	2·4	2·2	U.K.[2]	3·8	2·2
1973–75	2·1	3·3			
Correlation coefficient	+0·3			−0·2	

[1]Fourteen-year period 1960 to 1973/4/5.
[2]Ten-year period 1963/4/5 to 1973/4/5.
[3]Nine-year period 1963/4/5 to 1972/3/4.

Source: Data for Ireland as in Table 6.3. GAO data for other countries from index numbers of total agricultural production as published in FAO *Production Yearbooks;* labour data from OECD labour statistics, various issues.

is positive for Ireland and negative for the international data. In both cases, however, it is exceedingly low.

The lack of evidence of a relationship in the data does not mean that there would not in reality be a relationship if the variation between rates of growth were substantial and were sustained over a reasonably long period, and if the effects of the many other possible confounding variables could be removed. The two countries, Denmark and the Netherlands, have fairly similar agricultures but strikingly different growth rates. The differences in the rates of decline in the work-force indicate a negative relationship, i.e., the slow growing Danish agriculture has the higher rate of labour decline. However, the difference between the rates of decline in the two countries is not great.

As stated at the beginning of this Chapter, the logic of the situation would also suggest some negative relationship. Rapid growth would involve considerably more work on farms, and it is unlikely that all of this would be absorbed by increased productivity. For the low and high growth rates in this study, which are 3·0 and 5·5% (Model I) per annum, the productivity gains given the projected labour decline of 2·1% per annum would be 5·2% and 7·8% per annum, respectively. Furthermore, high growth would generate higher relative incomes than low growth and this should tend to slow down the decline of workers.

Thus, at one extreme one could project no additional on-farm employment for the high growth models—all the additional growth being absorbed in productivity rather than in additional jobs. The other extreme would be to project the same productivity gains for both rates of growth with all the additional growth being contributed from additional employment. This would involve a productivity gain of 5·4% per annum in both models which would mean no change in the work-force for the high growth models. The total work-force on farms in $\overline{1985}$ as compared with $\overline{1974}$ would then be 248,000 as against 196,000 projected for the trend model. This represents a difference of 52,000 jobs. Clearly this is an upper limit, and all that has been established is that the additional on-farm employment arising from high growth would be somewhere between 0 and 52,000. The problem remains of narrowing this gap to a more useful range.

For this purpose, one approach is to argue that the higher growth would raise the aggregate incomes of farm workers relative to off-farm workers above the level of trend growth to the extent of the difference between the net outputs of the two models. This implies the assumption that the additional output from a more rapid growth would not depress prices and thereby reduce the income effect of additional volume. As shown in Chapter 5, the annual growth rates in net output for the two models are 2·0 and 3·7%. The consequent improved income situation can in turn be assumed to have the same magnitude of effect on slowing the decline in employment as already experienced in 1972, 1973 and 1974.

On the basis of these assumptions, the data in Table 6.5 can be re-calculated as shown in Table 6.7. The improving relative income position of farm workers would gradually slow down the initial rate of outflow; in the case of family males the reduction is from 1·80% per annum in $\overline{1974}$ to 1·59% in $\overline{1985}$; in the case of hired workers the reduction is from 5·00% per annum in $\overline{1974}$ to 3·93% in $\overline{1985}$. Other family workers are projected as for the trend model, namely, as a proportion of total family workers. Miscellaneous workers are omitted since no basis exists for projecting them in relation to growth rates.

TABLE 6.7.

Projections of on-farm employment for high growth models, $\overline{1985}$.

	1971	$\overline{1974}$	Basis of projection	$\overline{1985}$
Family males, 18 years and over	204,747	193,888	−1·80% falling to −1·59% per annum	160,900
Family females, 18 years and over	24,187	—	7·8% of total family 18 years and over	13,600
Family work-force, under 18 years	5,614	—	0·8% of total family work-force	1,400
Agricultural labourers	24,660	21,143	−5·00% falling to −3·93% per annum	12,600
Total	259,208	—	—	188,500

The overall result shows a total work-force in 1985 of 188·5 thousand versus the comparable group in the trend model of 185·6 thousand. This is an extremely small difference. It represents only an additional 2·9 thousand workers on farms in 1985 under high growth as distinct from low growth conditions.

An alternative approach to the problem is to calculate the additional employment potential which the high growth outputs entail in comparison with low growth outputs. This is done in Table 6·8 for the trend output and for the high growth Model I. The labour efficiencies used are in the form of Standard Man Years (SMYs). They are close to the highest being used in the Farm Modernisation Scheme for estimating the employment capacity of farms.[10]

TABLE 6.8.
Difference in employment potential between low and high growth models.

Enterprise	Units	Number of Units per SMY	Employment Potential, '000 SMYs	
			Low	High
Cattle	LUs	90	40·33	39·56
Cows, dairy	Numbers	40	44·05	52·50
Cows, other	Numbers	100	9·08	11·00
Ewes	Numbers	400	4·00	6·25
Sows	Numbers	35	3·43	5·00
Cereals	acres	100	9·10	10·95
Sugar beet	acres	35	2·00	2·00
Potatoes	acres	25	2·40	2·40
Total			114·39	129·66

The results show a difference of 15 thousand potential jobs between low and high growths.[11] Whether or not these potential jobs would materialise in about the same number of "statistical" jobs

[10]Farm Modernisation, Scheme, "Standard Labour Requirements for the main Agricultural Enterprises", Department of Agriculture and Fisheries, Dublin.
[11]For high Model II the difference would be 17 thousand potential jobs.

is impossible to say. If they did arise in the form of additional people employed, the on-farm work-force under the high growth model would be some 211,000 instead of the 196,000 projected for the trend model in Table 6.5. This would represent a decline from 1974 levels at a rate of 1·46% per annum in contrast to the 2·1% rate of the trend situation. The corresponding productivity gains would be 5·2% and 7·1% per annum for the trend and high growth situations, respectively. These seem to be plausible magnitudes.

It is possible that some of the additional potential employment would be absorbed by the prevailing work-force with even higher productivity gains than the 7·1%. On the other hand, it is possible that the level of efficiency assumed in Table 6.8 is too high in which case more than 15 thousand additional jobs would have to be created to sustain the high growth outputs.

There is no objective means of resolving these issues. The purpose of this chapter is to argue (a) that there is likely to be a positive response in on-farm employment to sustained rapid growth in agricultural output and (b) that the possible order of magnitude of that response in the context of this study is broadly in the region of 15 thousand jobs. It could be more—especially if off-farm employment opportunities are scarce. It could also, however, be less.

CHAPTER 7

IN-FACTORY EMPLOYMENT

Industries which are directly associated with agricultural production can be broadly classified into those supplying inputs to the farm sector and those processing the primary products that are produced on farms. A large number of such industries are identified in the Census of Industrial Production.[1] They are animal feed compounding and fertiliser manufacture on the input side; on the processing side they are dairy processing; cattle and sheep processing; pig processing; sugar refining; fruit and vegetable processing; flour milling; bread, biscuit and flour confectionery; margarine, compound cooking fats and butter blending; distilling; malting; brewing; cocoa, chocolate and sugar confectionery; miscellaneous food preparations; and fellmongery and tanning. Other industries directly associated with agriculture which are not identified in the CIP include agricultural equipment and machinery manufacture, and agrochemical manufacture.

Not all of these industries, however, are of relevance in this study. Since the study concerns the employment consequences of alternative agricultural growth rates, only those industries likely to experience an employment effect as a result of the projections in Section II have to be considered. The identification of those industries in which the employment is causally determined by the level of domestic on-farm production is therefore necessary.

(a) Dependent Associated Industries

In the Irish context it would not be very meaningful to consider the size of the brewing industry for example, as being determined by the volume of malting barley grown in the country. The direction

[1]See for example the *Irish Statistical Bulletin*, March 1976, p. 64.

of the relationship is clearly the reverse, namely, the volume of malting barley grown in the country is determined by the size of the brewing industry. The size of the brewing industry is presumably determined by the demand for the products of brewing and by its competitiveness in both the domestic and export markets rather than by the volume of malting barley grown.

Similarly the size of the agricultural engineering industry has not been determined by the level of activity on Irish farms. A recent report on the industry gave the numbers employed as 940 in 1975. In relation to its future prospects the report states: "With certain exceptions, it is difficult to measure objectively and accurately progress made by the Agricultural Engineering Industry in adaptation. There are, however, some indicators. Gross output for the industry has not increased to any significant extent. There is little evidence of product development either through investment or through new products. Employment has not increased significantly."[2] The size of, and employment in, the agricultural engineering industry is not therefore likely to be influenced over the next decade by the extent of on-farm activity in Ireland.

The brewing and engineering industries are illustrative of industries the size of which are not determined by the level of domestic on-farm production. There are other industries which utilise domestically produced agricultural produce only to a limited extent in their total input structure. Thus, on average 50% of the wheat input to flour milling is imported, two-thirds of the value of input to the cocoa, chocolate and sugar confectionery industry is imported, and a very large proportion of the input to the fruit and vegetable processing industry is imported. The bread, biscuit and sugar confectionery industry, the margarine, compound cooking fat and butter blending industry, miscellaneous foods preparations, and the fellmongery and tanning industry also utilise imported agricultural produce.

Even if domestic agricultural products were to replace imported agricultural products to the full extent possible in the current input

[2]Kenny, James, *The Irish Agricultural Engineering Industry*, Report to the National Science Council. Stationery Office.

structure of these industries, there would be a resultant import saving effect but there would not necessarily be any increase in employment as a consequence of increased domestic agricultural output.

Where demand for the processed goods is the effective constraint on expansion of both processing and farm production, this has been taken into account in the projections in Section II. The level of malting barley production, for example, is the same in the high as in the low growth models and in both models it is about the same as the level in recent years. Similarly, sugar beet production has not been projected to increase because its production is effectively limited by EEC quotas. Therefore employment in the industries processing these products cannot be affected by our output projections.

The main industries then in which significant increases in employment could reasonably be expected to occur as a direct consequence of autonomous increases in agricultural output are dairy processing, cattle and sheep processing, pig processing, animal feed compounding and fertiliser manufacture. These are studied in detail in the following chapters.

(b) Methodology

Two approaches have been adopted to the estimation of employment levels in 1985. One is based on a statistical analysis of past performance in the respective industries and the other is based on data obtained in a survey of the industries.

7.1 Statistical Analysis

The statistical approach consists of correlating employment in each industry over the 1960 to 1975 period with that industry's intake of its main agriculturally produced raw material in the same period. The numerical relationship thus obtained between volume of intake and employment is used to project employment in 1985 given the volume of intake in 1985.

At any point in time the relationship between intake and employment depends on such things as the levels of technology, efficiency

and output mix. Over time the level of these variables may change. Therefore the relationship between intake and employment obtained from the statistical analysis of time series data reflects the combined effect which these variables had on employment in that period. There is no guarantee that similar changes in technology, efficiency and output mix will pertain in the future, or that future changes in these areas would have the same effect on employment as in the past. To overcome this problem the second approach was developed.

7.2 Survey Approach

The second approach adopted consisted of a survey of the industries. In the case of dairy processing, cattle and sheep processing, pig processing and animal feeds, the managers of selected firms were visited and the purpose of the study was explained to them. The contents of a questionnaire were also explained and they were asked to fill in this questionnaire giving information on, *inter alia,* labour contents by product for the 1975 range of output produced by their firms and also the estimated labour contents by product for the same output range in 1985. For the fertiliser industry, because of the small number of industries involved, personal interviews were employed rather than questionnaires. Seasonality of production and employment is a major problem in some of the industries studied, especially the dairy and beef industries. The extent of seasonal employment and the resultant problems were not examined here. The statistical analysis is based on annual employment data from the CIP which relate to September. Survey data were collected on the basis of a continuation of the 1975 seasonality pattern. The data were expressed in terms of man-months and were grossed into full-time job equivalents. Therefore, the results of this analysis are in terms of full-time job equivalents and no analysis is carried out into the distribution of these job equivalents as between full-time and part-time workers.

With the survey information it was possible to project employment levels which incorporated the Industries' estimates of productivity changes from 1975 to 1985. This overcame the deficiencies in the predictions based on historical time series analysis alone. This type of information also enabled an assessment to be made of the effects on employment of varying output mixes. For the dairy processing,

cattle and sheep processing, and pig processing industries an assessment is made of the effects of changing product mix on employment. Three sets of product mixes are assumed, the 1975 mix, a medium labour intensity mix and a high labour intensity mix. For all industries, the medium and high mixes are more labour intensive than that prevailing in 1975. Estimates are thereby derived of the employment implications of moving towards more labour intensive processing

(c) Contents of the Following Chapters

The following chapters contain numerical and graphical descriptions of employment for the period 1960 to 1975 in each of the industries studied, together with discussion on the background to these employment changes. In addition a statistical analysis of employment changes is presented for each industry.

The statistical relationships were first used to project 1985 employment levels. However, the validity of the results derived in this manner depends on the extent to which the future is likely to be a reproduction of the past. In most industries this is unlikely to be the case, so alternative and more valid employment estimates for 1985 are derived by using industry estimates of productivity changes from 1975 to 1985.

CHAPTER 8

THE DAIRY PROCESSING INDUSTRY

(a) Employment, 1960 to 1975

Official employment statistics are classified into industrial and administrative categories. Administrative employment is the Census of Industrial Production category 'administrative, clerical and technical.' It is defined to include:

(i) Proprietors working in the business, managerial and technical areas and other salaried staff,

(ii) Clerical and other office staff, and

(iii) Basic supervisory staff (including foremen, supervisors, etc.). The industrial employment category is defined in the CIP to include all workers other than those in the administrative classification. Table 8.1 shows the levels of manufacturing milk output and employment in dairy processing for the period 1960 to 1975.

In the period from 1960/61/62 to 1973/74/75 output of manufacturing milk increased by 97%. In the same period industrial employment in dairy processing increased by 92% and administrative employment by 89%. Milk output and total employment are shown graphed against time in Figure 8.1. The change in employment was roughly proportional to the change in the volume of milk processed over the period.

In addition to the change which occurred in the volume of milk, however, there were other changes which affected employment in this period. In particular, there was a change in the dairy product mix and a change in the structure of this industry.

TABLE 8.1

Output of manufacturing milk, and employment in dairy processing, 1960 to 1975.

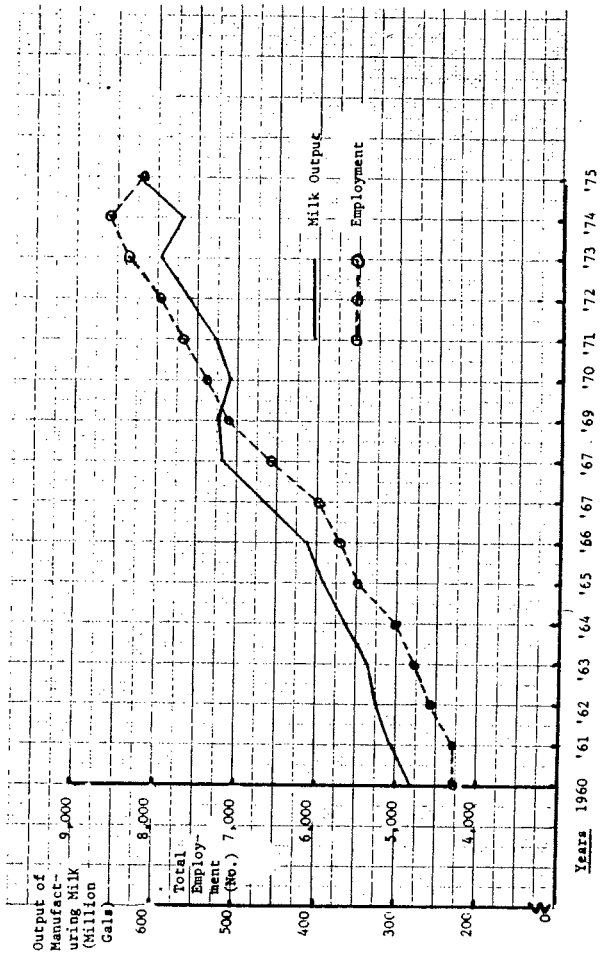
Year	Milk output (m gals)	Industrial employment (no.)	Administrative employment (no.)	Total employment (no.)
1960	281	3,215	1,068	4,283
1961	305	3,238	1,064	4,302
1962	324	3,446	1,124	4,570
1963	336	3,656	1,134	4,790
1964	362	3,883	1,163	5,046
1965	391	4,219	1,246	5,465
1966	413	4,404	1,326	5,730
1967	467	4,561	1,325	5,886
1968	516	5,011	1,567	6,578
1969	521	5,450	1,720	7,170
1970	509	5,650	1,720	7,370
1971	527	5,930	1,790	7,720
1972	561	6,110	1,850	7,960
1973	596	6,410	1,940	8,350
1974	569	6,506	2,094	8,600
1975	625	6,088	2,112	8,200

Source: Irish Statistical Bulletins. The data for the years 1960 to 1973 are as returned in the CIP and relate to a week in September. For 1974 and 1975 total employment is the September figure from the Quarterly Industrial Production Inquiry, and the break-down between industrial and administrative employment is the authors' estimate.

Considerable changes in the product mix occurred in the data period. At the start of the period very little skimmed milk was processed, whereas at the end of the period virtually all was utilised in the production of skimmed milk powder. Over the period the processing of skimmed milk increased 7·5 times as fast as the intake of whole milk. At the same time, the total volume and the proportion of intake of whole milk allocated to cheese production increased very significantly. The increase was from 4% of total intake in the early 1960's to 20% by the mid-1970's.

FIGURE 8.1

Milk Output and Employment in Dairy Processing



The structure of the industry also underwent considerable change between 1960 and 1975. In the early 1960s there were approximately 200 establishments manufacturing milk products while in 1975 there were only about 50. Concurrent with this decline there was a very great increase in capital investment and in the average throughput per establishment. The structural changes in themselves would be expected to have a negative effect on employment in the industry. Since these structural changes have been concentrated in the period 1970 to 1975, their effects may not be fully reflected in the data.

Another factor which affects employment is the seasonal pattern of milk supply. The current ratio of milk supply in the peak to trough months is about 15 : 1. The peak : trough supply ratio has increased over time. Employment figures, however, show that creameries have not increased their peak : trough employment ratio in line with the worsening supply pattern.

A number of equations were tested in an effort to explain the varying employment levels in the industry over the period. The increase in the production of skim powder was found not to have a significant effect in increasing employment. This arose because of the low labour content of skim powder production. On the other hand, the increase in the production of cheese was found to be very significantly related to increasing employment.

The equation which best explained industrial employment levels in the dairy processing industry is given below:

1. Industrial employment $= 595{\cdot}4 + 8{\cdot}8M + 13{\cdot}3C$, $\overline{R^2} = 0{\cdot}95$
   where M = output of manufacturing milk *less* milk allocated to cheese production (million gals.)
   C = milk allocated to cheese production (million gals.)

The equation shows that the production of cheese has been a labour intensive process. Each million gallons of milk channelled into cheese production generated 13·3 minus 8·8 or 4·5 jobs more than would have been generated by the utilisation of that milk for non-cheese uses.

A similar approach was used in the case of administrative employment. The equation corresponding to that estimated for industrial employment is:

II. Administrative employment $= 441{\cdot}0 + 1{\cdot}8M + 6{\cdot}3C$, $\overline{R^2} = 0{\cdot}96$
where variables M and C are as in Equation 1.

(b) Employment Projections

8.1 Equation Estimates

An estimate can be got of the level of employment in the industry for any given level of milk output and cheese production simply by inserting the level of milk output *less* milk allocated to cheese production along with the level of milk allocated to cheese production into the equations. The trend projection for manufacturing milk output in $\overline{1985}$ was given in Section II as 1,208 million gallons. Assuming that 21% of manufacturing milk would be allocated to cheese production by $\overline{1985}$—the same percentage as in 1975—the estimated employment is:

$\overline{1985}$ Industrial employment $= 595{\cdot}4 + 8{\cdot}8(954) + 13{\cdot}3(254) = 12{,}369$

$\overline{1985}$ Administrative employment $= 441{\cdot}0 + 1{\cdot}8(954) + 6{\cdot}3(254) = 3{,}758$

Total estimated employment for 1985 is therefore 12,369 + 3,758 or 16,127.

The high Model I projection for manufacturing milk output in $\overline{1985}$ was given in Section II as 1,735 million gallons. Using the same proportional allocation of milk between cheese and non-cheese uses as employed above, the predicted level of industrial employment is estimated as 17,503 and administrative employment as 5,203. The total employment is therefore 22,706.

These estimates derived from past relationships indicate very large increases in employment from a total of 8,200 in 1975 to between 16,000 and 23,000 in $\overline{1985}$. However, these estimates cannot be considered to be very realistic because of the assumptions that are involved. In particular the productivity effects of the structural reorganisation of the industry in recent years are unlikely to be represented in the equations in a manner appropriate to developments in the future. Therefore, the estimates derived below from the survey data are considered to be more reliable.

8.2 Survey Estimates

The survey of the industry covered creameries which between them handled 80% of manufacturing milk in 1975. Estimates of

expected productivity changes in the period 1975 to $\overline{1985}$ were provided in answers to two sets of questions. The first question required the quantity of each product produced in 1975 to be given together with the direct employment associated with that production. The second half of that question required that indirect employment be specified by function. The second question asked what would be the effect on direct employment by $\overline{1985}$, given that the output of each product produced in 1975 would have doubled by $\overline{1985}$. The second half of that question dealt with the likely effect of a doubling of output on indirect employment. Thus each respondent was invited to answer the question of productivity change in the context of the products produced and the functions performed by his own creamery.

Direct employment was defined as all staff other than foremen, quality controllers and graders, maintenance workers, store workers, transport workers, hygiene and cleaning workers, office workers and management workers. Indirect employment therefore incorporates all the above categories. This employment breakdown into direct and indirect employment is not the same as the industrial and administrative categories used in the CIP. However, it was possible to reclassify the survey data so as to link the results with the CIP categories.

The survey provided (a) direct employment contents by product and (b) estimates of productivity changes between 1975 and $\overline{1985}$. The direct employment contents are shown in Table 8.2. The labour intensity of the different products is seen to vary considerably. In 1975 one million gallons of whole milk yielding 900,000 gallons of skim milk, if utilised to produce butter plus skimmed powder, provided direct employment for:

$$\frac{1{,}000{,}000}{1{,}156{,}000} + \frac{900{,}000}{745{,}000} = 2{\cdot}1 \text{ people}$$

The same amount of milk going to processed cheese production provided direct employment for $(1{,}000{,}000 \div 219{,}000) = 4{\cdot}6$ workers to get to bulk cheddar; a further $(1{,}000{,}000 \div 65{,}000) = 15{\cdot}4$ workers would be involved if that cheese were processed.

TABLE 8.2.

Thousands of gallons of milk per direct worker per year.

	Butter	Bulk cheddar	Pre-packed cheddar	Pro-cessed cheese	Whole milk powder	Skim powder	Fat filled powder	Choc-olate crumb	Other
1975	1,156	219	106	65	460	745	343	106	300
$\overline{1985}$	1,778	310	124	104	658	1,166	386	690	500

The figures in the column headed Others in Table 8.2 represent the average of the labour contents of yogurt, frozen cream, UHT products, and ice-cream. These have been grouped together because their individual production levels are very low. Even relatively large percentage increases in their production—such as have been projected in the high intensity product mix—have little effect on overall employment.

Data are also available on casein and whey products. These have been omitted because they have low current production levels; in addition they have relatively low labour intensities. It should also be borne in mind that in any exercise attempting to quantify the increased employment deriving from the increased production of whey products, one would have to quantify the decrease in employment arising from the elimination of the transport of whey from the factory to the farm.

The estimates of expected productivity change by $\overline{1985}$ were procured in the context of a doubling of output. Productivity changes may be due, *inter alia*, to technology change and/or throughput changes. The actual output increases arising from the two growth models projected in Section II are +91% and +178% of the 1975 level. Since the level of throughput specified in the questionnaire fell between these output increases it is considered to be reasonably valid for both projections.

The survey provided productivity data for a number of factories and a number of products. Aggregate productivity for the entire industry for all products was calculated by dividing the total milk by total workers employed in 1975 and $\overline{1985}$.

The productivity gain from 1975 to $\overline{1985}$ as suggested by the survey is 59% for industrial workers and 71% for administrative workers. In the past, industrial workers have comprised a fairly constant 75% of all workers. Weighting the estimated productivity gains in the ratio ·75 : ·25 for industrial and administrative employment, the overall productivity increase expected by the industry in the period 1975 to $\overline{1985}$ was:

$$(\cdot 75 \times 59\%) + (\cdot 25 \times 71\%) = 62 \cdot 0\%$$

Since the Irish dairy processing industry has recently undergone dramatic structural and technological change, the level of estimated productivity gain derived from the survey results does not seem unrealistic.

The survey productivity estimates were used to assess the employment effects of changing milk output and changing product mix. Two levels of milk output were used, namely, trend and high output levels, and three product mixes were used, namely, the 1975 product mix, a medium intensity product mix and a high intensity product mix. The alternative product mixes are presented in Table 8.3.

TABLE 8.3.

Alternative product mixes (percentage of milk output).

	1975	$\overline{1985}$	
		Medium Intensity	High Intensity
Butter	69·0	61·0	45·0
Bulk cheddar	17·3	19·0	30·0
Prepacked cheddar	1·0	2·0	4·0
Processed cheese	2·7	3·0	3·5
Whole milk powder	3·0	5·0	5·5
Chocolate crumb	4·0	5·0	6·0
Others	3·0	5·0	6·0
Skim powder*	53·0	41·0	25·0
Fat filled powder/Calf milk replacer*	9·0	13·0	16·0

*These products do not utilise whole milk, but for computational purposes their utilisation of skimmed milk has been expressed as a percentage of whole milk intake.

Both the medium and high intensity product mixes are more labour intensive than the 1975 mix. They are presented to illustrate the effects of moving towards product mixes with greater labour intensity than currently pertains. The question of the feasibility of achieving greater labour intensity in processing will be examined in the final Report of this study.

The methodology employed in studying the employment potential of alternative milk outputs and alternative product mixes involves firstly, getting a base employment figure by applying the 1975 labour content figures from the survey to the 1975 product mix figures. This gives a survey estimate of the direct labour involved in producing the various products. Indirect workers in 1975 are similarly estimated on the basis of their productivity in terms of gallons of milk per worker as given by the survey results. The single estimate for indirect workers is added to the total of the individual product-direct workers to give an estimated total employment figure.

The product mix is then changed for both the trend and high milk projections for $\overline{1985}$, and the employment effect of alternative product mixes is estimated using the $\overline{1985}$ productivity figures from the survey. The percentage changes in employment over the base employment estimate arising from the changes in output and product mix are then applied to the national employment total in dairy processing in the base period to show how changes in milk output and product mix could affect the overall employment level in the industry. The calculations for the 1975 product mix are shown in Table 8.4.

8.3 Summary of Employment Possibilities in Dairy Processing

Calculations for the alternative levels of output and product mixes were carried out in similar fashion to those in Table 8.4. A summary of the results is given in Table 8.5.

It is estimated that about 1,600 new jobs would be created in dairy processing given the trend output of milk and no change in the product mix compared to 1975. At the other extreme, it is estimated that almost 14,000 new jobs could be created on the basis of the high milk production and high processing intensity. The equation pro-

TABLE 8.4.

Employment for 1975 product mix.

	Product mix (% total milk)	Milk going to each product (m gals)	Product-ivity of direct workers (m gals. per worker)	Direct workers (No.)	Product-ivity of indir-workers (m gals. per worker)	Indirect workers (No.)	Total employment (No.)
Butter	69·0	431·0	1·156	373			
Bulk cheddar	17·3	108·0	0·219	493			
Prepacked cheddar	1·0	6·0	0·106*	84			
Processed cheese	2·7	17·0	0·065*	340			
Whole milk powder	3·0	19·0	0·460	41	0·177	3,531	
Skim milk powder	53·0	331·0	0·745	444			
Fat filled powder/ Calf milk replacer	9·0	56·0	0·343	163			
Chocolate crumb	4·0	25·0	0·106	236			
Other	3·0	19·0	0·300	62			
Total				2,236		3,531	5,767

*Additional to the labour required for bulk cheddar.

TABLE 8.5.

Summary of total employment in dairy processing for alternative product mixes and milk projections, changes compared with 1975 actual.

Processing intensity	Trend Output	High Output (Model I)*
1975		
Medium	+1,601	+5,904
High	+2,017	+10,291
	+2,933	+13,759

*The employment effects of high growth Model II (i.e., with calf exports) are not calculated since the output of manufacturing milk under that model would be 1,817 million gallons, only 82 million gallons more than the output under Model I. Consequently employment levels would not differ greatly from those obtained under Model I.

jections showed an increase of 7,927 for the trend milk output and an increase of 14,506 in the case of the high milk output both of which were estimated using the 1975 allocation of milk output as between cheese and non-cheese uses.

The large divergence between the two sets of estimates derives largely from the very different structural and technological environment obtaining in the dairy processing industry in the survey period of 1975 to 1985 compared with that obtaining in the equation data period of 1960 to 1975. The equation co-efficients were derived from data which largely pertained to the un-reorganised structure of the industry. On the other hand, the survey estimates of productivity for 1985 were made by people in the industry in the context of the amount of reorganisation which had already taken place and having regard to future reorganisation and its likely effects on worker productivity. Consequently, the survey estimates are taken as the more reliable indicators of the magnitude of employment which might be forthcoming by 1985, given the specified levels of milk output and processing intensity.

Even the survey estimates are likely to be upper estimates. The survey data were obtained on the basis that the present seasonality pattern would continue to obtain in 1985. Some of the creameries

surveyed either had price incentive schemes in operation or intended introducing them to reduce the peak-to-trough ratio through inducing farmers to get their cows to calve earlier in the year. To the extent that these schemes are successful in obtaining a more even distribution of milk supply throughout the year, they will also have the effect of reducing the extra employment which is currently required at the peak supply period.

CHAPTER 9

THE CATTLE AND SHEEP PROCESSING INDUSTRY

(a) Employment, 1960 to 1975

The throughput of the cattle and sheep processing industry increased very rapidly up to 1975. Table 9.1 shows cattle and sheep

TABLE 9.1.

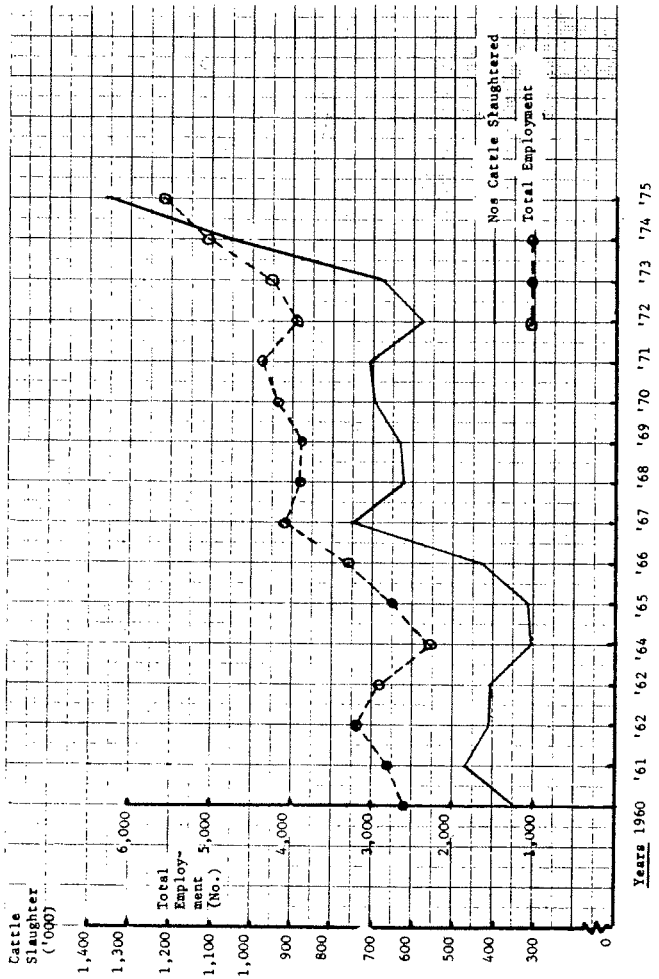
Slaughterings of cattle and sheep and corresponding in-factory employment levels.

	Cattle Slaughtering	Sheep Slaughtering	Industrial employment	Administrative employment	Total employment
	('000)	('000)	(no.)	(no.)	(no.)
1960	340·0	547·8	2,329	267	2,596
1961	470·5	439·8	2,534	295	2,829
1962	409·6	809·6	2,823	344	3,167
1963	405·6	895·6	2,581	352	2,933
1964	301·3	841·4	1,933	359	2,292
1965	312·1	782·6	2,376	385	2,761
1966	429·5	940·9	2,877	419	3,296
1967	752·7	744·5	3,665	473	4,138
1968	621·1	736·2	3,406	501	3,907
1969	633·0	686·8	3,390	490	3,880
1970	697·6	553·0	3,670	520	4,190
1971	708·3	871·1	3,820	570	4,390
1972	578·8	812·1	3,410	550	3,960
1973	677·2	787·5	3,740	510	4,250
1974	1,061·6	772·6	4,444	606	5,050
1975	1.363·6	762·7	4,928	672	5,600

Source: Irish Statistical Bulletins. See Table 8.1.

FIGURE 9.1

Cattle slaughterings and corresponding employment



slaughtering levels and employment in the cattle and sheep processing industries for the period 1960 to 1975. In the period 1960/61/62 to 1973/74/75, slaughterings of cattle and sheep increased by 154% and 29%, respectively. In the same period industrial and administrative employment levels increased by 71% and 97%, respectively. The movements in total employment and total cattle slaughterings are shown over time in Figure 9.1.

Detailed data are not available on the product mix changes which took place in this period. However, cow slaughterings comprised an important although declining proportion of total slaughterings in the period. A large proportion of cow beef output has always been in the boneless form, and in the recent years of the data period vacuum-packing of this beef has developed. Prime beef output (i.e. non-cow) has generally been in carcase form although boning-out of this beef has developed largely as a result of EEC regulations. Vacuum-packing of prime beef has also developed since the early 1970s but not on a very large scale. Canned beef output has generally been declining throughout the period but improved in 1974 consequent on an EEC canning regulation. Forms of processing other than those identified have not developed to any significant degree. Overall, therefore there would appear to have been a move towards more intensive processing though that move was very much dependent on EEC regulations relating to intervention in 1974 and 1975.

In addition to the volume of throughput and product mix aspects, the structure of the industry and the seasonality of supply are further factors which can affect employment performance and prospects. Compared with the dairy processing industry, the cattle and sheep processing industry is a relatively new industry. Therefore, structural and technological developments in the past and in the future are unlikely to have as great an effect on relationships between throughput and employment as in the dairy processing industry.

Like the supply pattern in the dairy industry, there is also seasonality in the supply pattern of the cattle and sheep processing industry though to a much lesser extent. The greatest proportion of slaughtering is typically done in the October-December period and the smallest

proportion in the April-June period. The employment estimates in this study are based on the assumption of a non-changing seasonality pattern.

Equations were fitted to the data to investigate factors associated with employment. Sheep slaughterings were found not to have significantly influenced the level of employment. Cattle slaughterings and time explain employment levels rather well as shown by the following equations:

III. Industrial employment $= 1623 + 1{\cdot}99C + 54{\cdot}6T$, $\bar{R}^2 = 0{\cdot}94$

IV. Administrative employment $= 257 + 0{\cdot}09C + 19{\cdot}3T$, $\bar{R}^2 = 0{\cdot}96$

where C = cattle slaughterings ('000)
T = time, 1960 = 0

These were used to provide a first estimate of industrial and administrative employment levels in 1985.

(b) Employment Projections

In estimating employment levels in 1985 from any given level of cattle output, regard must be had to the position of live exports. Two approaches were taken here. Firstly, employment was estimated on the assumption that live exports of store and fat animals in 1985 would be at the same absolute level as the average of 1973/74/75, which was 490,000. Secondly, employment was estimated on the basis of no live exports in 1985. In all cases domestic consumption was taken to be 430,000 by 1985. This was derived by projecting consumption and population trends as explained in Chapter 14. Imports were assumed to continue at 100,000 head per year which has been their approximate level in recent years. The availability of cattle for slaughter derived from the trend and high projections in Section II is shown in Table 9.2.

TABLE 9.2

Supply of cattle for factory slaughter in 1985.

	Trend Output	High Output
With 490,000 live exports and 100,000 live imports	1,460,000	1,980,000
With no live exports and 100,000 live imports	1,950,000	2,470,000

9.1 Equation Estimates

On the basis of factory slaughterings of 1·46 million derived from the trend model with live exports continuing, total factory employment is estimated from Equations III and IV as 6,764, an increase of 1,164 on the 1975 level. If live exports ceased, the total number of cattle available for slaughter would be 1·95 million. The factory employment which these would provide is estimated as 7,783 which represents an increase of 1,019 resulting from the termination of live exports. With high output and live exports, factory slaughterings would be 1·98 million and the equation estimate of employment is 6,493, an increase of 893 on 1975. Finally, on the basis of high output and no live exports, there would be 2·47 million cattle available for slaughter and the resulting employment would be 8,153, an increase of 2,553 on 1975 employment. These equation estimates were next supplemented by estimates derived from a survey of the industry.

9.2 Survey Estimates

Managers of beef factories were questioned in a survey as to the labour content involved in processing in 1975 and 1985. The format of the questions was similar to that employed in the survey of the dairy industry. Factories accounting for over 60% of the industry's throughput were canvassed in the survey but disappointingly only about one-third of them co-operated in supplying complete returns. The labour coefficients for the beef industry are therefore not as reliable as those for the dairy industry.

The survey provided data on average labour contents by different forms of processing and on expected productivity gains by 1985.

The labour involved in processing consists of both direct and indirect labour. For direct labour the most reliable labour content figures available from the survey relate to the production of carcases, deboned meat, vacuum packed meat, bulk packed manufacturing meat, and the recovery of red and green offals. These data expressed as full-time direct jobs per 1,000 cattle are presented in Table 9.3 for both 1975 and 1985.

TABLE 9.3

Direct workers per 1,000 cattle, man-years.

Direct Workers	1975	1985
Live to carcase	0·49	0·43
Carcase to vac-pack	1·93	1·49
Carcase to boneless intervention meat or to bulk-pack manufacturing meat	1·84	1·41
Recovery of red offals	0·15	0·15
Recovery of green offals	0·14	0·14

The survey provided satisfactory data relating to productivity only for direct industrial workers. This indicated a gain in productivity for those workers of 20% between 1975 and 1985. In the absence of any better data this gain of 20% was also applied to indirect workers which consist of the two sub-groups, indirect industrial workers and administrative workers. The number of indirect workers per 1,000 cattle was 1·9 in 1975 according to the survey results; with the 20% productivity gain it would be 1·58 in 1985.

The productivity gain of 20% in the cattle and sheep processing industry is very low compared with the 62% gain estimated in dairy processing. This large difference may be explained by the different circumstances of the two industries. The cattle processing industry

is a much newer industry than dairy processing and has not undergone recent rationalisation of the magnitude that has taken place in dairy processing. In addition the cattle slaughtering level of the base year 1975 was the highest ever achieved and is not likely to be achieved again for some years. Consequently, the productivity in that year was very high by comparison with other recent years. In the case of dairy processing, on the other hand, supply of milk is expected to increase fairly continuously in the period 1975 to 1985. For these reasons a lower productivity growth in cattle processing than in dairy processing is to be expected.

The labour coefficients both for direct and indirect employment were used to assess the likely employment changes arising from alternative output levels and product mixes in 1985. The employment effects of two output levels—namely, trend and high—and three processing intensities—namely, the 1975 level, a medium level, and a high level—were assessed.

The composition of the kill available for slaughter is shown in Table 9.4. Cows are assumed to comprise 19% of cattle output in the trend output and 21% in the high output; all cows are assumed to be slaughtered in factories. The live exports at 490,000 are assumed to consist totally of prime cattle. The 100,000 imports and the 430,000 cattle required from output for the domestic trade are also considered to consist of prime cattle.

TABLE 9.4

Prime cattle and cows available for factory slaughter in 1985.

	Trend Output	High Output
Total	2,280,000	2,800,000
Cows	433,000	608,000
Imports	100,000	100,000
Domestic requirements	430,000	430,000
Prime cattle availability with no live exports	1,517,000	1,862,000
Live exports	490,000	490,000
Prime cattle availability with live exports	1,027,000	1,372,000

The product mixes associated with the different processing intensities are presented in Table 9.5.

TABLE 9.5

Alternative product mixes (% of cattle slaughtered).

	1975	1985	
		Medium intensity	High intensity
Prime cattle			
Carcase	74	55	30
Boneless intervention	23	20	20
Vac-pack	2	25	50
Cows			
Carcase	44	10	0
Boneless intervention	13	0	0
Vac-pack	10	40	50
Bulk-pack	33	50	50

The employment content of the 1975 output level and product mix was first estimated. The 1985 estimates were then expressed as a proportion of this base figure and the actual 1975 employment was then multiplied by this proportion to give an estimate of the total 1985 level of employment. The calculations involved in deriving the employment associated with the 1975 output level and product mix are shown in Table 9.6. Similar calculations were used to derive the employment levels for the alternative outputs and product mixes.

(c) Summary of Employment Possibilities in Cattle Processing

The employment estimates for the different levels of output and for the different product mixes are presented in Table 9.7.

As in the case of the dairy employment estimates, these estimates of employment in cattle processing are based on the assumption

TABLE 9.6

Employment arising for 1975 product mix.

Product Mix	Cattle nos.	Direct employment per 1,000 cattle, (man-years)	Total direct employment (no.)
Prime cattle:			
74% Carcase	573,373	0·49	281
23% Boneless intervention	178,211	2·32	413
3% Vac-pack	23,245	2·42	56
Cows:			
44% Carcase	259,066	0·49	127
13% Boneless intervention	76,542	2·32	178
10% Vac-pack	58,879	2·42	142
33% Bulk-pack	194,300	2·32	451
Offal:			
Red offal	1,363,600	0·15	205
Green offal	1,363,600	0·14	191
Total direct workers			2,044
Total indirect workers			2,591
Total direct and indirect			4,635

TABLE 9.7.

Employment effects of alternative output levels and alternative product mixes in cattle processing, changes compared with 1975 actual

Processing intensity	Trend output with live exports			Trend output with no live exports		
	1975	Medium	High	1975	Medium	High
	−672	−56	+504	+896	+1,680	+2,464
Processing intensity	High output with live exports			High output with no live exports		
	1975	Medium	High	1975	Medium	High
	+1,097	+1,942	+2,668	+2,670	+3,692	+4,639

of no change in the seasonality pattern of cattle supply. If the supply pattern becomes more even in the period 1975–1985, then the estimates may overstate the potential employment in this industry. This would be the case for the high output projections which involve a substantial proportion of 24-month beef most of which would be produced in the spring. The converse would be the case if the seasonality of supply became even more accentuated than at present.

The results show that the effect of going from trend to high output levels varies between about 1,700 and 2,100 extra jobs depending on the level of processing intensity. On the other hand the effect of going from the 1975 level of processing intensity to the high processing intensity varies between about 1,200 and 1,700 extra jobs depending on the level of output. The effect of having no live exports varies between about 1,500 and 2,000 extra jobs. At worst the employment in this industry could have declined by almost 700 by 1985 given the trend output and the 1975 level of processing intensity. At best it could provide 4,600 new jobs by 1985 given the high output level, no live exports, and a high level of processing intensity.

The survey estimates indicate lower employment potential than the first estimates provided by using the equation of past trends. The divergence between the equation estimates and the survey estimates is not as great as for the dairy industry. However, as in the case of the dairy industry, the survey estimates are considered the more reliable.

(d) Sheep Processing

It was not possible to do any reliable statistical analysis of the effect of changes in sheep slaughtering on employment. This arises because sheep are a relatively small portion of the total cattle and sheep processing industry and also in the data period the variation in sheep slaughterings was very small relative to the variation in cattle slaughterings. From the survey results, however, it was calculated that in 1975 the direct labour required to bring 100 live sheep to the carcase stage was 0·27 times that required to bring 100 live cattle to the carcase stage. This relativity was expected to remain roughly the same up to 1985.

The trend projection for sheep output for 1985 is 1,520,000. This is below the annual output levels of 1973/74/75 so that on the basis of this projection there is no possibility of increased employment in sheep processing by 1985 unless there was to be a significant change in the degree of intensity of sheep processing. This was not considered likely and was not investigated.

The high projection output for sheep in 1985 is 2,375,000 or 523,000 above the 1975 output. The direct labour required per 1,000 animals was calculated as 0·27 times the 1985 requirement for cattle, as shown in Table 9.6, or as $0{\cdot}27 \times 0{\cdot}43$ which is 0·12 man years. Applying this coefficient to the additional 523,000 animals it would mean a possible increase in direct factory employment of $523 \times 0{\cdot}12 = 63$ people. There might also be some corresponding increase in indirect employment but it is obvious that, in the absence of a change in the degree of intensity of sheep processing, the potential for increased employment in sheep slaughtering by 1985 is very small given the projected output levels.

CHAPTER 10

THE PIG PROCESSING INDUSTRY

(a) Employment, 1960 to 1975

Table 10.1 shows pig output levels and employment in the pig processing industry for the period 1960 to 1975. In the period

TABLE 10.1.

Pig output and employment in pig processing.

	Pig output ('000)	Industrial employment (no.)	Administrative employment (no.)	Total employment (no.)
1960	1,407	3,450	780	4,230
1961	1,563	3,606	804	4,410
1962	1,687	3,795	810	4,605
1963	1,672	3,803	819	4,622
1964	1,692	3,528	837	4,365
1965	1,954	3,927	818	4,745
1966	1,767	3,928	869	4,797
1967	1,552	3,863	879	4,742
1968	1,772	3,826	889	4,715
1969	2,083	3,810	840	4,650
1970	2,085	3,890	830	4,720
1971	2,269	3,970	810	4,780
1972	2,350	3,890	790	4,680
1973	2,104	3,772	828	4,600
1974	1,888	3,916	859	4,775
1975	1,534	3,567	783	4,350

Source: Irish Statistical Bulletins. See Table 8.1.

1960/61/62 to 1973/74/75 pig output increased by 19%. In the same period industrial and administrative employment increased by 4% and 3%, respectively. Pig output and total employment are graphed over time in Figure 10.1.

This industry has exhibited little change in the data period in terms of throughput, employment or structure. Pig output increased at an average annual rate of only 1·2%; total employment in pig processing increased at an average annual rate of only 0·3%; and the number of establishments in the industry remained relatively static at about 40 in the early 1960s and about 36 in the early 1970s.

Like the dairy processing industry, the pig processing industry is a long established industry and while plans for its reorganisation and rationalisation have been put forward, very little structural change has in fact occurred. Unlike both the dairy processing and the cattle and sheep processing industries, seasonality of supply is not a problem in this industry. Cyclicality in supply, however, is a problem but with the development of fewer and larger pig producers and more backward integration by pig processors, this problem may be less acute in future than in the past.

Employment in pig processing was regressed on pig output and on time for the period 1960–1975. The most satisfactory equations resulting were:

V. Industrial employment $= 3090 + 0.38P$ $\bar{R}^2 = 0.40$

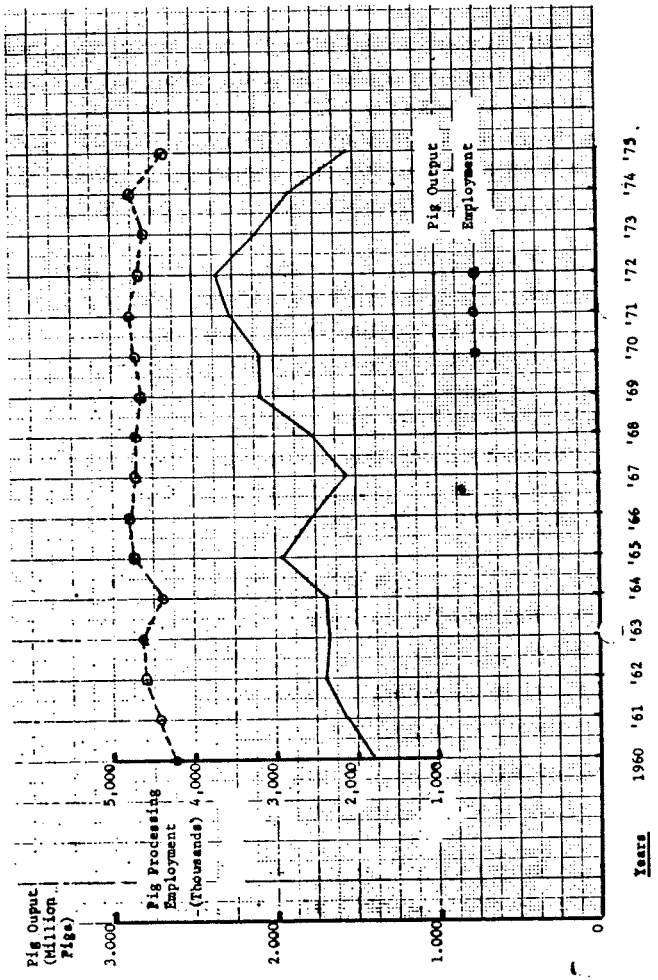
VI. Administrative employment $= 841 - 0{\cdot}01P + 1{\cdot}11T$ $\bar{R}^2 = 0{\cdot}13$

where P = Output of pigs ('000)
T = Time where 1960 = 0.

The proportion of the variation in employment accounted for in these equations is much less satisfactory than for the beef and dairy industries. However, the degree of variation in employment in the first instance is very low, the coefficients of variation for both industrial and administrative employment being less than 5%. Because of this, more reliance can be placed on the equations than would be warranted from their assessment on $\bar{R}^2$ alone.

FIGURE 10.1

Pig Output and Employment in Pig Processing



(b) Employment Projections

10.1 Equation Estimates

The trend projection for pig output in $\overline{1985}$ is 2,160,000. Inserting this output level into the equations gives an estimated total employment of 4,759 which represents an increase of 409 on the 1975 level of employment. The high projection for pig output in $\overline{1985}$ is 3,150,000. At this level of output the equations indicate a total employment level of 5,125, an increase of 775 over 1975. However, as before, more reliance is placed in the employment estimates derived below from the survey data as they incorporate the productivity expectations of people in the industry.

10.2 Survey Estimates

Although the managers of factories whose combined throughput accounted for over 50% of the total in 1975 were asked to co-operate in the survey, completed questionnaires were received from factories whose combined throughput accounted for only 20% of pig output. The survey provided data on the employment content of different products in 1975 and of expected productivity gains between 1975 and $\overline{1985}$. The employment contents relate to direct employment and are shown in Table 10.2. The indirect worker coefficient in Table 10.2 for 1975 was estimated simply by dividing total pig numbers handled by the surveyed factories into the total number of indirect workers in those factories.

TABLE 10.2.

Employment content of pig products (pigs per worker),

Direct workers	1975	$\overline{1985}$
Wiltshire sides	1,256	1,959
Pork sides	2,688	4,193
Bacon cuts (wholesale type)	1,231	1,920
Pork cuts (wholesale type)	1,608	2,508
Consumer bacon cuts/portion control	377	588
Canned pigmeat	414	646
Indirect workers	1,193	1,994

The industry productivity estimates indicate an increase in industrial worker productivity of 53% and in administrative worker productivity of 89%. These estimates were derived in the context of a doubling of 1975 throughput. The trend output for 1985 is 26% higher than that of 1975, while the high output projection is 105% higher. The industry productivity estimates are more suited therefore to the high output situation than to the trend output. Insofar as the estimated productivity gains are a function of throughput rather than time, they may be overstated for the trend output with the consequence that 1985 employment levels may be underestimated somewhat for this level of output.

Employment estimates are made for two output levels, namely trend output and high output, and for three product mixes, namely the 1975 product mix, a medium intensity product mix and a high intensity product mix. The alternative product mixes are shown in Table 10.3.

In making the 1985 employment estimates it was necessary to allocate total pig output between the domestic and export markets. If the

TABLE 10.3.

Alternative product mixes (percentage of pig output).

	Domestic market			Export market		
	1975	Medium intensity	High intensity	1975	Medium intensity	High intensity
Wiltshire sides	75	65	50	57	30	20
Pork sides	11	11	6	9	18	13
Bacon cuts	2	5	9	16	20	25
Pork cuts	2	2	2	3	12	16
Consumer bacon cuts/ portion control	7	11	21	8	10	13
Canned pig-meat	3	6	12	7	10	13
Totals	100	100	100	100	100	100

level of 1985 slaughterings for the domestic market is 1·9 million pigs as estimated in Chapter 14, then the level of pig slaughtering for export would be 40,000 with the trend output and 1,250,000 with the high output.

To provide a base for comparison, the employment associated with the 1975 output level and product mix was first estimated using the survey data. The subsequent 1985 estimates were expressed as a proportion of this base figure and the actual 1975 employment was then multiplied by this proportion to give an estimate of the total 1985 level of employment. The calculations involved in deriving the employment associated with the 1975 output level and product mix are shown in Table 10.4.

TABLE 10.4.

Employment arising from 1975 output and product mix

Domestic market	Pig nos. ('000)	Pigs/ direct worker (No.)	Total direct employment (No.)
Wiltshire sides	929	1,256	740
Pork sides	136	2,688	51
Bacon cuts	25	1,231	20
Pork cuts	25	1,608	16
Consumer bacon cuts/portion control	87	377	231
Canned pigmeat	37	414	89
Export market			
Wiltshire sides	171	1,256	136
Pork sides	27	2,688	10
Bacon cuts	48	1,231	39
Pork cuts	9	1,608	6
Consumer bacon cuts/portion control	24	377	64
Canned pigmeat	21	414	51
Total direct workers			1,453
Total indirect workers			1,289
Total direct and indirect employment			2,742

(c) Summary of Employment Possibilities in Pig Processing

A summary of employment possibilities in pig processing is presented in Table 10.5. The effect of going from trend to high output is

TABLE 10.5.

Summary of employment possibilities in pig processing in 1985, changes compared with 1975 actual.

Processing intensity	Trend output	High output
1975	−971	+1,262
Medium	−739	+1,579
High	−130	+2,284

between about 2,200 and 2,400 extra jobs, depending on the intensity of processing. The effect of going from the 1975 level of processing intensity to high processing is between about 800 and 1,000 extra jobs, depending on the output level. At worst this industry could have lost almost 1,000 jobs by 1985 on the basis of the trend output and the 1975 processing intensity. At best, it could provide over 2,000 extra jobs by 1985 on the basis of the high output and high processing intensity.

The productivity gains which were used in the derivation of these employment estimates were given by respondents in the survey in the context of the current structure and technology level of the industry. Should the industry undergo rationalisation in the period 1975 to 1985, such as has already occurred in the dairy processing industry, the estimates in Table 10.5 would probably prove to be optimistic because the rationalisation could well bring about productivity gains in excess of those given by the survey respondents.

On the other hand, the productivity estimates were obtained in the context of a doubling of output by 1985 over that of 1975. The trend output figure is however only 26% above the 1975 output level. Insofar as productivity estimates are a function of throughput, the productivity estimates used in deriving the employment figures for the trend output may have been too high. Consequently the employment losses in Table 10.5 may be overstated.

Furthermore, past employment levels in this industry have been invariant with pig output levels. This can be seen from the data in Table 10.1 and in Figure 10.1 at the start of this chapter. Pig output declined by 21% from 1965 to 1967 and in the same period employment showed virtually no change. Conversely, from 1967 to 1972 pig output increased by 51% and again there was virtually no change in employment. If this stability continues in the period 1975 to 1985 the employment estimates in Table 10.5 will prove incorrect.

The results of Table 10.5 refer only to the pig slaughtering factories and do not show the total employment involved in pig processing. A large amount of processing of pigmeat for the domestic market is carried out by distributors. Increased employment in the factories due to increased processing could in fact be accompanied by a decline in employment in the distributive sector among those workers previously engaged in pigmeat processing.

CHAPTER 11

THE ANIMAL FEED INDUSTRY

(a) Employment, 1960 to 1975

Table 11.1 shows the volume of throughput of animal feed and corresponding employment for the period 1960 to 1975. Throughput increased by 87 per cent in the period 1960/61/62 to 1973/74/75. In the same period industrial employment declined by 12 per cent and administrative employment declined by 9%. Throughput and total employment are graphed against time in Figure 11.1.

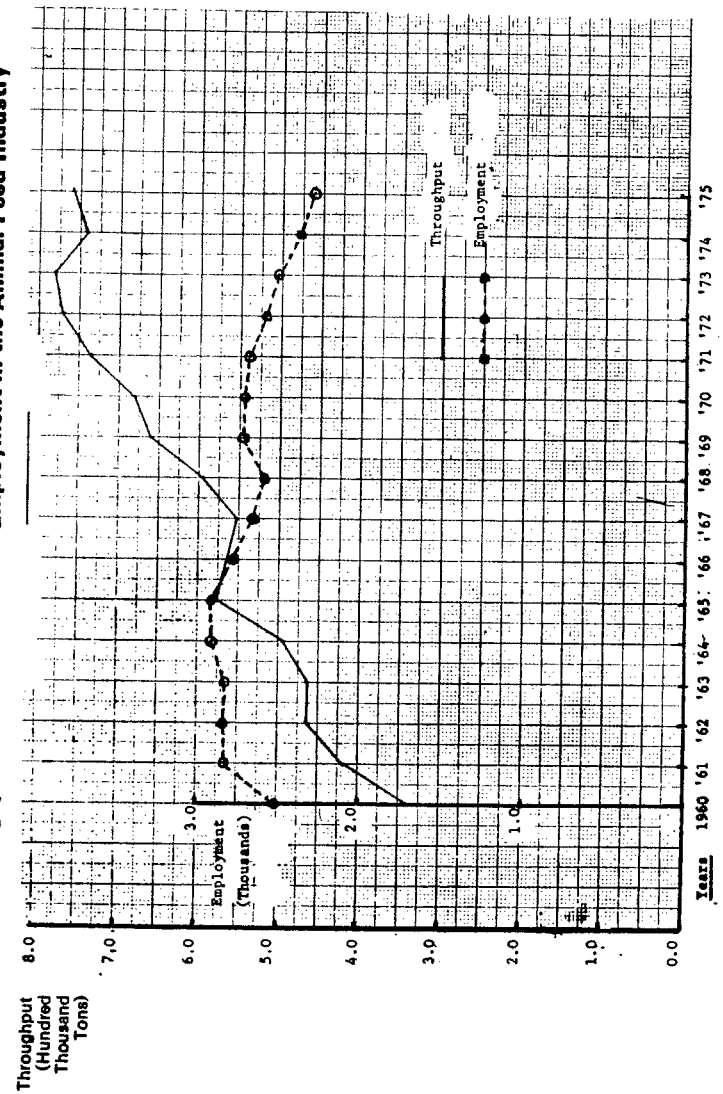
TABLE 11.1.

Volume of throughput of animal feed and corresponding employment.

	Throughput ('000 tons)	Industrial employment (no.)	Administrative employment (no.)	Total employment (no.)
1960	340·1	1,916	602	2,518
1961	417·9	2,180	645	2,825
1962	464·2	2,176	663	2 839
1963	465·0	2,148	659	2,807
1964	495·4	2,239	681	2,920
1965	576·7	2,213	697	2,910
1966	563·9	2,110	688	2,798
1967	553·1	2,005	667	2,672
1968	595·7	1,933	666	2,599
1969	662·1	1,960	772	2,732
1970	682·9	1,976	751	2,727
1971	736·9	1,939	756	2,695
1972	770·0	1,868	740	2,608
1973	780·2	1,919	606	2,525
1974	740·0	1,816	573	2,389
1975	760·0	1,765	557	2,322

FIGURE 11.1

Throughput of Animal Feed and Employment in the Animal Feed Industry



Employment was regressed on throughput and on time for the period 1960–75. However, the degree of correlation between throughput and time was unacceptably high at 0·97. Accordingly, the equations were estimated from the first differences of the original data. These equations are as follows:

VII. Industrial employment $= 1488 + 1.53V - 52.8T$ $\bar{R}^2 = 0.26$

VIII. Administrative employment $= 381 + 0.8V - 25.5T$ $\bar{R}^2 = 0.27$

where V = volume of throughput ('000 tons)
T = time, 1960 = 0.

The $\bar{R}^2$'s which in this case refer to the ability of the first difference data to explain changes in employment are very low so that the level of confidence one can have in employment estimates derived from these equations is low.

(b) Employment Projections

11.1 Equation Estimates

The 1985 trend level of feed consumption is 1,150 thousand tons higher than the 1975 consumption level. It is assumed that all of this extra consumption will be in the form of compounds and that it will all therefore constitute extra production for the animal feed industry. The 1975 production level of this industry was 760 thousand tons. Adding the trend increase in consumption to this gives a trend production level in 1985 of 1,910 thousand tons. Inserting this into equations VII and VIII and summing the results gives a total employment level in 1985 of 4,283, an increase of 1,961 on that of 1975.

The 1985 high output level of feed consumption is 2,730 thousand tons higher than the 1975 consumption level. Adding this to the 1975 production level gives a 1985 high production level for the animal feed industry of 3,490 thousand tons. Inserting this into Equations VII and VIII and summing the results gives a total employment level in 1985 of 7,357, an increase of 5,053 on the 1975 employment level.

11.2 Survey Estimates

Completed questionaires were received from firms whose combined turnover accounted for 22% of the total throughput of the

industry in 1975. Measuring productivity as tonnes of throughput per worker in 1975 and 1985, and putting the productivity question in the context of a doubling of throughput, their productivity gain expectations averaged out at +90% for industrial workers and +135% for administrative workers.

The only product mix of significance is the breakdown between bagged and bulk intake and output. However, respondents to the questionnaire were unable to allocate employment as between bagged and bulk throughput so no analysis along these lines could be done. The trend is, however, towards more bulk handling which of course is less labour intensive than the handling of the bagged product. Respondents to the survey stressed that very large productivity gains are possible in this industry, the extent to which they will be realised depending on the level of automation incorporated in new capital investment.

The survey employment estimates were therefore obtained simply by increasing the 1975 industry productivity level by the productivity gain estimates derived from the survey results and dividing the trend and high output levels by these productivity levels. Using this methodology, total 1985 employment is estimated as 2,931 for the trend output, an increase of 609 on the 1975 level of employment and as 5,354 for the high output, an increase of 3,032 on the 1975 level. These estimates contrast with the higher figures derived using the equation.

The survey employment estimates are again considered more reliable than the equation estimates. These results are derived on the basis of an assumption that all extra feed would be compounded. In practice some of the extra feed would be used as straights so that the employment results are to some extent biased upwards.

CHAPTER 12

THE FERTILISER MANUFACTURING INDUSTRY

12.1 Employment, 1960 to 1975

Table 12.1 shows production of fertiliser and corresponding employment for the period 1960 to 1975. Because of data problems only total employment is used for this industry. In the period 1960/61/62 to 1973/74/75 production increased by 175%. In the same period total employment increased by 34%. Total production and employment are graphed against time in Figure 12.1.

TABLE 12.1.

Production of fertiliser and corresponding employment

	Fertiliser ('000 tons of element)	Total employment (no.)
1960	71·6	1,730
1961	93·0	2,001
1962	94·5	1,994
1963	102·8	1,851
1964	104·7	1,984
1965	104·1	2,121
1966	114·2	2,603
1967	142·6	2,633
1968	155·6	2,288
1969	171·2	2,240
1970	193·5	2,240
1971	216·3	2,240
1972	201·7	2,270
1973	258·2	2,450
1974	261·7	2,600
1975	191·7	2,600

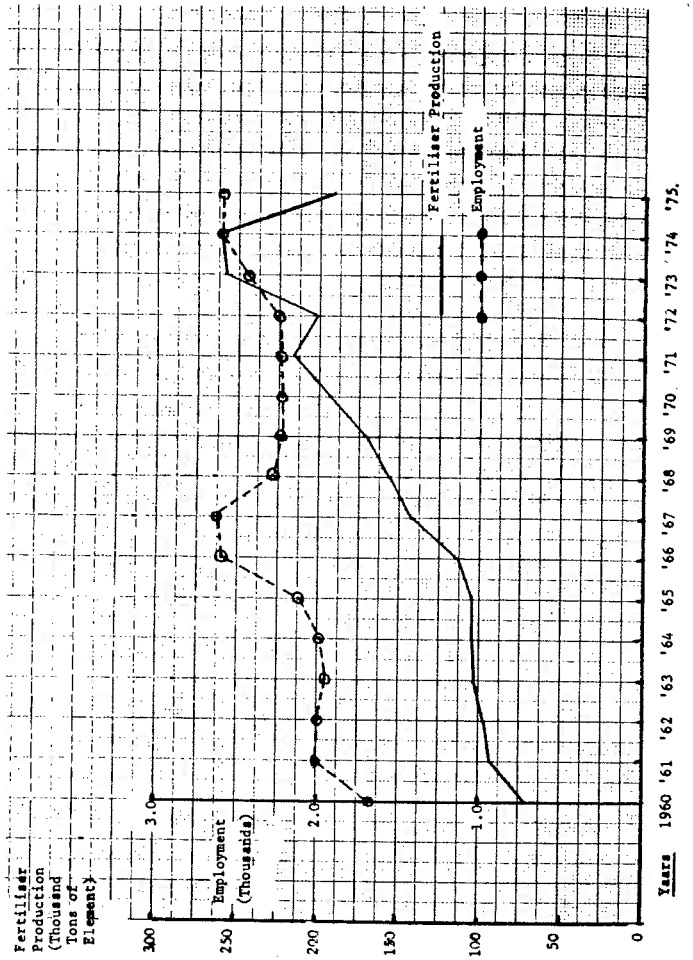
Source: Irish Statistical Bulletins. See Table 8.1.

The fertiliser industry is undergoing radical structural change. The new Cork plant for Nitrogen Eireann Teo. which is under construction will increase production capacity of ammonia in the country elevenfold. This is just equivalent to the total nitrogen requirements of 403,000 tonnes projected in the high growth model. On the other hand the manufacture of phosphoric acid in the country has greatly declined and now only meets about one-third of domestic requirements. All potash is of course imported.

Given this situation, projection of employment from equations fitted to the data would not be meaningful. The considered view of the people consulted in the industry was that no additional employment would arise as a consequence of either the trend or high requirements projected in this study. There could be increases in indirect employment —mainly in transport—but these are considered to be embraced by the multiplier used in Chapter 13.

FIGURE 12.1

Fertiliser Production and Corresponding Employment



CHAPTER 13

SUMMARY OF EMPLOYMENT PROJECTIONS

Estimates of the direct employment consequences both on-farm and in-factory of two alternative levels of agricultural growth have been made in the preceding chapters. Within the two growth rates, the level of processing intensity has been varied with three levels being studied, namely, the 1975 intensity level, medium intensity and high intensity. Furthermore, the estimates have been calculated on the basis of live cattle exports continuing at the 1973/74/75 level and, alternatively, on the basis of their termination. The employment consequences of high growth Model II involving substantial calf exports is not reported because the resulting output mix and the resulting employment were not very different from Model I. The on-farm employment estimates are much more subjective than the in-factory estimates. Nevertheless, the results are considered to be a reasonable guide as to the various possible outcomes.

13.1 On-farm Employment

The total employment on farms by $\overline{1985}$ for the trend model was estimated at 196,000. This represents a continuing decline of the on-farm work-force from present levels. The rate of decline involved is 2·1% per annum which is considerably less than projected in NESC Report No. 5. The main reason for the deceleration of the decline is the significant improvement in farmers' incomes relative to others' incomes since 1972.

The estimation of the $\overline{1985}$ on-farm employment for the high growth model is exceedingly difficult. Neither cross-sectional nor time series data provide usable measures of the complex relationships involved. However, it is suggested that an extra 15,000 on-farm jobs over and

above the trend model projection is a reasonable expectation. This would still represent a drop in the on-farm workforce below present levels, but the annual rate of decline would only be 1·5%.

13.2 In-factory Employment

In-factory estimates of employment were made in two ways: by fitting equations to past data and by using survey data supplied by management in the industries studied. Those industries are dairy processing, cattle and sheep processing, pig processing, animal feed compounding and fertiliser manufacture. The estimates as derived from the survey data are summarised in Table 13.1 and these estimates are compared with equation estimates in Table 13.2. The figures are expressed as changes over the 1975 employment levels. Since no product mix analysis was done in the case of the animal feed and fertiliser industries, the estimate of their trend and high employments are added to each of the three levels of processing intensity.

Before commenting on the results in Table 13.1 it is of interest to compare them with the results obtained from the equations. The estimation of the equations served several functions. Firstly, they quantified past relationships between throughput and employment in the industries studied. Since it was considered likely, because of technology improvements, that increases in throughput in future would give rise to less employment than in the past, the employment estimates derived from the equations provided upper limits to the employment increases that could be expected from future increases in throughput. Secondly, in the case of the dairy processing industry for which historical product mix data were available it was possible, using the equations, to quantify the labour intensity of certain dairy products, namely, cheese and skim powder. The conclusions with regard to the labour intensity of these products derived from the equations were subsequently validated by the survey data. Thirdly, a comparison of the results obtained from the equations with those obtained from the survey data demonstrate in a very striking way the declining potential of increases in the volume of raw materials to generate increased employment in the processing sector.

This comparison is presented in Table 13.2. It is presented only for the trend growth because the coefficients of the equations may not

TABLE 13.1.

Summary of employment estimates by industry, level of output and intensity of processing; change in number of jobs compared with 1975.

Industry	Output	1975 intensity	Medium intensity	High intensity
Dairy	Trend	+1,601	+2,017	+2.933
	High	+5,904	+10,291	+13,759
Cattle	Trend with live exports	−672	−56	+504
	Trend without live exports	+896	+1,680	+2,464
	High with live exports	+1,097	+1,942	+2,668
	High without live exports	+2,670	+3,692	+4,639
Sheep	Trend	—	—	—
	High	+63	+63	+63
Pig	Trend	−971	−739	−130
	High	+1,262	+1,579	+2,284
Feed	Trend	+609	+609	+609
	High	+3,032	+3,032	+ 3,032
Fertiliser	Trend	—	—	—
	High	—	—	—
All	Trend with live exports	+567	+1,831	+3,916
	Trend without live exports	+2,135	+3,567	+5,876
	High with live exports	+11,358	+16,907	+21,806
	High without live exports	+12,931	+18,657	+23,777

give valid results when used to derive employment estimates from the high growth level which is far in excess of that experienced during the data period.

It is difficult to know with what level of processing intensity the equation estimates should be compared. In most cases the product mix or level of intensity changed over the data period but apart from the equations relating to dairy processing it was not possible to

quantify the effects of this change in the equations. Consequently, in Table 13.2 the total employment changes derived from the equations are compared with the total employment changes for the 1975 level of processing intensity and the high level of processing intensity.

TABLE 13.2.

Comparison of employment changes derived from equations with those derived from survey data.

Output level	Equations	Survey data	
		1975 processing intensity	High processing intensity
Trend with live exports	+11,461	+567	+3,916
Trend without live exports	+12,480	+2,135	+5,876

The differences between the estimates obtained from the equations and those obtained from the survey data are very large even in the case of the high processing intensity estimates. The equation estimates show the likely level of employment increases that could be expected if past relationships between throughput and employment obtained in 1985. However, when allowance is made for likely productivity gains by 1985 as estimated by people in the industries surveyed, the potential employment increases are very greatly reduced. Even with the highest processing intensity studied, the job-creating potential of increased output is not even a half of the past experience.

Returning now to the data in Table 13.1, the estimated increases in employment over the 1975 level for the industries studied range from +567 in the case of trend output with live exports and 1975 processing intensity to +23,777 for high output without live exports and high processing intensity. More specifically the difference between the potential employment of trend output and high output lies between about 11,000 and 18,000 depending on the intensity of processing. Intensive processing could add from 3,350 to 10,600 extra jobs depending on the level of output.

In making these projections two factors were of prime importance. These were, firstly, the employment contents of the various products as derived from surveys of the industry and, secondly, the rates of productivity gain expected by 1985.

There is little doubt that the employment content data for 1975 were as accurate as possible for those firms the management of which completed the questionnaire. The necessity for accurate data was impressed upon the managers, and it was obvious from the returns that the majority of firms completed the questionnaire in a very conscientious manner. In addition, any apparent discrepancies in the returns were discussed with the managers and other personnel of the firm concerned and corrections were made where necessary.

Another question relating to the employment content data is the extent to which in each case they were representative of the total industry. Because of the methodology employed this issue relates to the productivity expectations implicit in the data rather than the absolute level of the coefficients In 1975. In all cases the survey data were used firstly, to estimate a base 1975 employment level, and, secondly, to estimate 1985 employment levels. The percentage change between these estimates was then applied to the 1975 *actual* employment to give an estimate of projected employment in 1985. Thus any bias in the 1975 levels of the survey data would affect both the base year estimate and the 1985 estimate.

There could, however, be bias in the expected rates of productivity changes derived from the survey results. With the exception of the cattle and sheep processing industry for which personal estimates were made for some employment categories, productivity estimates were derived from the survey results. For industrial workers, the expected productivity gains from 1975 to 1985 expressed in annual percentage changes were: for the animal feed industry +6·6, for dairy processing +4·7, for pig processing +4·4 and for cattle and sheep processing +1·8. In the case of administrative employment, the expected productivity gains were: animal feed +8·9, dairy processing +5·5, pig processing +6·6, cattle and sheep processing +1·8. The relatively low figures for the cattle and sheep processing industry must be related to the modernised state of that industry and

the exceptionally high productivity prevailing in the base year, 1975, as discussed in Chapter 9. Furthermore, the low supply situation over the immediate years ahead will probably inhibit productivity growth.

Industrial employment in the industries being studied averaged 80% of their total employment in 1975. Weighting the above increases in the ratio 0·8 for industrial workers and 0·2 for administrative, the simple average productivity expectation of these industries is +4·8% per annum. The annual productivity gain in all transportable goods industries over the period 1959/60/61 to 1973/74/75 was +4·7%. Therefore, the productivity expectations used to derive the employment estimates in this study do not appear to be excessive.

On the contrary the assumptions underlying the analysis would if anything tend to bias the resulting estimates upwards. All estimates were made on the basis that the 1975 seasonality pattern would obtain in 1985. In the case of the dairy processing industry some creameries are already operating price incentive schemes designed to improve the seasonal supply pattern. As already discussed in Chapter 8, any improvement which these schemes achieve would have a reducing effect on potential new employment.

While no such schemes are in operation in the cattle processing industry, any improvement in the supply pattern of cattle would have a similarly reducing effect on potential new employment. Furthermore, the high output level in the case of cattle incorporates production of 24 month-old beef cattle. With late Winter and Spring calving this system would give rise to an increased proportion of cattle being slaughtered in the April–June period which at present is the trough period of cattle slaughter. It is likely that increased throughput in that period would be absorbed by existing employment in the cattle processing industry rather than giving rise to increased employment as assumed in this study.

Some upward bias in the employment levels estimated for the animal feed industry is also likely. In the analysis for that industry it was assumed that all additional feed requirements for both the trend and high output projections would be compounded. To the extent that this would not be the case, then employment in the animal feed industry would be reduced.

In the case of the pig processing industry, two further issues arise, one related to its structure and one related to the stability of past employment. As far back as 1963 it was recommended that capacity in pig processing be reduced by the purchase of production licences.[1] However, despite this and despite subsequent plans to rationalise the industry very little has been achieved. If rationalisation were to occur in the period 1975 to 1985, it might give rise to greater productivity gains than those obtained in the survey and therefore to greater employment losses and smaller employment increases than those estimated in Chapter 10. On the other hand, as already discussed in Chapter 10, employment in pig processing in the period 1960 to 1975 exhibited extraordinary stability when viewed in relation to the fluctuations which occurred in pig output in that period. Should that stability continue in the period 1975 to 1985, then the estimates for employment changes in pig processing estimated here would prove incorrect.

13.3 Indirect and Induced Employment

The *direct* jobs created by more rapid agricultural growth and/or more intensive processing would in turn lead to further employment in other industries and services. This would arise in a number of ways. Some additional employment would be generated *indirectly* in areas servicing farming and factories which have not been identified in this study. Examples of such areas would be land reclamation, machinery contracting, farm building, agrochemical provision (other than fertiliser), packaging, fuel and power manufacture and transport. Furthermore, there would be additional employment *induced* by the expenditure of the incomes earned by all of these additional workers arising either directly or indirectly from agricultural expansion.

The extent of the additional indirect and induced employment is almost impossible to quantify. The relationship between direct employment, on the one hand, and indirect and induced employment, on the other, is exceedingly complex. It presumably varies over time depending on such factors as the extent of underemployment prevailing and the capital intensity of economic activity. The Industrial Development Authority (IDA) have in the past employed a ratio of 1·5 new jobs in

[1] *Report of the Survey team established by the Minister for Agriculture on the Bacon and Pigmeat Industry.* Stationery Office, 1963.

the indirect and induced areas for every one new direct manufacturing job. However, the indirect and induced effects are thought to have declined due to increased capitalisation. For this reason the IDA currently employs a ratio of one new job in the indirect and induced areas for every new job in manufacturing.

This 1:1 ratio is employed here subject to the qualifications expressed above. Therefore, for every extra job arising either on farms or in factories as a direct result of increased agricultural output, another job is assumed to be created elsewhere in the economy. The application of the multiplier to the on-farm as well as the in-factory jobs applies to the estimated 15,000 jobs that would be retained in farming under high growth which would otherwise be lost. These jobs are considered to be fully remunerated just as in-factory jobs; therefore the logic of the situation would suggest a multiplier of similar magnitude for both types of job. The effect of using the 1:1 ratio is to double the estimates of total job creation already referred to in this chapter.

SECTION IV

CHAPTER 14

BALANCE OF PAYMENTS EFFECTS

In this chapter an attempt is made to assess the balance of payments effects of the alternative agricultural growth rates. To do this it was necessary first of all to estimate 1985 domestic consumption levels of foodstuffs. These were then deducted from output levels to get the quantities available for export. Linear trend lines based on per capita consumption data over the period 1960 to 1975 were used to estimate per capita consumption in 1985. These 1985 estimates were then multiplied by the projected 1985 population.

A linear trend based on increasing absolute data gives a declining percentage rate of increase per annum. The latter is plausible given evidence that the income elasticity for food tends to decline with rising incomes.[1] Incomes in the above projection are of course assumed to be directly correlated with time and to continue to increase up to 1985 as they have done over the past fifteen years. Also simple projections of this sort imply that relative prices will move in the future as they have moved in the past. The projected 1985 population was taken as 3·6 million which is the average of the high and low estimates derived from NESC Report No. 5.[2] The estimated consumption levels are given in Table 14.1.

The balance of payments effects were estimated at the average import and export prices of the years 1973/74/75. The volume of imports of milk products, live cattle, beef, live sheep, mutton and lamb, live pigs, pigmeat and wheat were held at their average 1973/74/75

[1]Leser, C. E. V. *Demand Relationships for Food.* The ESRI, Paper No. 4, 1962.
[2]*Population and Employment Projections: 1871-86.* NESC Report, No. 5, 1975.

TABLE 14.1.

Projected domestic consumption levels, 1985

Cattle ('000 head)	430
Pigs ,,	1,900
Sheep ,,	1,420
Total milk (million gallons)	456
Wheat ('000 tonnes)	266

absolute level. In the case of wheat it was assumed that 50% of domestic requirements would be supplied from domestic sources as in recent years. Domestically produced wheat surplus to domestic requirements along with wheat offals were allocated to animal feed.

In the case of feed and fertilisers the differences between domestic requirements and domestic supplies are imported. With regard to the import of animal feeds, only barley, maize, oilseed cake, meat and bone meal, and fish meal are included in the calculations. The difference between domestic requirements of animal feed and domestic supplies of animal feed is assumed to consist of 80% carbohydrate and 20% protein. The carbohydrate quantity is multiplied by the average unit import price of barley and maize in 1973/74/75, while the protein quantity is multiplied by the average unit import price of the combination of oilseed cake, meat and bone meal, and fish meal imported over the period 1973/74/75.

With regard to the import of fertilisers it is assumed that there will be no imports of nitrogenous fertiliser or of ammonia in 1985. This is a reasonable assumption since NET are currently expanding their nitrogen producing capacity eleven-fold based on natural gas feedstock.

On the export side the exports of live cattle, live sheep, live pigs, exports of animal feed and fertiliser are held at their average 1973/74/75 absolute levels. By far the most important of these items is the export of live cattle. If these animals were slaughtered before export their export value would be increased by the value added in processing. This was taken as the ratio of net output to value of livestock input in the Census of Industrial Production, which was 25% in 1973. Therefore the balance of payments effect of terminating live cattle exports is taken as a quarter of their base period value of

TABLE. 14. 2

Estimation of balance of payments effects

Product	73/4/5 Unit Export Values	73/4/5 Unit Import Values	73/4/5 Value of Exports	73/4/5 Value of Imports	73/4/5 Value of net Trade	Value of 1985 exports arising from trend output levels	Value of 1985 exports arising from high output		Value of Imports 1985	Value of 1985 Net trade arising from			Change in Value of Net Trade. 1973/4/5–1985		
							Model I	Model II		Trend Output	High Output Model I	High Output Model II	Trend	High Model I	High Model II
	£	£	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m
Milk products	0·27/Gal	—	104	10	94	244	386	408	10	234	376	398	140	282	304
Live cattle	165·75/hd	103·68/hd	83	10	74	83	83	97	10	74	74	87	—	—	13
Beef	167·33/hd	—	148	1	148	244	331	301	1	243	330	300	95	182	152
Live sheep	12·72/hd	11·12/hd	2	2	0	2	2	2	2	0	0	0	—	—	—
Mutton and lamb	18·82/hd	—	8	0	8	2	18	18	0	2	18	18	−6	10	10
Live pigs	40·98/hd	24·78/hd	1	1	0	1	1	1	1	0	0	0	—	—	—
Pigmeat	43·09/hd	—	16	1	15	2	54	54	1	1	53	53	−14	38	38
Wheat	61·12/ tonne	70·94/ tonne	1	14	−12	0	1	1	9	−9	−8	−8	3	4	4
Animal feed	43·2/ tonne	60·54/ tonne	2	33	−29	2	2	2	***	−71	−152	−140	−42	−123	−111
Fertiliser	—	—	9	25	−17	9	9	9	†††	−28	−34	−34	−11	−17	−17
			375	96	279	589	887	893	–	446	657	674	+165	+376	+393

Data have been rounded to the nearest £m.

***Trend 73
High 1 154
High II 142

†††Trend 37
High I 43
High II 43

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£83·3 million or £20·8 million. Under high output Model II an addition of 300,000 calves valued at £45 per head is made to these exports.

The only remaining item of importance is the export level of fertilisers in 1985. These have also been held at their 1973/74/75 average level although it is possible because of the NET investment in Cork that there could be significant increases in fertiliser exports by 1985. These exports would not occur as a consequence of the increased output of Irish agriculture and consequently, no attempt has been made to quantify them here.

Estimation of the balance of payments effects involves firstly, estimating the net trade effect in 1973/74/75. This is done by getting the difference between the average value of exports and the average value of imports of the items listed in Table 14.2 in the period 1973/74/75. A similar exercise is then carried out for the trend output projection and high output Models I and II. The change in the value of net trade from 1973/74/75 to 1985 is then calculated as the difference between the value of the 1973/74/75 average net trade and the value of 1985 net trade.

As can be seen in Table 14.2 the change in the value of net trade is approximately +£165 million for the trend projection and +£376 million and +£393 million for high Models I and II, respectively. These represent volume increases over the average net trade position of 1973/74/75 of 59%, 135%, and 141% for the trend, high Model I, and high Model II projections, respectively. The equivalent annual percentage growth rates are 4·4, 8·1 and 8·4, respectively. If live cattle exports ceased, all the above figures would be increased by an estimated £21 million.

The difference between the level of net trade arising from the trend output and high outputs is about £220 million. For the high outputs this represents an increase in the volume of net trade of 49% over the trend model. The ratio of the level of high output to the level of trend output is 1·30. Therefore for a 30% greater output by 1985 from more rapid growth, net trade would have increased by an extra 49%. This occurs because all of the difference in growth goes for export. The difference corresponds to almost 60% of the average trade deficit in 1973/74/75.

SECTION V

CHAPTER 15

SUMMARY

The contribution of agricultural growth to employment is usually regarded as being negative. Agriculture in economic development is seen as a shedder of labour which must be employed in the other sectors of the economy, namely, industry and services. The relegation of agriculture to this negative role is valid if it is accepted that the pace of its growth is limited by external constraints. This would be the case in a closed economy because the relatively slow rate of increase in aggregate demand for agricultural products would limit the rate of agricultural growth. It is not necessarily the case, however, in Ireland as a member of the EEC. Irish agriculture could grow more rapidly than aggregate demand for food provided the industry was capable of increasing its share of the total EEC market.

If rapid growth is possible in Irish agriculture, the question then arises as to what its likely consequences would be. The purpose of this study was to map out in detail production patterns involving alternative rates of agricultural growth and to study mainly the employment consequences, but also the balance of payments effects of the alternatives. The study is strictly a technical exercise; no effort is made to specify the economic relationships that would be consistent with the different alternatives. A further Report will examine the economic and policy issues relating to accelerated growth. The question posed here is simply—if agriculture were to grow at different rates over a period of years what would be the required patterns of production and what would be the resulting employment and balance of payments effects?

Additional employment could be generated either by accelerated growth in the volume of agricultural output and/or by more intensive processing of such output as is produced. There is a widespread view that the present degree of processing of agricultural output is not as intensive as it might be and that more intensive processing could contribute significantly to employment. A survey of the appropriate industries provided data which were used to assess the extent to which further processing could generate additional jobs. The barriers to more intensive processing and the likelihood of its achievement are not studied here but will be dealt with in the next Report.

The capital implications of accelerated growth have not been considered. In other words, it has been assumed that capital would not be a constraint on growth. In reality capital availability would operate to some extent to constrain job creation—either directly by slowing down agricultural growth or indirectly by inhibiting job creation in other sectors of the economy. For these reasons the employment estimates in this study are biased upwards. Additional reasons for upward bias are indicated in Section 15.2 below.

15.1 Alternative Growth Rates

Two rates of growth were selected. One is essentially a projection of past trends. It gives an annual growth rate in Gross Agricultural Output of 3·0% or in Net Agricultural Output of 2·0%. The second is a more rapid rate—rapid enough to be significantly different from the trend, but not so rapid as to be judged infeasible. It involves an annual growth rate in the region of 5·5% in GAO and 3·7% in NAO. This represents a doubling of gross output in thirteen years and is considerably greater than the target in the 1976 Government Green Paper. To some agriculturalists even this would be considered cautious, but on the basis of the past record it must be considered a very ambitious target.

Within the high growth model, two alternative paths of development were specified—Model I assuming no calf exports and Model II including the export of calves to the extent of approximately 10% of calf production. The exported calves were replaced in the enterprise mix by 140,000 additional cows and 100,000 acres of cereals to utilise the land released by the exported calves.

Despite considerable apprehension in recent years at the initiation of live calf exports, the results of this study show that such a development would make little difference to the agricultural economy if the land released by calf exports were suitably allocated to other enterprises. In fact the difference in the output mix between Model I and Model II were not large enough to warrant detailed investigation of their separate employment consequences. Therefore, only the employment effects of the trend model and high growth Model I are reported.

The method adopted in the projections was relatively straightforward. For the trend model the relationships of the past 15 years or so were studied and these were projected forward to 1985. This date was selected because it is a period sufficient in length to highlight the technical implications of sustained rapid growth while being short enough that market and technological conditions could be claimed to be broadly anticipatable. In practice, the target date must be interpreted as being in the vicinity of 1985 rather than precisely the year 1985. Therefore, the date is indicated by $\overline{1985}$ and may be regarded as an average of 1984, 1985 and 1986. The base period from which all the output projections were made is the average of 1973, 1974 and 1975, designated as $\overline{1974}$. Thus, the projections extend over an 11 year period.

The main result of the output projections is the detailed specification of the components of growth in the alternative models. This is a necessary input to any rational debate about growth in agriculture and for systematic planning of the sector.

The trend model involves a projected growth rate of 2·0% for the crop sector compared to a rate of 1·9% over the period 1960 to 1975. The growth in this sector is mainly the result of a rising acreage under feeding barley offset to a considerable extent by continued decline in wheat, oats and potatoes. In the livestock sector, cow numbers are projected to continue to increase by an average of 56,000 cows per year as in the period 1960 to 1975; in addition, the milk yield was projected to increase to 800 gallons per cow compared with 565 gallons in the base period. These give rise to increases in milk and cattle output amounting to 5·7% and 2·4% per annum, respectively. Only small changes are projected for pig and sheep output in the

trend model. The aggregate growth rate projected for the livestock sector is 3·1% per annum which is the same as that recorded in the period 1960 to 1975.

In high growth Model I substantial changes were superimposed on the trends in order to arrive at a growth rate for GAO in the region of 5% to 6%. The more important changes prescribed for the $\overline{1974}$ to $\overline{1985}$ period were:

(1) an average increase of 100,000 cows per year compared with 56,000 in 1960 to 1975;

(2) a projected milk yield of 900 gallons per cow in $\overline{1985}$ compared with 565 gallons in $\overline{1974}$;

(3) a population of 175,000 sows in $\overline{1985}$ compared with 107,000 in $\overline{1974}$;

(4) an average annual increase of approximately 30,000 acres in feeding barley compared with 16,000 acres in 1960 to 1975;

(5) a halt in the decline in wheat acreage; and

(6) a more intensive beef production system where at least 75% of cattle output would be disposed of as 24-month-old beef.

15.2 Employment Consequences

The main focus of this study is the assessment of the likely employment implications of the alternative growth paths specified. Both on-farm and in-factory employment are analysed.

On-farm employment has been declining for many years and is expected to continue to decline. But the critical factor here is the rate of decline. A slower rate of decline means the retention of jobs on farms that would otherwise be lost. Provided these retained jobs are economically productive they are presumably as good as—if not better than—alternative jobs created in industry or services.

On-farm employment was expected to be related to such factors as the incomes of farm workers—both family and hired—compared with other workers, the availability of off-farm employment, the employment status as between farmers, relatives assisting, and hired workers of the

farm workforce, and the demographic structure of that workforce. Analysis of the available data, however, failed to produce acceptable relationships for projection purposes. Projection had therefore to be undertaken on a more subjective basis.

Earlier projections of the farm workforce in NESC Report No. 5 would seem to be too pessimistic. This has arisen because of the abnormal base period of 1966/71 used for those projections and because of a subsequent substantial improvement in the incomes of people working on farms compared with other workers. The after-tax income position of farm workers improved by 23% relative to industrial workers in the post-1971 period compared with the 'sixties. This in turn was associated with a significant decline in the rate of outflow of agricultural workers. The rate of decline of family workers dropped from 2·1 to 1·8% per annum and of hired workers from 6·4 to 5·0% per annum. The projections for trend output of on-farm employment to 1985 were based on these reduced rates of decline. They give by 1985 196,000 employed in agriculture compared with 248,000 in 1974.

The estimation of on-farm employment associated with the high growth model proved more difficult and the outcome must be viewed more tentatively. Undoubtedly the high growth outputs would require some additional on-farm workers to produce them. The best judgement that could be arrived at was that the additional output would entail an additional 15,000 workers. The annual rate of decline which this projection implies is 1·5% in contrast to the 2·1% rate of the trend projections. The productivity gain implied is 7·1% per year compared with the trend model productivity gain of 5·2%. It must be emphasised, however, that this estimate of additional jobs could be significantly more or significantly less.

The in-factory employment effects of alternative growth rates and processing intensities were studied for those industries which would be affected by the varying levels of output projected in this study. These are the dairy processing, cattle and sheep processing, pig processing, animal feed compounding and fertiliser manufacturing industries.

Each of these industries was studied on the basis of its past employment record related to volume of agricultural production and on the

basis of surveys to provide information about expected developments up to 1985. The key data supplied through the surveys pertain to the labour intensity of the main products now produced and to expected productivity changes by 1985. While the degree of response to the surveys varied, it is believed that reliable information was collected for each industry.

With the available data it was possible to assess not only the effect of increased volume of agricultural output but also increased degrees of processing in the industries. Thus, employment projections are made for the trend and high agricultural growth rates and with both medium and high intensity of processing as well as the level of processing prevailing in 1975. In addition to these alternatives, live cattle exports were treated in two ways: they were assumed to continue at the level of 1974 and, alternatively, they were assumed to have ceased entirely by 1985.

It has been already stated that the employment estimates are likely to be biased upwards because the constraining effects of capital have not been taken into account. In addition the assumptions used in the individual industry estimates would also on balance tend to yield over-estimates rather than under-estimates of potential jobs. Therefore, the figures produced in this study are probably too high, but the extent of over-estimation is impossible to quantify.

The employment estimates are striking. With trend output, 1975 processing intensity and the continuation of live cattle exports, the increase in in-factory jobs by 1985 would be a mere 567. Since this would be associated with a drop of 52,000 in on-farm employment compared with 1974, it represents a substantial negative contribution by agriculture towards solving the employment needs of the country. Comparison of the experience of the 1960 to 1975 period with the expectations of the 1975 to 1985 period indicated that, even with the highest assumed processing intensity, increased output in the future would generate less than half the employment of a corresponding increase in the past.

Employment possibilities would still, however, be greatly increased by more rapid growth and more intensive processing. The high growth projected in this study could add between 11,000 and 18,000 extra

jobs in factories depending on the intensity of processing. Intensive processing, on the other hand, could add between 3,350 and 10,600 extra jobs depending on the level of output. Termination of live exports could create between 1,500 and 2,000 extra jobs depending again on the intensity of processing; these increased factory jobs would, however, be offset to some extent by the loss of the jobs of present live exporters. There could also be an adverse effect on competition within the cattle industry.

The maximum difference among the projections amounts to 23,200 factory jobs and 15,000 on-farm jobs. This is the difference between the employment potential of trend growth with 1975 processing intensity and a continuation of live cattle exports and of high growth with high processing intensity and a termination of live cattle exports. These 38,200 jobs are estimated to arise directly as a consequence of the alternative scenarios projected. These *direct* jobs would in turn give rise to further *indirect* and *induced* jobs. The relationships between direct jobs and indirect and induced jobs is a complex one which has not been quantified. On the assumption of a ratio of 1:1 between the two, the difference in total estimated employment between the lowest projection and the highest projection would be 76,400 jobs.

Even after allowing for likely upward bias in this estimate, it would still be a significant contribution towards achieving full employment if it could be realised. It is, however, considerably less than all previous estimates as reviewed in Chapter 1. The Irish Grassland and Animal Production Association estimated an extra 80,000 jobs over five to six years from an annual growth rate less than the high rate of this study and without any assumption about intensified processing. The Irish Farmers' Association estimated an extra 102,000 jobs over ten years also from an annual rate of growth less than the high in this study and without intensifying processing. Even the more cautious estimate of the Agricultural Graduates Business Association of 5,000 to 6,500 new jobs in the food industry by 1980 would only materialise by considerably accelerating the growth in output over trend levels.

15.3 Balance of Payments Effects

In estimating the balance of payments effects of different growth rates, projected domestic market consumption in 1985 was deducted

from projected domestic output and imports in that year. The difference was assumed to be exported. All imports and exports were valued at their $\overline{1974}$ unit values. The average net trade in $\overline{1974}$ was used as a standard against which to compare the net trade effects of the alternative growth rates by $\overline{1985}$. Net trade was calculated as the difference between imports and exports.

The net trade effects at $\overline{1974}$ values were a gain of £165 million from the trend projection, a gain of £376 million from the high output Model I projection and a gain of £393 million from the high output Model II projection. The difference between the gains of the trend projection and of the average of the two high projections was £220 million. This is equivalent to almost 60% of the average trade deficit in the period 1973/74/75.

15.4 Conclusion

The contribution of agricultural growth to national employment and to the balance of payments has been shown to be heavily dependent on its rate of growth. If agriculture in the future continued to grow at only the rate of the past 15 years, the numbers employed on farms would continue to decline even though the improvement in the relative incomes of the farm workforce since 1971 if maintained would slow down the rate of decline. The growth rate of the past would yield very few new in-factory jobs to offset the loss of on-farm jobs. A rapid rate of growth in agriculture, on the other hand, could make a significant contribution to national employment which would be further augmented if the intensity of processing could also be raised.

APPENDIX TABLES

TABLE 1.1.

Eleven year growth rates in Gross Agricultural Output for selected countries 1954 to 1975.

	1954–65	1955–66	1956–67	1957–68	1958–69	1959–70	1960–71	1961–72	1962–73	1963–74	1964–75
Canada	3·3	3·3	3·3	3·8	3·5	2·8	2·6	2·2	1·1	0·4	0·6
U.S.A.	1·8	1·7	1·9	2·0	1·7	1·6	1·8	1·8	1·8	1·7	2·0
Belgium	2·3	1·8	1·8	1·9	2·1	2·2	2·1	2·2	2·2	2·5	2·3
Denmark	1·9	1·6	1·4	1·3	1·2	0·5	0·1	–0·2	–0·3	0·1	0·2
France	3·0	3·2	3·4	3·5	3·1	2·7	2·4	2·4	2·2	2·4	2·1
Germany, Fed.	2·2	2·1	2·2	2·2	2·0	2·1	1·9	1·9	1·5	1·5	1·7
Ireland	1·7	1·9	2·1	2·4	2·8	2·6	2·5	2·3	2·3	2·7	2·7
Italy	2·4	2·3	2·6	2·6	2·4	2·6	2·7	2·1	2·0	1·9	1·5
Netherlands	2·4	2·1	2·4	2·4	2·3	2·5	2·8	3·2	3·4	4·0	4·1
Sweden	0·5	0·5	0·4	0·7	0·4	0·3	0·4	0·6	0·5	1·3	1·2
U.K.	3·5	3·6	3·4	3·3	2·9	2·5	2·3	2·2	2·0	2·2	1·9
Australia	3·7	3·8	3·5	3·7	3·0	3·0	2·9	2·6	2·4	2·0	1·9
New Zealand	3·3	3·2	3·1	3·1	3·0	2·8	2·6	2·4	2·0	1·5	1·1

Source: Derived from index numbers of total agricultural production as published in FAO Production Yearbooks.

TABLE 2.1.

Unit values in 1974 for the main products in agricultural output

Product	Unit	Average quantity 1973 to 1975	Average value 1973 to 1975	Value per unit
		'000	£m	£
Horses	No.	16	5·9	367·1
Cattle*	,,	1,732	275·0	158·8
Sheep and lambs	,,	1,743	26·7	15·3
Pigs	,,	1,843	63·6	34·5
Poultry	,,	25,200	17·7	0·70
Liquid Milk	Gals	137,000	36·4	265·46
Other milk	,,	611,800	149·1	243·68
Cattle hides (casualty)	No.	100	0·223	2·24
Wool	Lb.	15,800	3·50	0·22
Eggs	120	5,650	15·7	2·80
Wheat	Tonnes	194	11·0	56·8
Oats	,,	30	1·4	45·0
Barley	,,	656	34·0	51·8
Sugar beet	,,	1,222	15·5	12·7
Potatoes	,,	424	16·3	38·4

*An unusually high number of calves were exported in 1975. Their quantity and value were excluded from the 1975 data.

Source: Irish Statistical Bulletins.

TABLE 3.1.

Trend equations and 1985 projections for selected scale factors.

Item	Unit (X)	Trend Equation	Correlation Co-efficient	1985 Projection
Wheat	'000 acres	$\text{Log}_e X = 5{\cdot}724 - 0{\cdot}0548t$	−0·81	78
Oats	'000 acres	$\text{Log}_e X = 6{\cdot}052 - 0{\cdot}0918t$	−0·99	42
Malting Barley	'000 acres	$X = 120{\cdot}8 + 1{\cdot}043t$	0·47	147
Feeding Barley	'000 acres	$X = 236{\cdot}8 + 16{\cdot}26t$	0·95	643
Sugar Beet	'000 acres	$X = 75{\cdot}96 - 0{\cdot}157t$	−0·06	72
Potatoes	'000 acres	$\text{Log}_e X = 5{\cdot}436 - 0{\cdot}054t$	−0.97	60
Other Tillage Crops	'000 acres	$\text{Log}_e X = 5{\cdot}556 - 0{\cdot}044t$	−0·90	86
Total Cows	'000 head	$X = 1214{\cdot}75 + 55{\cdot}50t$	0·96	2,602
Ewes	'000 head	$X = 2{,}084{\cdot}2 - 20{\cdot}64t$	−0·66	1,568
Sows	'000 head	$X = 127{\cdot}13 - 0{\cdot}7775t$	−0·26	107·7

All equations were estimated from 1960–'76 data except "Other Tillage" which was based on 1960–'75 data. $t = 0$ for 1960 in all equations. All acreages and livestock numbers relate to the June enumerations.

Source: Appendix Tables 3.1(*a*), 3.4, 3.6 and 3.7.

TABLE 3.1 (a).

Acreage of selected tillage crops in Ireland, 1960–'76.

Year	Wheat	Oats	Malting Barley	Feeding Barley	Sugar Beet	Potatoes	Total Tillage
1960	366·3	425·6	118·6	210·0	68·3	233·8	1,675
1961	344·8	367·8	121·1	240·6	78·8	213·1	1,599
1962	314·0	346·0	127·7	278·1	78·1	209·2	1,586
1963	232·7	331·7	120·8	308·2	88·3	204·9	1,513
1964	214·4	288·6	125·3	328·6	79·8	182·3	1,438
1965	182·2	284·4	135·5	328·5	107·3	174·3	1,395
1966	131·3	242·8	134·9	326·7	53·5	167·5	1,262
1967	188·8	237·9	127·4	323·8	63·9	159·6	1,302
1968	223·6	218·3	118·6	335·5	64·1	146·5	1,306
1969	199·9	188·5	117·2	373·3	61·0	135·9	1,272
1970	233·7	168·0	125·6	403·9	63·7	140·4	1,315
1971	224·7	148·1	130·5	450·7	73·6	127·6	1,322
1972	168·0	128·8	137·7	484·1	84·1	109·0	1,260
1973	144·5	122·7	128·9	471·2	74·6	117·9	1,196
1974	136·1	108·3	159·7	448·3	63·7	98·7	1,145
1975	117·7	124·2	147·4	439·1	82·2	97·6	1,132
1976*	130·0	92·0	119·0	487·0	85·0	116·0	N.A.

*Provisional.

Source: Irish Statistical Bulletin, June enumerations.

TABLE 3.2.

Trend equations and $\overline{1985}$ projections for selected intensity factors.

Item	Unit(X)	Trend Equation	Correlation Coefficient	$\overline{1985}$ Projection
Wheat	Tonnes/Acre	$X = 1{\cdot}2674 + 0{\cdot}0354t$	0·81	2·153
Oats	" "	$X = 1{\cdot}0272 + 0{\cdot}0270t$	0·93	1·701
Malting Barley	" "	$X = 1{\cdot}2757 + 0{\cdot}0209t$	0·72	1·801
Feeding Barley	" "	$X = 1{\cdot}3455 + 0{\cdot}0235t$	0·74	1·933
Sugar Beet	" "	$X = 11{\cdot}5352 + 0{\cdot}3570t$	0·72	20·460
Sugar Beet[1]	" "	$X = 9{\cdot}4981 + 0{\cdot}2753t$	0·81	19·134
Potatoes	" "	$X = 9{\cdot}1364 + 0{\cdot}1354t$	0·64	12·521
Milk	Gal/Cow	$X = 485{\cdot}76 + 4{\cdot}21t$	0·81	595·2
Cattle[2]	Output/Cow	$X = 83{\cdot}31 + 0{\cdot}113t$	0·33	87·3
Pigs	Output/Sow	$X = 12{\cdot}89 + {\cdot}298t$	0·89	20·3
Sheep	Output/Ewe	$X = 0{\cdot}8345 + 0{\cdot}0045t$	0·41	0·95

[1]Based on 1950–'75 data, t = 0 for 1950

[2]Based on 1953–'75 data. t = 0 for 1950. Output includes inventory changes.

Source: Appendix Tables 3.2 (*a*), 3.4, 3.5, 3.6 and 3.7. All equations based on 1960–'75 data with t = 0 for 1960 unless stated otherwise in the above notes.

TABLE 3.2 (a)

Yield per acre of selected crops in Ireland, 1960–'75.

Year	Wheat	Oats	Malting Barley	Feeding Barley	Sugar Beet	Potatoes
1960	1·28	1·00	1·28	1·38	14·12	7·82
1961	1·36	1·04	1·37	1·45	11·38	10·05
1962	1·40	1·14	1·44	1·50	11·99	10·16
1963	1·27	1·11	1·33	1·40	10·87	9·65
1964	1·26	1·08	1·16	1·23	11·28	8·33
1965	1·28	1·14	1·28	1·34	11·68	9·45
1966	1·41	1·16	1·31	1·41	13·31	10·06
1967	1·58	1·23	1·42	1·53	15·10	10·97
1968	1·84	1·31	1·59	1·68	17·27	11·07
1969	1·78	1·32	1·52	1·63	14·93	10·67
1970	1·63	1·23	1·41	1·50	15·64	10·46
1971	1·69	1·40	1·66	1·72	16·76	11·17
1972	1·61	1·39	1·51	1·59	13·21	9·85
1973	1·58	1·32	1·47	1·52	17·78	11·28
1974	1·80	1·45	1·61	1·74	14·63	11·28
1975	1·76	1·35	1·56	1·73	17·47	10·16

Source: Irish Statistical Bulletins.

TABLE 3.3.

Selected output: production ratios in Irish agriculture, 1960–'75.

Year	Wheat	Oats	Barley[1]	Sugar Beet	Potatoes
1960	·93	·15	·61	1·0	·31
1961	·94	·14	·66	1·0	·23
1962	·96	·13	·72	1·0	·25
1963	·90	·21	·71	1·0	·27
1964	·91	·20	·74	1·0	·36
1965	·87	·13	·68	1·0	·29
1966	·93	·13	·69	1·0	·29
1967	·96	·14	·68	1·0	·28
1968	·99	·14	·71	1·0	·31
1969	·99	·17	·73	1·0	·35
1970	·97	·22	·77	1·0	·32
1971	·96	·19	·73	1·0	·33
1972	·89	·19	·76	1·0	·42
1973	·80	·24	·67	1·0	·32
1974	·85	·15	·66	1·0	·39
1975	·91	·17	·68	1·0	·41

[1]These ratios were derived by dividing *total* output of barley (*malting and feeding*) by the *total* production of barley.

TABLE 3.4.

Total number of cows, milk output and average milk yield per cow in Ireland, 1960–'76.

Year (1)	Total Cows (2)	Total Milk Output (m gals.) (3)	Milk Yield per Cow (gals.) (4)
1960	1,284	479·6	477
1961	1,291	503·2	492
1962	1,309	522·9	504
1963	1,323	525·1	505
1964	1,400	543·7	503
1965	1,547	562·8	493
1966	1,582	579·6	493
1967	1,568	629·7	519
1968	1,607	671·8	529
1969	1,657	671·0	527
1970	1,699	656·2	537
1971	1,782	674·5	555
1972	1,895	708·1	544
1973	2,096	741·5	530
1974	2,151	712·6	507
1975	2,035	767·1	538
1976*	1,973	n.a.	578

*Provisional.

Source: Total cows: Irish Statistical Bulletin, June enumerations.

Yield: Irish Statistical Bulletin for 1960 to 1969. This series was discontinued after 1969. For subsequent years the series was extrapolated to 1972 on the basis of creamery milk supplies and creamery cow numbers as provided by the Dept. of Agriculture and from 1972 to 1976 on the basis of a yield series from creamery cows obtained from the Farm Management Survey of An Foras Talúntais. Note that the data in column (3) is *not* equal to columns (2) × (4) because (*a*) output excludes all milk fed to calves and (*b*) the yield series does not relate to all cows but to cows less sucklers.

TABLE 3.5

Cattle output as a percentage of cow numbers in Ireland, 1953–75.

Year	Total Cows ('000)	Cattle Output (incl. inventory changes) ('000)	Output as % of Cows
1953	1,174	955	81·3
1954	1,204	1,015	84·3
1955	1,198	1,048	87·5
1956	1,187	947	79·8
1957	1,236	1,052	85·1
1958	1,260	1,042	82·7
1959	1,272	1,121	88·1
1960	1,284	1,064	82·9
1961	1,291	1,096	84·9
1962	1,309	1,186	90·6
1963	1,323	1,194	90·2
1964	1,400	1,292	90·8
1965	1,547	1,409	91·1
1966	1,582	1,374	86·9
1967	1,568	1,328	84·7
1968	1,607	1,384	86·0
1969	1,657	1,401	84·5
1970	1,699	1.449	85·3
1971	1,782	1,550	87·0
1972	1,895	1,677	88·6
1973	2,096	1,752	83·6
1974	2,151	1,746	81·2
1975	2,035	1,808	88·8

Source: Irish Statistical Bulletins

TABLE 3.6

Ewe numbers in Ireland in June of each year, 1960–'76, and output of sheep and lambs per 100 ewes, 1960–'75.

Year (1)	Output (including inventory changes) ('000) (2)	Number of Ewes ('000) (3)	Output per 100 ewes (4)
1960	1,464	1,837·3	80
1961	1,648	1,926·6	86
1962	1,782	2,040·5	87
1963	1,901	2,084·9	91
1964	1,977	2,200·3	90
1965	1,861	2,196·8	85
1966	1,610	2,084·2	77
1967	1,684	1,936·3	87
1968	1,553	1,882·1	83
1969	1,566	1,800·0	87
1970	1,452	1,843·7	79
1971	1,784	1,888·1	94
1972	1,715	1,873·8	92
1973	1,667	1,872·4	89
1974	1,584	1,804·1	88
1975	1,646	1,730·2	95
1976*	n.a.	1,623·0	—

*Provisional
Source: Irish Statistical Bulletins

TABLE 3.7

Sow numbers In Ireland in June of each year, 1960–76, and output of pigs as a ratio of sow numbers, 1960–75.

Year (1)	Output (including inventory changes) ('000) (2)	Breeding Herd[1] ('000 sows) (3)	Ratio (1) ÷ (2) (4)
1960	1,476·6	119·4	12·4
1961	1,698·4	121·0	14·0
1962	1,621·1	123·6	13·1
1963	1,671·3	123·1	13·6
1964	1,836·5	133·5	13·8
1965	1,897·7	139·3	13·6
1966	1,586·3	102·9	15·4
1967	1,650·1	110·4	14·9
1968	1,817·0	118·1	15·4
1969	2,086·3	120·3	17·3
1970	2,175·5	138·9	15·7
1971	2,257·0	147·6	15·3
1972	2,213·7	128·9	17·2
1973	2,127·1	129·7	16·4
1974	1,633·1	92·7	17·6
1975	1,623·8	99·0	16·4
1976*	n.a.	107·0	—

*Provisional
[1]Excluding gilts not yet served,
Source: Irish Statistical Bulletins.

TABLE 4.1

Estimated stocking rates (SR), 1960–75, and projection to 1985.

Year	Net Lowland "feed acres" (M. ac.)	Total LU's (million)	Mountain SR (est) (LU/100 ac.)	LU's on Mountain soils (million)	LU's on L.M. soils[1] (million)	SR on L.M. soils[1] (LU/100 ac.)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1960	9,166	4·34	8·0	0·264	4·08	43·7
1961	9,227	4·33	8·2	0·271	4·05	43·9
1962	9,237	4·36	8·4	0·277	4·08	44·2
1963	9,308	4·45	8·5	0·280	4·17	44·8
1964	9,374	4·58	8·7	0·287	4·29	45·7
1965	9,414	4·68	8·9	0·294	4·50	48·7
1966	9,535	4·95	9·1	0·300	4·65	48·7
1967	9,491	4·88	9·3	0·307	4·57	48·1
1968	9,485	4·84	9·5	0·314	4·53	47·7
1969	9,301	4·91	9·8	0·323	4·59	49·3
1970	9,450	5·11	10·0	0·330	4·78	50·6
1971	9,432	5·26	10·2	0·337	4·92	52·2
1972	9,484	5·51	10·4	0·343	5·17	54·5
1973	9,531	5·68	10·7	0·353	5·53	58·0
1974	9,570	6·01	10·9	0·360	5·65	59·1
1975	9,583	5·79	11·1	0·366	5·42	56·6

Projection: Log_e SR = 3·7405 + 0·0211 t (t = 0 in 1960)
SR in 1985 = 71 LU./100 acres where SR is Stocking Rate as shown in column (7)

[1]L.M. Soils = Lowland Mineral Soils.

Source: See Appendix Tables 4·2 and 4·3 for methodology used in estimating net lowland "feed acres", total LU's and stocking rate,

TABLE 4.2

Estimation of the total "feed acres" directly[1] available to livestock in 1985 under the trend and high growth models

	Lowland Mineral Soils (M. AC)			Mountain and Hill Soils (M.AC)
	Trend Model	Model I	Model II	All Models
Gross Area[2]	11·700	11·700	11·700	3·5
Less Urban, roads and fences[2]	1·100	1·100	1·100	0·2
Less Tillage not devoted to Livestock[3]	1·070	1·255	1·355	—
	9·530	9·345	9·245	3·3
Plus Allowance for Sugar Beet Tops (½Area)	0·023	0·023	0·023	—
Total Feed Acres	9·553	9·368	9·268	3·3

[1]. Excludes acreage equivalent of grain fed to livestock.
[2]. Source: Lee and Diamond *Ibid,* pp. 25–26.
[3]. Total tillage acreage less the acreage under mangels, turnips, fodder beet, and "other root and green crops" except vegetables. The deducted area is estimated at approximately 70,000 acres for 1985 in both high growth models and 60,000 acres in the trend model.

Sources: Irish Statistical Bulletin and *Agricultural Statistics.* S.O.E.C. Brussels.

TABLE 4.3.

Total LU's and estimated stocking rate—trend model, 1985

	L.U. Equivalent[1]	Inventory[2] (m. head)	Total L.U.'s (millions)
Cattle			
Cows	1·05	2·60	2·73
Heifers in calf	1·00	0·27	0·27
0–1 yr. old	0·40	2·30	0·92
1–2 yr. old	0·75	2·24	1·68
2–3 yr. old	0·67	1·34	0·90
Over 3 yr old	0·25	0·11	0·03
Bulls	1·00	0·02	0·02
Total		8·61	6·55
Sheep			
Ewes and rams	0·20	1·65	0·33
0–1 yr. old	0·08	1·60	0·13
Over 1 yr. old	0·20	0·16	0·03
Total		3·41	0·49
Horses			
Working Horses	1·5	0·05	0·08
Other Horses	1·0	0·05	0·05
Total		0·10	0·13
Total cattle, sheep and horses			7·17
Assume 0·5m L.U.'s carried on mountain and hill soils			0·50
Total L.U.'s on Lowland and Mineral (L.M.) soils			6·67
Total feed acres on L.M. soils			9·55m. acres
Average stocking rate on L.M. soils			0·70 L.U./acre

[1]Standard L.U. equivalents adjusted for the proportion of animals surviving on farms throughout the year.

[2]The cattle inventories were derived from the projected figure for cow numbers by means of a set of cow productivity and cattle survivorship coefficients which take account of the changing structure of the Irish cattle herd over time. A similar approach was applied to the sheep inventories. The more important coefficients are given in the notes accompanying Appendix Table 4.4.

Source: See accompanying notes on following page for details.

TABLE 4.4.

Livestock numbers and livestock units in 1985 under high growth models I and II

	L.U. per head	Model I		Model II	
		M. head	M.L.U.	M. head	M.L.U.
Cattle					
Cows	1·05	3·20	3·36	3·20	3·36
Heifers in calf	1·00	0·38	0·38	0·38	0·38
0–1 year old	0·40	2·83	1·13	2·53	1·01
1–2 year old	0·75	2·76	2·07	2·47	1·85
2–3 year old	0·67	0·53	0·36	0·46	0·31
3 + year old	0·25	0·05	0·01	0·04	0·01
Bulls	1·00	0·02	0·02	0·02	0·02
Total		9·77	7·34	9·10	6·94
Sheep					
Ewes and rams	0·20	2·57	0·51	2·57	0·51
< 1 year old	0·08	2·50	0·20	2·50	0·20
>1 year old	0·20	0·25	0·05	0·25	0·05
Total		5·32	0·76	5·32	0·76
Horses					
Working	1·50	0·05	0·08	0·05	0·08
Other	1·00	0·05	0·05	0·05	0·05
Total		0·10	0·13	0·10	0·13
Total cattle, sheep and horses			8·23		7·83

Notes on Appendix Tables 4.3. and 4.4.

(a) In Appendix Table 4.4 cow numbers are set at 3.20 m in both models to illustrate the reduction of cattle LU's arising out of the export of 300,000 calves without any counter-balancing adjustments.

(b) Replacement of cows = 17·5% annually in trend model and 20% in the high growth models.

(c) Inventory of heifers-in-calf (June) = 60% of replacements.

(d) Inventory of 0–1 year olds = 88·5% of cows (less ·3m in Model II).

(e) Inventory of 1–2 year olds = 97·5% of 0–1 year olds.

(f) Inventory of 2–3 year olds in trend model = 75% of (1–2 year olds less the number of heifers used as cow replacements.) Inventory of 2–3 years olds in high growth Models I and II = 25% of (1–2 year olds less replacement heifers).

(g) Inventory of cattle over 3 years of age = 8·5% of 2–3 year olds.

(h) Inventory of < 1 year old sheep = Inventory of ewes.

(i) Inventory of > 1 year old sheep = 10% of < 1 year olds.

TABLE 5.1.

Gross Agricultural Output (GAO) and Net Agricultural Output (NAO) at constant 1974 prices and their ratio, 1960–76.

Year (1)	GAO (2)	NAO (3)	Ratio (3) ÷ (2) (4)
1960	480·2	406·3	0·846
1961	498·9	415·3	0·832
1962	513·8	418·5	0·815
1963	515·2	413·6	0·803
1964	534·9	430·3	0·804
1965	539·7	417·3	0·773
1966	538·3	418·5	0·777
1967	556·0	429·1	0·772
1968	594·4	453·4	0·763
1969	595·9	444·9	0·747
1970	612·7	453·0	0·739
1971	650·1	479·5	0·738
1972	674·2	500·6	0·743
1973	691·0	501·4	0·726
1974	688·6	517·6	0·752
1975	737·5	582·7	0·790
1976	708·0	536·1	0·757

Source: Irish Statistical Bulletin. Derived from G.A.O. and expenditure on feed, seeds and fertiliser deflated by appropriate price indices.

Note: Trend in ratio 1960–73: Log_e (Ratio) = −0·1808 − 0·0113t where t = 0 in 1960. Predicted ratio for 1985 = 0·63.