

COMMISSION OF THE EUROPEAN COMMUNITIES

INTERNAL INFORMATION
on **AGRICULTURE**

**Models for analysis mixed crop
and cattle farms**

VI. Characteristics and possible applications

- South-East Leinster (Ireland), West Cambridgeshire (United Kingdom), Fünen (Denmark), Schwäbisch-bayerisches Hügelland (F.R. Germany)

COMMISSION OF THE EUROPEAN COMMUNITIES

DIRECTORATE-GENERAL FOR AGRICULTURE

Directorate for Agricultural Economics and Structure – Division for «Balance-sheets, Studies, Information»

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I N T R O D U C T I O N

This study, which is one of a series of studies for the preparation of models for analysis mixed crop and cattle farms ⁽¹⁾ was carried out as part of the study programme of the Directorate-General for Agriculture by the Rural Economy Laboratory of Grignon (National Institute for Economic Research), under the guidance of Mr. Pierre Cordonnier, Assistant Director of Research (INRA), with the assistance of Mr. L. Grandclaude, Engineer (SEI-INRA) and Mr. Guinet, Engineer and Doctor of Geography (INRA).

This volume sets out the characteristics and possible applications of models in the following districts : South East Leinster (Ireland), West Cambridgeshire (United Kingdom), Finen (Denmark) and Schwäbisch-bayerisches Hügelland (F.R. Germany).

The basic techno-economic data needed ⁽²⁾ to prepare the models were collected by Mr. P. Mac Canna (Ireland), Mr. W.H. Helme (United Kingdom), Mr. P.E. Stryg (Denmark) and Dr. B. Geissler (Germany). These experts also helped to prepare the models and studied the results of the first interviews.

The following divisions also assisted in the work : " Statistics, Balance-sheets, General Studies ", " Analysis of the situation of Agricultural holdings " and " Production structures and environment ".

Original : French language

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This study does not necessarily reflect the views of the Commission of the European Communities in this sphere and in no way commits the Commission as to its future position on the subject.

(1) and (2) see page II.

(1) Models for analysis mixed crop and cattle farms

I. Characteristics and possible applications,
Series "Internal Information on Agriculture" N° 97

II. Basic techno-economic data - district of Nord-Picardie and
alluvial plain of the Limbourg area in Belgium,
Series "Internal Information on Agriculture" N° 111

III. Basic techno-economic data - "Noordelijke Bouwstreek"
(Netherlands),
Series "Internal Information on Agriculture" N° 140

IV. Basic techno-economic data - "Pianura Veneto-Friulana" region
(Italy)
Series "Internal Information on Agriculture" N° 141

V. Basic techno-economic data - "Südniechersachsen" region
(F.R. Germany)
Series "Internal Information on Agriculture" N° 151

(2) Basic techno-economic data collected for these districts will
subsequently be published in the series "Internal Information on
Agriculture".

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STUDY MODELS FOR MIXED CROP AND LIVESTOCK FARMS

I - G E N E R A L R E P O R T

The four models ALBION, ERIN, FUNEN and BAYERN on which we report in this document have the same general characteristics and the same overall policy as the models previously set-up as part of the programme of studies by the Directorate-General for Agriculture on models of mixed crop and cattle-breeding farms. (1). These models are designed to exemplify the operation of mixed crop and livestock farms and to facilitate study of them.

1. Examples of the operation of mixed crop and livestock farms

The models concerned are the farms situated in a relatively homogeneous geographical area (2) as regards agronomic and economic potential but structural factors and the economic policy of the farms may vary

(1) Cf Internal data on Agriculture. Models of mixed crop and cattle-breeding farms n° 97, January 1973. Commission of the European Communities. Directorate-General for Agriculture.

(2) Cf ANNEX C, map showing the geographical location of the regions.

considerable. (1).

In a given region the model is considered to be a reliable example of farm when the date of prices, area, fixed farm capital, fulltime labour and the techniques which are non-specific to the area are given. Mutatis Mutandis other farms with different capabilities or governed by different price systems could be represented by the model. The permanent features of the model are the data on geographical location, the general production policy and techniques which depend on climate and soil. It should be stressed that account is taken only of advanced production techniques in general use on the part of farmers having good farming knowledge.

(1) ALBION relates to the region situated west of Cambridge which is marked by soil of good agronomic potential and regular rainfall but with summer droughts in some years. Crop rotation is widely practised. The average size of farms is about 100 hectares.

ERIN was set up for farms situated in the region of Leinster in the South East. The rainfall is regular and permanent pasture predominates. The average farm covers 30 hectares.

FUNEN was set up for the farms on the island of Funen, which is a region with great potential where diversified mixed crop and livestock farming is practised. Sugar beet is relatively important there. The average size of farms is about 20 hectares.

BAYERN was set up for farms in the hills of Swabia and Bavaria. This region has fairly heavy yearly rainfall (800 mm) mean temperatures of about 15 degrees during the frozing season and relatively cold winters. Permanent grass land occupies about 40 % of the cultivated area; 85 % of the farms are less than 20 hectares. The classical crops—cereals, sugar beet, maize and potatoes — are grown there, generally combined with cattle-breeding and pig-breeding. The biggest farms are seeking to simplify their systems.

2. Study and calculation of economic choices in the mixed crop and livestock farm :

The models are means of determining economic choices aimed essentially at maximising income from full-time labour :

For a farming year the economic function is a monetary value corresponding to the difference between the gross annual output of the farm and the purchases of goods and services and casual labour. This is the net farm income from which cost of casual labour is deducted. The full-time labour income is simply the value of the economic function less rent and the interest on farm capital (cf ANNEX B)

- The models can provide solutions to the problem of determining the optimum combinations between production factors and products according to the criterion stated above, on the basis of different assumptions relating to :

. prices of products and/or production factors. Thus it is possible to modify periodically the price data according to variations observed in these figures as a result of economic factors, in order to establish the tendencies which are spontaneously manifested in the general policy of production systems and in the effect on income.

. the choice of production methods. It is possible to consider improvements to methods of cultivation or breeding or to bear in mind the opportunity for farming new crops or animals so as to measure the effect of these choices on the economic results.

. the size of the farm. A fairly wide range of farms, depending on area, capacity of cow sheds or piggeries and the number of full-time farm hands, can serve as the basis for numerous studies which can show the balances appearing in different types of farm in the same region.

3. Study of the most widespread types of farm in the countries of the European Economic Community

The Albion, Erin, Funen and Bayern models belong to a large family of models suitable for reproducing the activity and measuring the economic results of the most widespread type of farm in the countries of the European Economic Community.

The four new models are to a large extent, comparable to the study models for mixed crop and livestock farms previously set-up as part of the programme of studies by the Directorate-General for Agriculture (1) as regards.

- methodology : the conception of the models as methods of representing mixed crop and livestock farms and the medium of this representation and of calculation which is the linear-programming model are similar. The only variable factors are the dimensions of the models, depending on the regions described.

- the available range of technical choices and general production policy. These choices themselves depend on the potentialities and practices of the regions studied. It should however be pointed out that pig-breeding has been systematically introduced into the new models as it is widely carried on in the regions concerned, so as to measure if necessary the effect of this animal on the results of the different production system. Likewise, and for the same reasons, sheep-farming has been included in the ERIN model (2)

- the choice of calculation techniques : all that needs to be said is that the scope of the study has been extended by the inclusion of the possibility of calculating

- . either assuming new investment in building for livestock
- . or assuming old investment with or without partly enlarging the buildings. The first assumption accords with the calculation rule applied to the models which were previously set-up. The second assumption offers the advantage of proposing a rule for deducting depreciation in accordance with the situations which are most frequently met with.

(1) Cf reference quoted above

(2) In the models which were previously set-up, pig-breeding and poultry-farming which were deemed to be "outside the system" and sheep-farming were not introduced. There will be no major difficulty in introducing some of these elements into the new models.

II - MAIN ASSUMPTIONS USED IN THE CALCULATIONS

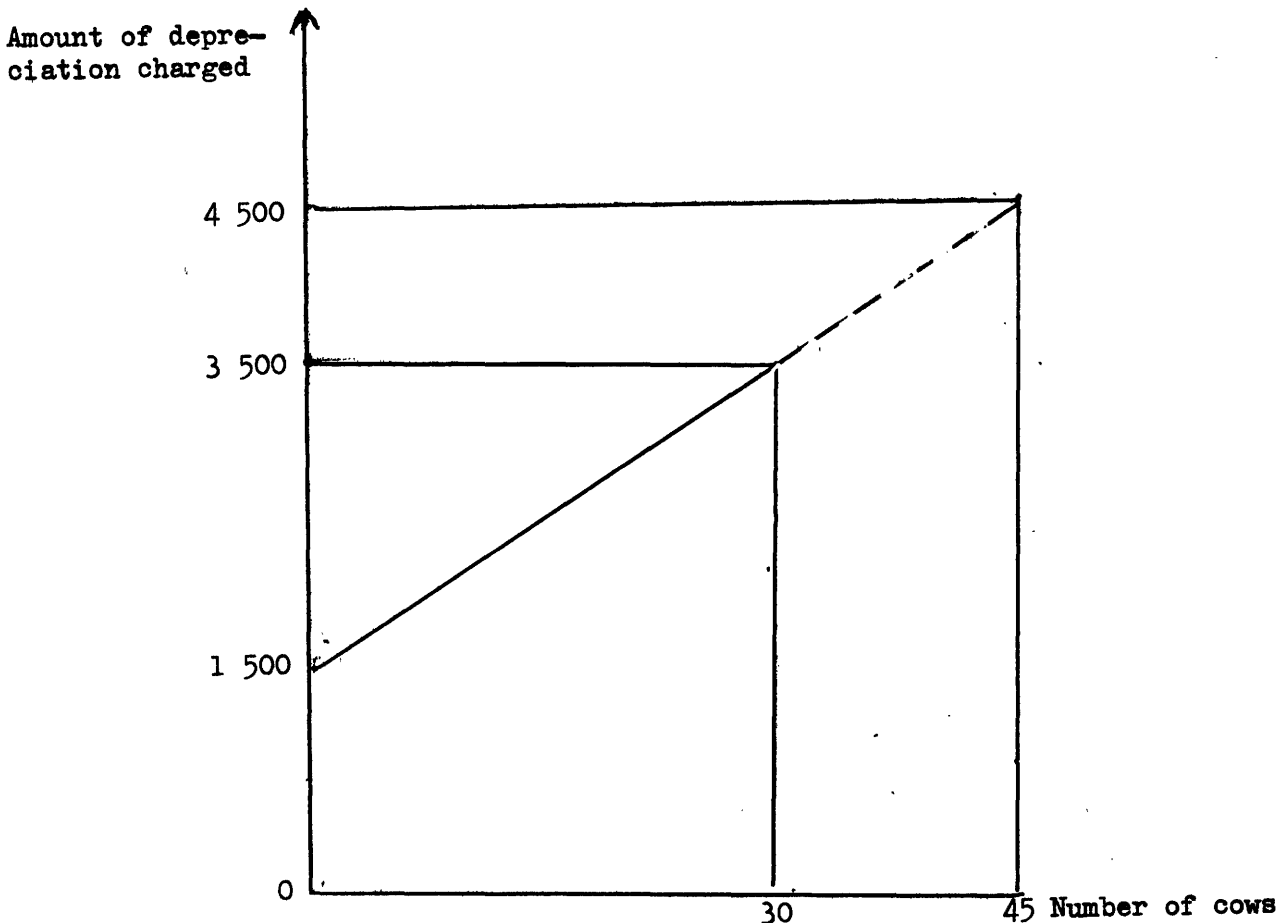
1. Assumption common to all models

Farm machinery is partly related to the farm structure expressed in terms of the area/full-time labour ratio. Thus for :

- Traction : One worker has a 60 H.P. tractor at his disposal.
Two workers have one 60 H.P. tractor and one 45 H.P. tractor at their disposal.
Three workers are the sum of two workers (two tractors) and one cow herd.

- Cow shed : All farm structures have a cow shed the capacity of which will be given for each model.

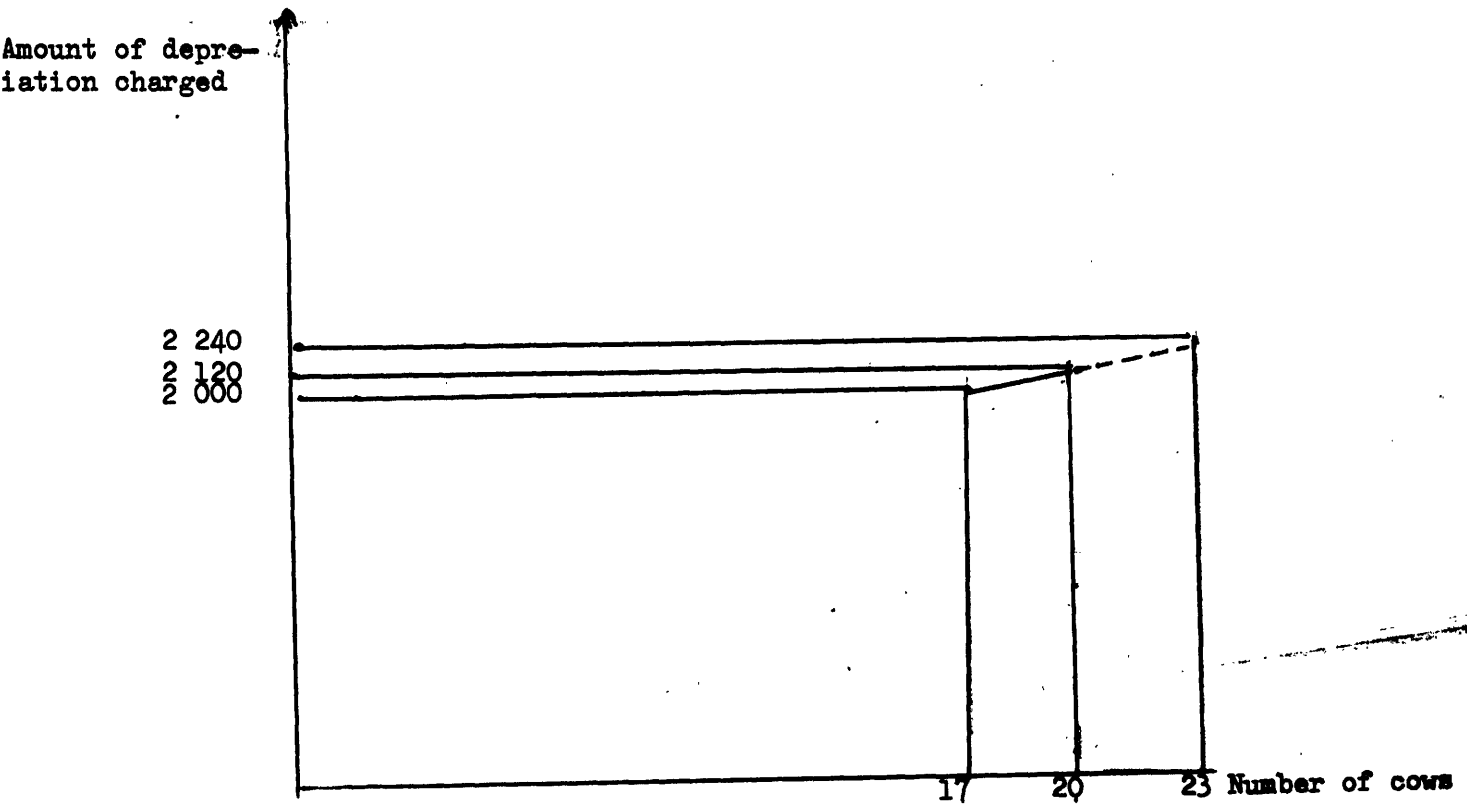
In the case of a new cow shed the charge to depreciation is treated partly as a fixed charge and partly in proportion to the area of the shed which is actually used. The method adopted consists in taking a fixed charge equal to 1/3rd of the total cost of depreciation when the cow shed is used to full capacity.



Example : If the accounting charge to depreciation of a cow shed with a capacity of 45 cows is 4,500 U.A. and the cow shed actually houses 30 cows, the charge taken into account will be 1,500 U.A. $(\frac{4,500}{45})$ (fixed charge) plus 2,000 U.A. $(\frac{4,500 - 1,500}{45} \times 30)$ i.e. a total of 3,500 U.A.

If the cow shed is an old one the charge to depreciation is considered a fixed charge only; there is an additional charge in proportion to the number of spaces only for that of the shed which would result from a new extension.

Example : If the accounting charge to depreciation of a cow shed with a capacity of 17 cows is 2,000 U.A. and the cow shed actually houses 20 cows after the extension (with room for 6 more), the charge taken into account will be the total of 2,000 U.A. (fixed charge) plus 120 U.A. corresponding to the depreciation on the additional spaces (3 x 40 U.A.) i.e. a total of 2,120 U.A.



- other equipment : unless the work is done on contract, the main items of highcost equipment (combine harvester, beet harvester) are purchased strictly according to need, in single numbers.

- raw food which can be produced on the farm may not be purchased.

2. Assumptions for the ALBION model

Crop extension limits :

Rotated crops are subject to upper limits expressed as a percentage of arable land:

Beets	25 %
Oats	25 %
Potatoes	20 %
Legumes (peas, beans)	20 %
Cereals	66 %
Fodder crops	50 %
Crucifers	25 %

Equipment :

Three types of shedding are set out, with a respective capacity of 45, 60 and 80 milking cows, it being possible to extend the shedding to accomodate 55, 80 and 100 cows respectively. Generally shedding for 45 to 55 milking cows is assumed for small and medium farms with few workers (20 hectares - 1 MWU, 20 hectares - 2 MWU, 40 hectares - 1 MWU), cow sheds with greater capacity being reserved for the larger farms.

Work and outside services :

Recrutement of casual labour and work on contract are not allowed for save where potatoes are concerned (possible employment of 30 hours of casual labour per hectare).

Inter-relationship of cereal and animal production :

Purchases of straw are possible. Temporary pasture may be sown directly or under cereals.

PIGS :

Breeding and fattening are the operations considered.

3. Assumption for the ERIN model

Crop extension limits.

Grassland accounts for at least 60 % of the usable agricultural area. Beet is limited to 33 % of arable land, as also is wheat.

COW SHEDS :

There are two types of shed : One with a capacity of 45 cows with the possibility of extension to accommodate 30 additional animals. This is reserved for small and medium farms. The other is for larger farms and has a capacity of 90 cows, which can be increased to 120 cows.

WORK ON CONTRACT :

Work on contract is widely used for all crops.

Inter-relationship of cereal and animal production:

Purchases of straw are possible. Undersowings of pasture on ground already used for cereals are made every six years

HAY :

The hay necessary for livestock feeding is bought.

PIGS :

Breeding and fattening are the operations considered.

SHEEP :

Allowance is made for sheep-farming without upper limit to the exclusion of cattle-breeding; it may be combined with pig-breeding.

4. Assumptions for the FUNEN model

Crop extension limits.

Permanent pasture covers between 10 % and 50 % of the usable agricultural area. Rotation crop extension limits are expressed as percentages of arable land : Fodder crops 50 %, sugar beet 25 %, rape-seed 15 %, undersown ray-grass 15 %, beet 33 %, winter cereals 20 %, oats 15 %, all cereals 75 %, grain fodder crops 12 %.

COW SHEDS :

The maximum cow shed capacity is 45 cows in all farms other than the 80 hectare/3 worker ones for which the capacity is a minimum of 60 and a maximum of 70 cows.

CASUAL LABOUR :

This is possible for harvesting cereals and for harvesting and singling beet. It is restricted for these categories of work to 80, 160 and 280 hours respectively per full-time farm worker.

WORK ON CONTRACT :

Provision is made for this for specific tasks (sprayings, dressings, etc.)

Inter-relationship of cereal and animal production :

No provision is made for purchasing straw. Ray-grass is undersown every two years.

P I G S :

The number of breeder sows is restricted to 20 on the 20 hectares/1 worker farm, to 35 on the 20 hectares/2 worker farm and to 50 on the 40 hectares/2 workers farms.

5. Assumption for the BAYERN model

Crop extension limits :

Permanent pasture covers at least 20 % of the usable agricultural area.

a) - Agronomic limits

Rotation crop extension limits are expressed as percentage of arable land.

Cereals	75 %
Potatoes	33 %
Beet	25 %
Maize	50 %
Clover	25 %
Rape-seed	20 %
Rape-seed and beet	33 %
Field beans	25 %
Oats	25 %
Barley and winter barley	33 %
Winter wheat and spring wheat	40 %

b) - Market's Limits (contingents)

Beet 15 % of arable land

Potatoes 40 % of arable land

Equipment

For the 20 hectares/1 MWU, 20 hectares/2 MWU and 40 hectares/1 MWU it is assumed that there is existing shedding.

for 17 cows with the possibility of an extension to provide an additional six spaces (maximum capacity 23 cows).

for the 40 hectares/2 MWU farm there is existing capacity for 24 cows with a possible extension to give a capacity for 32 cows.

for the 80 hectares/2 MWU farm the existing capacity is for 35 cows with a possible extension to give a capacity for 45 cows.

for the 80 hectares/3 MWU farm there is capacity for 80 cows.

Casual Labour :

This is possible for hoeing and harvesting beet, harvesting potatoes and harvesting maize heads.

Inter-relation of cereal and animal production :

Clover is sown on ground already used for cereals.

Pigs :

The number of breeder sows is restricted to 28 on the 20 hectares/1 MWU farm, to 100 on the 20 hectares/2 MWU farm and to 40 on the 40 hectares/2 MWU farm.

III. INTERROGATION OF MODELS

Interrogation of the models is directed to establishing the results of

- price movements which have been ascertained or projected in products and/or the cost of production factors.

- differentiation in the size and other factors affecting the farms.

The differentiation relates to the choice of the area of the farm, full-time labour capacity, the type of shedding for milking cows, high-cost equipment and a minimum and/or maximum number of dairy cows. Results can be obtained for any combination of these different parameters so long as it is remembered that the equipment and buildings are in whole numbers and limited to certain types and that the choice of equipment must be in harmony both with land resources and available labour and with the general policy of the farm. "Second-string" types corresponding to possible combinations of the main factors of land and labour are proposed with the general matrix of the models.

- variations in actual production yields.

Variations in cultivation techniques and animal-husbandry practices would necessitate either correction of certain coefficients of the model or introducing new activities, or partly setting up a fresh models.

IV - REFERENCE TO ACTUAL PRICES

As used at present, the models are subject to a type of interrogation which consists in measuring the effect of variations in the prices of all products and production factors over a given period of reference. The preparation of such interrogation involves modifications in price data depending on actual economic circumstances or according to special variation indices for each product and each production factor. According to the model, the procedure which is followed reveals features which are bound up with the nature and coding of different activities and limits thereon.

V - EXAMINATION AND STUDY OF RESULTS

1. Examination

In order to facilitate examination of the results in accordance with a table showing the main accounting results (products, expenses and income) and the essential factors determining productions systems (soil utilisation, choice of animal production, composition of farm capital, number of workers and how employed), an examination appendix is provided for each model.

Thanks to a number of accounting operations and to the definition of expenses the results in actual terms are obtained directly in the solution or after elementary calculations. The data for production systems are indicated either by the figure given for certain activities (e.g. crop production) or by the figure for certain variables (e.g. working hours not used) or by a total at the level of the equations for calculation (e.g. man-hours for casual labour).

2. Study

After examination, satisfactory interpretation of the results necessitates

- good knowledge of the main features of the systems (potentiality and capacity) which are contained both in the basic data the assumptions of calculation,
- using the results expressed in physical values in the primal solution of the model,
- interpretation of the monetary values of the dual solution

For each model we present a study table in which knowledge of these different elements is used for a coherent explanation and economic interpretation of the results.

A L B I O N M O D E L

The features of the ALBION model are a wide range of crops and animals which offer, for the most part, relatively high productivity of land and labour. This can result in intensive and relatively complex systems depending on the structure of farm, with a predominance of milk production (annual yield per cow : 400 litres), potatoes (yield 300 qx/hectare) beans (yield of 27 to 28 qx/hectare) and barley (40 qx/hectare).

A - ANIMAL PRODUCTION

The dairy herd is foddered from the temporary pasture which is restricted to 50 % of the useful agricultural area and from the permanent pasture the area of which is not subject to any limit. There are four winter variants of feed, two of which are based on grass hay and two on grass silage. The summer feed comes exclusively from pasturing which is carried on more or less intensively with three methods of using the herbage (exclusive pasturing - pasturing and hay - pasturing and ensilage).

- a) After finding the number of animals, the type and amount of fodder production, it is useful to check the relationship between the number of cattle expressed in bovine units and the pasture area used. This ratio is fairly high and should be greater than one bovine unit per acre for most farms.
- b) The size of the dairy herd may be explained by the following factors limiting its size :
 - either the fodder resources, especially on small farms,
 - or the shed capacity. It will be recalled that these are of 6 different types depending on the particular farm:

- . shed with a capacity of 45 cows or more (up to 55 cows) on small and medium farms with few workers (20 hectares/1 MWU. 20 hectares/ 2 MWU. 40 hectares/1 MWU).
- . shed with a capacity of 60 cows, or 80 cows, and with a capacity of more than 60 (up to 80 cows) or more than 80 (up to 100 cows) on larger farms.
- . or by the available full-time labour, where labour is scarce (40 hectares/1 MWU, 80 hectares/ 2 MWU).

To find the cost of feed it is useful to establish the dual purchase values : of hay (unit : quintal), of silage (unit : quintal) and of grass (unit : bovine unit).

B/ CROPS

Subject to the following agronomic limitations expressed as a percentage of arable land : best 25 %, cabs 25 %, crucifers 25 %, they are grown on a rotation system of the extensive type based on cereals on farms with few workers or intensive based on potatoes and beans where there is more labour.

However, it should be noted that best production, the actual yields of which are average, is difficult to include in a rotation system under the yield and price conditions appertaining in Autumn 1973.

The sum up, there appears to be fairly open competition between crops and animals; livestock farming is directly connected with the more or less high profitability of animals, which depends basically on the milk yield, the prices of milk and meat (cf. basic data) and the cost of feed (cf. dual solution.

The share taken by crops is connected with the productivity of the less frequent factors such as labour, which favours cereals and oilseeds on farms with few hands, and the land itself, which favours potatoes and beans where more labour is available.

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ERIN MODEL

The study deals mainly with animals, the importance of which is due to the fact that at least 60 % of the useful agricultural area is given over to grass crops. The explanation for this relative importance of animals in the production system will be found in examining the results.

A/ ANIMALS

The number of livestock is limited by the particular production factors :

- by the fodder resources themselves. The extension of this beyond the minimum of 60 % of the useful agricultural area may in effect be thwarted by the planting of crops which are relatively more profitable than milk or meat. These crops are sugar beet, wheat, barley and possibly turnips for sheep.
- by full-time labour available, this will affect farms with few workers.
- by the shedding capacity : on this point it should be remembered that the farms for which figures are given are of three types :

- type 1 : maximum 45 milking cows for farms of
20 hectares (1 or 2 MWU) or 40 hectares (1 MWU)
- type 2 : maximum capacity 75 milking cows generally taken
for farms of 40 hectares (2 MWU) or 80 hectares (2 MWU)
- type 3 : maximum capacity 120 milking cows for farms
of 80 hectares (3 MWU).

- by competing livestock such as pigs or sheep.

Pig production may be allowed at a maximum of 1,000 pigs per year.

The competition of the feed for dairy cows varies very little; there is only one type of fodder consisting of grass silage with the possible substitution of ensiled beet tops.

In summer the animals are on grass which may be used either as permanent grazing, or as part grazing with an additional harvest of 200 quintal of silage, or further as part grazing with a harvest of 350 quintals of silage. If account is taken of the annual milk yield per cow, which is 3,045 liters, and of the conditions for feed, it will be found that dairy farming is conducted in an extensive way. This explains the relatively important contribution of sugar beet and wheat.

The exchange values of feeds are to be found in the dual solution for hay and silage expressed in quintal.

B/ C R O P S

Crops are generally grown on a three-year rotation system (beet, wheat, barley), wheat and beet both being limited to 33 % of the arable land. Barley is grown therefore on at least 33 % of the arable land and perhaps covers more than this minimum only on farm which have a relatively small full-time labour force (e.g.: 40 hectares/1 MWU, 80 hectares/2 MWU). Where the option to include crops exists for a farm, they are included to the optimum level, particularly when sugar beet forms part the rotation.

C/ L A B O U R

In spite of the widespread use of contract labour for harvesting cereals and beet, the ERIN model shows a rather low intensivity of utilisation of the labour force. This depends on a rather rough (and probably not so accurate) estimation of demand for labour which is not directly concerned with production (upkeep of land, machinery and buildings). It was evaluated at an average of 15 hours per hectare which is relatively heavier than those observed in the other models. Therefore one should not draw any firm conclusion from such a comparison of the use of labour.

The time spent on upkeep and maintenance is a residual after labour has been utilised for productive purpose. If the labour has been utilised for productive purpose. If the labour is scarce, then it is usually upkeep and maintenance that goes by default.

To sum up the most noticeable features of the results are :

- a necessarily large herd of cattle, the size of which varies according to the relative scarceness of resources of fodder, labour, equipment or competing animals, these four factors themselves being bound up with the structure of the farm.
- the simplicity of crop rotation, which tends towards a three-year system.
- the week average intensity of production systems due to the moderate intensity of animal production and the limited choice of crops.

F U N E N M O D E L

Study of the results centres on cattle breeding and in particular on dairy farming.

A/ ANIMAL HUSBANDRY

We shall establish whether the shedding capacities for the dairy herd are fully or partly used; the profit from dairy farming depends exactly on the extent to which this capacity is used.

However, the explanation for the size of the dairy herd may be found not only in the relationship between the production cost of dairy products and other products (economic aspect) but also in the number of full-time farm hands available (structural aspect), fodder consumption, yields of fodder crops and dairy cows (technical level), the cost of purchased feed and depreciation on shedding (elements of the cost of production).

Particular attention must be paid to labour and fodder consumption.

- a) So far as labour involved in dairy farming is concerned, it should be remembered that the labour requirements of one cow are 57.6 hours, of which 43.6 hours are outside the period in the case of shedding with a capacity of 45 cows; generally, that is to say, one man is fully occupied in working in a shed for 40 cows, excluding tasks connected with growing and harvesting fodder.
- b) Fodder consumption : The animal's fodder depends on a minimum permanent pasture area equivalent to 10 % of the useful agricultural area, availability of by-products from sugar beet and the inclusion of fodder beet in the rotation system.

There are two winter feeds, one based on fodder beet and pulp and the other on grass silage. It is interesting to evaluate the advantages, according to the different farms, of growing sugar beet or ray-grass for silage in the winter feed. Likewise, special attention should be given to the comparative costs of fodder units to be found in the dual solution for the pulp, crops and grass.

First, for example, an average (or low) cost for these fodder units would show that the production cost of basic feed is low thanks especially to the productivity of the fodder areas. A relatively low cost for the fodder unit represented by beet tops and pulp with respect to the cost of the unit represented by pasture would show that dairy farming is supported by the cultivation of beet.

The results for meat production will be evaluated on the footing that male animals born in the shed can be used in three ways : as 8 months, 11 months or 15 months bullocks, whereas female animals are used for reproduction or sold at 8 days for surplus.

Pigs are suitable for farms where labour is relatively plentiful. However their intrinsic value is shown by the difference between the actual numbers kept and the maximum permitted by the capacity of the piggery. It should be remembered that a maximum of 20 sows is allowed for in a farm of 20 hectares/ 1 MWU, 35 sows in a farm of 20 hectares/ 2 MWU and 50 sows on a farm of 40 hectares/ 2 MWU. The closer the number of animals kept comes to the maximum capacity, the more profitable the pigs will be.

B/ C R O P S

- B E E T

The importance of sugar beet is shown by the extent of the maximum area cultivated under this crop (25 % on arable land). Intensive beet production competes, to a small extent, with dairy farming for the use of full-time labour as casual labour can be used for thinning and harvesting beet. On the other hand, beet is complementary to dairy farming in that the by-products, tops and pulp can be used for animal feed. In this connection it is interesting to note that the tops and pulp may be wholly consumed, in without case there is a dual value : Fodder beet and pulp : beet tops. If they are only partly consumed, there is a divergent variable on the same lines indicating the unused surplus.

In the first case, sugar beet and dairy farming are to a large extent complementary. The opportunity for using by-products is shown by the value of the fodder unit given in the dual solution.

In the second case, the complementary relationship is not so strong; certain by-products are no longer used and this amount is shown in fodder units in the primal solution.

- Other crops

The limits on rotated crops expressed as a percentage of arable land should be borne in mind when considering the relative importance of extensive crops (cereals, oil seeds and fodder crops) thus fodder

crops occupy a maximum of 50 % of this land, rape seed 15 %, undersown ray-grass 15 %, winter cereals 20 %, oats 15 %, all cereals 75 % and grain fodder crops 12 %. The barley acreage is not limited by agromomic factors. Purchases of barley are freely allowed.

It will be noted that crops with a small gross output and requiring little labour (grain crops and oil seeds) tend to be farmed only in areas where little labour is available and land is left free of fodder crops necessary for animals, beet and wheat.

To sum up, the profitability of dairy farming and beet and the complementary relationship between meat and dairy products must be closely scrutinised to understand the balance between the different types of farming. The relative decline of these types of farming may be explained by the relative scarcity of labour. On the other hand, pig-farming, where it is permitted, may be either a competing activity (high profitability) or a complementary activity (underemployment of labour) with other types of farming.

B A Y E R N M O D E L

As a rule, mixed system afford the optimum economic return, sometimes with animals predominating when labour is relatively plentiful (more than 150 hours per hectoare), sometimes with crops predominating (120 to 150 hours per hectare). The reason for this is the disparity in labour productivity, which is to the advantage of crops (especially cereals) and to the disadvantage of animal farming (meat and milk). When the results are studied this general tendency should be borne in mind when seeking an explanation for the rotation of non-fodder crops and fodder crops, and the size and composition of herds.

A/ C R O P S

The proportion of non-fodder crops in the rotation system depends on the rotation limits (the crops which are affected will be noted in the breakdown) and the relative importance of the different products farmed. When a maximum agronomic limit relating to one crop is reached (e.g. equation maximum for potatoes) it will be seen that the dual variable attached to this limit gives the "safety margin" expressed in relation to the hectare from which the gross output of the crop may diminish without the optimum solution being affected.

The choice of fodder crops results from the requirements for cattle feed which, it will be remembered, has two variations in winter : one based on grass silage and hay, the other on fodder maize and hay. In view of the need to include 20 % permanent pasture in the useful agricultural area, the relative shares of clover, fodder maize and pasture must be studied. Fodder maize only appears when maize silage is more economical than clover silage. Clover appears if the number on animals is such that more hay is required than would be produced by the minimum of 20 % permanent pasture in the useful agricultural area and also if the extension of clover is economically superior to that of grass.

B/ ANIMAL PRODUCTIONS

So far dairy farming is concerned, the size of the herd depends on the available labour and the shedding capacity, which is as follows :

- 17 to 23 cows for farms of 20 hectares and 40 hectares/1 MWU
- 24 to 32 cows for farms of 40 hectares/2 MWU
- 35 to 45 cows for farms of 80 hectares/2 MWU
- and 80 cows for farms of 80 hectares/3 MWU.

The dual solution at the level of equations will give the domestic disposal costs relating respectively to hay (starch value), grass silage (starch value) and maize-fodder silage (starch value) which may be compared with the price of the starch unit represented by barley (approximately 700 grams).

The importance of meat is shown by the number of calves sold.

There are four types :

- milk calves
- calves of 70 kg
- 18 months calves
- 21 months calves

There is competition between these different types of animals and dairy farming, both for the available fodder and labour resources. A solution without animals reared for meat may reflect insufficient use of fodder land or of labour or both. For example, the choice of selling calves at birth where there is under-employment of labour shows that the opportunity to use labour to fatten cattle is negative, which comes down to losing money and is equivalent to reducing the number of cows in order to make meat; it would be better to leave the labour under-employed.

The use of surplus labour may be studied economically for pig farming the extension of which is normally allowed for as follows :

- 280 pigs for a farm of 20 hectares/1 MWU
- 400 pigs in a farm of 40 hectares/1 MWU
- and without limit on capacity in farms of 40 hectares/2 MWU.

A N N E X A

SYSTEMATIC INTERROGATIONS OF THE

ALBION, ERIN, FUNEN AND BAYERN

MODELS FOR DIFFERENT TYPES OF FARM

=====

INTERROGATIONS OF THE ALBION MODELS

Mixed crop and cattle farming
Prices (Autumn 1973)

listing number	02201	02202	02401	02402	6V402	02802	02803
... A.A. (ha)	20	20	40	40	40	80	80
... W.U.	1	2	1	2	2	2	3
* ECONOMIC RESULTS							
... total gross output	8 615	9 532	12 621	19 064	17 553	25 270	34 600
... gross output on crops	1 139	879	6 372	1 759	-	12 447	4 555
... gross output on livestock	7 476	8 652	6 249	17 305	17 553	12 823	30 045
... partial costs	3 333	4 128	4 032	8 228	7 300	7 995	13 325
... gross farm income	5 282	5 403	8 590	10 835	10 253	17 275	21 275
... purchases of goods and services	3 980	4 977	4 870	11 690	11 390	9 664	18 304
... net farm income	4 635	4 554	7 752	7 373	6 163	15 606	16 296
... purchased animal feed)	(1 482)	(2 249)	(934)	(4 498)	(3 595)	(1 838)	(6 026)
... rent	600	600	1 200	1 200	1 200	2 400	2 400
... interest on farm capital	579	700	571	1 902	2 064	11 174	2 975
... casual labour wages	-	-	-	-	-	-	-
... full-time labour wages	<u>3 456</u>	<u>3 254</u>	<u>5 981</u>	<u>4 271</u>	<u>2 900</u>	<u>12 032</u>	<u>10 921</u>
... labour income/MWU available	3 456	1 627	5 981	2 135	1 450	6 016	3 640
... wages of a full-time worker	1 805	1 805	1 805	1 805	1 805	1 805	1 805
1.- PRODUCTION SYSTEM							
... full-time labour (h)	2 300	4 600	2 300	4 600	4 600	4 600	6 900
... casual labour (h)	-	-	-	-	-	-	-
... labour efficiency (1)	1	0,58	1	0,91	0,77	1	0,91
... livestock	8 089	9 289	6 779	18 577	18 843	14 465	32 465
... head stock	1 203	1 898	1 611	13 028	16 132	2 984	16 694
... circulating capital	2 290	2 788	3 035	6 445	6 300	6 032	10 352
... farm capital	11 582	13 975	11 425	38 050	41 275	23 481	59 511
<u>crop production - (ha)</u>							
... oats	-	-	-	-	-	-	-
... sugar beets	-	-	-	-	-	-	-
... wheat	-	-	17,00	-	-	22,70	-
... spring barley	5,26	4,05	5,80	8,11	13,36	11,90	21,01
... winter barley	-	-	-	-	-	-	-
... beans	3,50	2,70	8,00	5,40	-	16,00	14,00
... dried peas	-	-	-	-	-	-	-
... potatoes	-	-	-	-	-	-	-
... permanent pasture	2,48	6,48	-	13,00	13,26	-	9,96

+ Showing inter-relationships between available and utilised labour
+Maximum possible

Hay for sale	-	-	-	-	-	-	-
Ray-grass for grazing and hay	1,55	1,81	1,30	3,62	3,67	2,51	6,24
Ray grass for silage and grazing	3,70	2,24	1,40	4,49	9,70*	7,41	14,80
Ray-grass for April silage	-	-	-	-	-	-	-
Ray-grass for grazing	-	1,10	-	-	-	1,94	-
Ray-grass direct sowing for pasture	3,07	-	3,34	-	-	7,53	-
Ray-grass direct sowing for silage	0,43	2,70	-	5,40	-	-	1,96
Ray-grass direct sowing for hay	-	-	-	-	-	-	-
<u>Livestock production (no)</u>							
Dairy cows	24,74	29,6	20,46	59,15	60,00 ^o	39,49	100,00
Heifers	4,93	5,9	4,1	11,82	12,00	7,70	20,00
Calves (0-6 months)	4,20	12,30	1,70	24,64	25,00	3,30	20,2
Bullocks (12 months)	6,07	-	6,75	-	-	4,80	20,2
Beef (24 months)	-	-	-	-	-	8,11	-

^o Minimum set

INTERROGATIONS OF THE ALBION MODEL
Systems : Mixed crops, cattle and pigs
Price (Autumn 1973)

Listing N°	P2 201	P2 202	P2 402
U.A.A. (ha)	20	20	40
M.W.U. available annually	1	2	2
I.- ECONOMIC RESULTS (V)			
Total gross output	8 615	17 984	17 380
Gross output of crops	1 139	1 134	2 282
Gross output of livestock	7 476	16 850	15 097
Partial costs	3 333	10 616	6 731
Gross farm income	5 282	7 368	10 649
Purchases of goods and services	3 980	12 819	8 030
Net farm income	4 635	5 165	10 649
(Purchased animal feed)	(1 482)	(8 359)	(3 077)
Rent	600	600	1 200
Interest on farm capital	579	910	1 145
Casual Labour wages	-	-	-
Full-time labour incomes	3 456	3 655	7 005
Labour income/MHU available	3 456	1 827	3 502
Wages of a full-time worker	1 805	1 805	1 805
II - PRODUCTION SYSTEM			
Full-time labour (h)	2 300	4 600	4 600
Casual Labour (h)	-	-	-
Labour efficiency	1	1	1
Livestock	8 089	9 505	16 115
Dead stock	1 203	1 963	2 178
Circulating capital	2 290	6 710	4 615
Farm capital	11 582	18 178	22 908
Crop production (ha)			
Wheat	-	-	-
Barley	5,26	5,23	10,53
Beans	3,50	3,48	7,02
Potatoes	-	-	-
Ray-grass for hay and grazing	1,55	1,60	2,41
Ray-grass for silage and grazing	3,70	3,62	8,12
Ray grass direct sowing for pasture	3,07	2,72	8,12
Ray grass direct sowing for silage	0,43	0,77	6,36
Permanent pasture	2,48	2,55	4,90
Livestock production			
Dairy cows	24,74	26,30	48,50
Heifers	4,93	5,25	9,7
Bullecks (6 months)	4,20	10,90	4,04
Bullecks (12 months)	6,07	-	16,00
Sows	-	26,95	0,82
Bears	-	1,08	-
Fattening pigs	-	421,00	12,77

* Maximum possible

A L B I O N M O D E L

I - PRODUCTION POLICY

1. Choice of lines of production.

The farms show a mixed tendency towards animal production and especially towards milk production. The size of the dairy herd is limited :

- either by the fodder available (20 hectares/1 MWU, 20 hectares/2 MWU and 40 hectares/2 MWU.
- or by the man power available (40 hectares/1 MWU and 80 hectares/2 MWU)
- or by the limitation of cow shed capacity to 100 cows (80 hectares/3 MWU).

In farm 6V402, the minimum number of cows has been taken at 60, which involves elimination of beans and reorganisation of fodder rotation.

Farms of this type have a very high cattle density per hectare, i.e. about 3 bovine units or an average annual allotment of 1 acre for 1.2 bovine units.

Crop production other than grasses consists mainly of barley, beans and wheat. This last crop appears basically on medium and large farms, especially where the labour force is small. Beet is absent because of its low yield and potatoes because they require too much labour.

2. Gross output of land

The gross output of the land is more or less the same on all the farms, between 750 and 1 150 u.a. per hectare (£ 310-E 480) a little higher on the small farms). This is in keeping with general production policy which is more or less constant with every type of farm involved.

GROSS OUTPUT/HECTARE (U.A.)

20ha/1MWU	20ha/2MWU	40ha/1MWU	40ha/2MWU	40ha/2MWU	80ha/2MWU	80ha/3MWU
1 033	1 144	757	1 144	1 053	758	1 038

II - ECONOMIC RESULTS

Gross output varies quite widely according to the amount of manpower used.

Output is :

- poor, about 3,840 u.a./MWU (£1,600/MWU) on 20 ha/2 MWU farms;
- low, about 5,000 u.a./MWU (£2,100/MWU) on 40 ha/2 MWU farms;
- average, about 8,400 u.a./MWU (£3,500/MWU on 20ha/1 MWU and 80 ha/3 MWU farms;
- high, about 14,400 u.a./MWU (£6,000/MWU) on 40 ha/1 MWU and 80 ha/2 MWU farms.

INCOME/FULL-TIME WORKER (u.a.)

20ha/1MWU	20ha/2MWU	40ha/1MWU	40ha/2MWU	40ha/2MWU	80ha/2MWU	80ha/3MWU
8,295	3,905	14,354	5,124	3,480	14,438	8,376

It is observed that dairy specialisation on 40 hectares (60 dairy cattle) gives a poorer economic result than mixed farming with beans. Gross output falls overall by £ 1,500 and full-time labour income by £1,370.

The introduction of pig-breeding has the effect of reducing under-employment of manpower on the 20 ha/2 MWU farm and consequently of increasing earned income by 480 u.a.

INTERROGATIONS OF THE ERIN MODEL
Systems : Mixed cropping, cattle
Price (Autumn 1973)

Listing N°	02 201	02 202	02 401	02 402	02 802	02 803
U. A. A. (ha)	20	20	40	40	80	80
M. W. U. available annually	1	2	1	2	2	3
I - ECONOMIC RESULTS (K)						
Total gross output	6 287	6 287	8 061	12 509	16 467	25 011
Gross output of crops	1 773	1 773	3 441	3 549	7 084	7 091
Gross output of livestock	4 514	4 514	4 620	8 960	9 383	17 921
Partial costs	2 670	2 689	3 357	5 312	6 844	10 589
Gross farm income	3 617	3 598	4 704	7 197	9 623	14 431
Purchases of goods and services	3 433	3 677	4 135	6 594	8 167	16 997
Net farm income	2 854	2 610	3 926	5 915	8 300	8 022
(Purchased animal feed)	(821)	(821)	(505)	(1 625)	(1 026)	(3 251)
Rent	500	500	1 000	1 000	2 000	2 000
Interest on farm capital	837	888	1 017	1 320	1 701	2 250
Casual labour wages	-	-	-	-	-	-
Full-time labour income	1 517	1 222	1 909	3 595	4 599	3 772
Labour income/MWU available	1 517	561	1 909	1 797	2 299	1 257
Wages of a fulltime worker	1 300	1 300	1 300	1 300	1 300	1 300
II - PRODUCTION SYSTEM						
Full-time labour (h)	2 300	4 600	2 300	4 600	4 600	6 900
Casual labour (h)	-	-	-	-	-	-
Labour efficiency	0,76	0,38	1	0,73	1	0,85
Livestock	6 984	6 984	9 971	13 910	20 250	27 821
Dead Stock	7 800	8 700	7 800	8 700	8 700	7 675
Circulating capital	1 966	2 090	2 567	3 797	5 083	9 500
Farm capital	16 750	17 774	20 338	26 407	34 033	44 996
- Crop Production (ha)						
Wheat	2 64*	2 64*	5 30*	5 28*	10 60*	10 56
Barley	2 72	2 72	7 70	5 44	13 60	10 88
Beets	2 64*	2 64*	3 00	5 28*	7 85*	10 56
Pasture April and silage	0 61	0 61		1 29	10 4	2 57
Pasturage and silage	5 04°	5 04°	5 50°	9 92°	- °	19 85
Permanent Pasture	6 34	6 34	18 50	12 78	37 57	25 57
- Livestock production						
Dairy cows	22 75	22 75	13 40	45 *	27*	90*
Heifers	5 30	5 30	3 10	10 5	6 3	21
Beef (30 months)	-	-	29 60	-	60 0	1

* Maximum possible

° set minimum

INTERROGATIONS OF THE ERIN MODEL

systems : Mixed cropping, cattle and pigs : mixed cropping and sheep - Prices Autumn 1973.

Listing No	PV 201	PV 202	P 2402	B 2402	MP 402
U.A.A. (ha)	20	20	20	20	20
M.W.U. available annually	1	2	2	2	2
I - ECONOMIC RESULTS (V)					
Total gross output	9 402	22 305	18 835	6 378	15 558
Gross output of crops	1 773	1 773	3 714	2 402	2 436
Gross output of livestock	7 621	20 532	15 121	3 976	13 122
Partials costs	5 164	15 508	10 375	2 162	9 518
Gross farm income	4 238	6 797	8 460	4 216	6 040
Purchases of goods and services	6 240	18 108	12 293	2 699	10 982
Net farm income	3 161	4 195	6 541	3 678	4 578
(Purchased animal fee)	(3 094)	(2 511)	(6 241)	(50)	(6 742)
Rent	500	500	1 000	1 000	1 000
Interest on farm capital	926	1 346	1 500	395	662
Casual labour charges	-	-	-	-	-
Full-time labour income	735	2 351	4 042	2 283	2 914
Labour income/MWU available	1 735	1 175	2 021	1 141	1 457
Wages of a full-time worker	1 300	1 300	1 300	1 300	1 300
II - PRODUCTION SYSTEM					
Full-time labour (h)	2 300	4 600	4 600	4 600	4 600
Casual labour (h)	-	-	-	-	-
Labour efficiency	1	1	1	0,65	1
Livestock	7 361	8 924	14 676	4 240	5 450
Dead stock	7 799	8 700	8 700	1 800	1 800
Circulating capital	3 370	9 304	6 646	1 850	5 991
Farm capital	18 530	26 928	30 022	7 890	13 241
- Crop production (ha)					
Wheat	2 64*	2 64 *	5 28 *	5,28 *	5 28 *
Barley	2 72	2 72	5 44	5 44	5 44
Beets	2 64 *	2 64 *	5 28 *	0 89 *	1 00
Feed roots (swedes)	-	-	-	4 39 *	4 28
Pasture and silage	5 04 } °	5 04 } °	9 92 } °	-	-
Pasture April and silage	0 62	0 62	1 29	-	0 1 °
Permanent pasture	6 34 } °	6 34 } °	12 78 } °	24 00 °	23 9 °
- Livestock production					
Dairy cows	22 75	22 75	45 *	-	-
Heifers	5 30	5 30	10 5	-	-
Sows	6 35	32 65	12 9	-	18 70
Fattening pigs	104	539	213	-	309
Ewes	-	-	-	219	214
Rams	-	-	-	6 6	6,4
Lamb sales	-	-	-	307	300
Beef (30 months)	-	-	-	2 75	3 71

* Maximum possible

° Set Minimum

ERIN MODEL

I - PRODUCTION POLICY :

1. Choice of lines of production

The chief features of production are pasture and dairy farming Grassland still accounts for a minimum of 60 % of usable farmland. **Beet, wheat and barley are rotated every 3 years on the land not used for pasture.**

Dairy production is being developed to the maximum allowed by fodder resources on 20 ha/1 MWU and 20 ha/2 MWU farms, by labour resources on 40 ha/1 MWU farms and by cowshed capacity on other farms.

2. Gross output of land.

The average gross output of land varies between 500 and 750 u.a./ha (£200 to £300).

GROSS OUTPUT/HA (u.a.)

20ha-1MWU	20ha-2MWU	40ha-1MWU	40ha-2MWU	80ha-2MWU	80ha-3MWU
754	754	493	751	500	751

II - ECONOMIC RESULTS

Net labour productivity (income/MWU) is high on the 40 ha/1 MWU and 80 ha/2 MWU farms where labour is fully employed. On the other hand, the 20 ha/2 MWU farm, where there is a considerable under-employment, has an income per worker more or less equal to the wages of a farm labourer.

EARNED INCOME PER WORKER (u.a.)

20ha-1MWU	20ha-2MWU	40ha-1MWU	40ha-2MWU	80ha-2MWU	80ha-3MWU
3641	1346	4831	4131	5671	3017

With the introduction of pig production, efficiency and net productivity of labour improves. The effect is particularly noticeable in the 20ha/2 MWU farms where the earned income almost doubles. It should however be considered :

- that pigs would be an option only for a very small percentage of farmers with necessary skills.
- that the farmers who make a new investment in pig expansion may be very little better off cashwise if repayment of loans were deducted from the earned income.

Sheep-farming : the adoption of sheep-farming to the exclusion of other animals appreciably lowered the income level and efficiency of labour. The combination of sheep-farming/pig-breeding improves the situation but does not provide as high a return as do production systems which include cattle-breeding.

INTERROGATIONS OF THE FUNEN MODEL

Systems : Mixed cropping, cattle
Prices (Autumn 1973)

Listing N°	02201	02202	02401	02402	02802	02803
U. A. A. (ha)	20	20	40	40	80	80
M.W.U. available annually	1	2	1	2	2	3
I - ECONOMIC RESULTS DKR						
Total gross output	120 308	125 487	210 016	240 616	418 895	477 758
Gross output of crops	31 477	33 858	103 583	62 955	206 292	131 483
Gross output of livestock	88 831	91 628	106 433	177 662	212 603	346 275
Partial costs	44 905	49 442	73 029	89 304	145 092	176 232
Gross farm income	75 403	76 045	136 907	151 312	273 813	301 526
Purchase of goods and services	67 095	75 898	114 156	126 948	220 629	246 546
Net farm income	53 213	49 589	95 860	113 668	198 266	231 212
(Purchased animal feed)	(15 547)	(19 817)	(21 284)	(31 095)	(42 540)	(60 949)
Rent	13 400	13 400	26 800	26 800	47 300	47 300
Interest on farm capital	16 755	17 930	16 607	24 800	30 480	45 871
Casual labour	26	-	4 107	52	8 133	5 014
Full-time labour income	23 032	18 259	48 256	62 016	112 353	133 027
Labour income/MWU available	23 032	9 129	48 256	31 008	56 176	44 342
Wages of a full-time worker	30 000	30 000	30 000	30 000	30 000	30 000
II - PRODUCTION SYSTEM						
Full-time labour (h)	2 300	4 600	2 300	4 600	4 600	6 900
Casual labour (h)	1 54	-	242	3	478	294
Labour efficiency	0 75	0 39	0 86	0 75	0 87	0 87
Livestock	104 782	108 082	125 545	209 565	250 781	408 456
Dead stock	190 073	205 873	197 725	209 553	224 872	362 048
Circulating capital	40 247	44 650	70 480	76 874	133 965	146 923
Farm capital	335 102	350 605	393 750	495 992	609 618	917 427
- Crop production (ha)						
Wheat	1 17	1 90	7 2	2 33	12 80	4 68
Barley	3 95	3 39	3 75	7 90	7 50	15 28
Rape seed	-	-	4 22	-	10 10	-
Dactylis seeds	-	-	4 32 +	-	8 60 +	1 72
Sugar beets	4 50 +	4 50 +	9 00 +	9 00 +	18 00 +	18 00 +
Half-sugar beets	0 47	1 44	-	0 95	-	1 77
Ray-grass pasture 2 years	5 38	5 31	5 28	10 75	10 54	20 80
Ray-grass silage 2 years	2 53	1 46	2 22	5 06	4 43	9 75
Permanent pasture	2 00 °	2 00 °	4 00 °	4 00 °	8 00 °	8 00 °
- Livestock production						
Dairy cows	17 95	18 52	21.5	35 91	42 97	70 +
Heifers	7 36	7 6	8 82	14 73	17 6	20 7
Bullocks (8 months)	-	8 01	9 30	15 54	18 6	-
Bullocks (18 months)	7 77	-	-	-	-	-

+ Maximum possible

° Set minimum

INTERROGATIONS OF THE FUNEN MODEL

Systems : Mixed cropping - cattle
and pigs

Prices (Autumn 1973)

Listing n°	P2 201	P2 202	P2 402
U. A. A. (ha)	20	20	40
M. W. U. available annually			
I - ECONOMIC RESULTS DKR			
Net gross output	249 316	341 877	553 121
Gross output of crops	40 196	39 297	92 713
Gross output of livestock	209 120	302 579	460 408
Partial costs	139 315	206 222	318 836
Net farm income	110 001	135 655	234 285
Purchases of goods and services	185 947	274 911	418 836
Net farm income	63 359	66 966	134 285
Purchased animal feed)	(105 762)	(169 068)	(250 068)
Rent	13 400	13 400	26 800
Interest on farm capital	18 576	20 905	28 335
Casual labour wages	551	-	1 089
Full-time labour income	30 842	32 661	78 861
Labour income /MWU available	30 842	16 330	39 030
Wages of full-time worker	30 000	30 000	30 000
II - PRODUCTION SYSTEM			
Full-time labour (h)	2 300	4 600	4 600
Casual Labour (h)	32	-	64
Labour efficiency	0 94	0 57	0 94
Livestock	80 100	85 411	128 977
Dead stock	191 751	208 536	214 914
Circulating capital	99 673	144 155	222 820
Farm capital	371 524	418 102	566 711
- Crop production			
Wheat	3 6 *	3 6 *	7 20 *
Barley	4 31	6 6	9 05
Rape Seed	-	-	-
Dactylis seeds	0 27	-	4 32 *
Sugar beets	4 5 *	4 5 *	9
Half-sugar beets	-	0 03	-
Ray-grass pasture 2 years	3 39	2 07	4 05
Ray-grass silage 2 years	1 92	1 19	2 38
(Undersewn ray-grass)	(1 66)	(2 70)	(5 40)
Permanent pasture	2 00 °	2 00 °	4 00 °
- Livestock production			
Dairy cows	13 72	11 2	22 10
Heifers	5 63	4 6	9 07
Bullecks (8 months)	5 93	4 85	9 56
Bullecks (18 months)	-	-	-
Sows	20 00 *	35 00 *	49 70
Pigs for bacon	327 00	572	812 74

* Maximum possible

° Set minimum

F U N E N M O D E L

I - P R O D U C T I O N P O L I C Y

1. Choice of lines of production

On all the farms animal husbandry makes the biggest contribution to gross output; it consists mainly of dairy farming and to a lesser extent of the production of 8 months old calves.

Sugar beet is still produced to the maximum quota.

Cereals, dactylis (cocksfoot) seed and rape seed are particularly developed on farms where there is a relative shortage of manpower.

2. Gross output of land.

The gross output levels of the land are high and increase in proportion to the density of manpower; they vary from 600 u.a. on 80 ha/2 MWU farms to 837 u.a. on 20 ha/2 MWU farms.

20ha/1MWU	20ha/2MWU	40ha/1MWU	40ha/2MWU	80ha/2MWU	80ha/3MWU
802	837	700	802	698	796

GROSS OUTPUT/ ha (u.a.)

However, the range is not very wide : this is due to the fact that opportunities for developing intensive production lines such as beet and milk are limited when there is plenty of labour available; on the one hand the planting of beet is restricted to 25 % of arable land, and on the other hand dairy farming depends partly on cereal production for supplies of straw so that there is always a certain percentage of wheat or barley in the rotation crop for animal feed.

In any case dairy farming could hardly be intensified considering the high cattle density per hectare of principal fodder area (about 3 bovine units on most farms).(1) It is observed that the cost of purchased feeding stuffs is extremely high and that the by-products of beet make a big contribution towards covering animal needs.

II - ECONOMIC RESULTS

1. Productivity of labour.

Labour efficiency varies greatly, depending on the farms, between 0.4 and 0.87. It is poor on the 20 ha/2 MWU farms (10 hectares per worker), average on the 20 ha/1 MWU and 40 ha/2 MWU farms (20 hectares per worker) for the reasons mentioned above.

EARNED INCOME PER FULL-TIME WORKER (u.a.)

20ha/1MWU	20ha/2MWU	40ha/1MWU	40ha/2MWU	80ha/2MWU	80ha/3MWU
3,071	1,217	6,434	4,134	7,490	5,912

The net productivity of labour (earned income from full-time labour) shows great disparities : it is especially low on the 20 ha/2 MWU farms (7,500 u.a. per worker) .

The introduction of pig-farming appreciably improves labour efficiency and the level of earned incomes. It is noticed that on 20 ha/1 MWU farms and 20 ha/2 MWU farms an increase in the capacity of piggeries is restricted by the maximum capacity limits adopted in the calculations.

(1) Bovine units reckoned per hectare of main fodder area.

INTERROGATIONS OF THE BAYERN MODEL
Systems : Mixed cropping, cattle
(Price (Autumn 1973))

Listing N°	01201	01202	01401	01402	01802	01803
U. A.A. (ha)	20	20	40	40	80	80
M.W.U.	1	2	1	2	2	3
I - ECONOMIC RESULTS (DM)						
-Total gross output	60 873	63 096	93 871	124 957	196 035	228 123
-Gross output of crops	21 189	17 008	61 957	42 876	110 107	97 059
Gross output of livestock	39 684	46 088	32 274	82 081	77 928	132 064
Partial costs	21 686	22 276	34 565	43 895	69 672	79 591
Gross farm income	39 187	40 820	59 306	81 062	126 363	148 532
Purchases of goods and services	25 727	27 947	40 087	52 257	80 013	104 825
Net farm income	35 146	35 148	53 784	72 099	116 022	123 399
(Purchased animal feed)	(4 542)	(5 290)	(3 585)	(10 648)	(10 118)	(17 155)
Rent	4 600	4 412	9 200	9 200	18 400	18 400
Interest on farm capital	4 000	4 850	4 440	7 660	8 555	23 035
Casual labour wages	-	-	2 263	-	3 394	-
Full-time labour income	26 540	25 886	37 881	55 839	85 673	81 964
Labour income/MWU	26 540	12 943	37 881	27 920	42 836	27 321
Wages of full-time worker (1)	15 000	15 000	15 000	15 000	15 000	15 000
II - PRODUCTION SYSTEM						
Full-time labour (h)	2 300	4 600	2 300	4 600	4 600	6 900
Casual labour (h)	-	-	323	-	485	-
Labour efficiency	1	0 55	1	0 89	1	1
Livestock	43 978	51 075	38 111	85 641	87 153	137 529
Dead stock	20 790	29 723	26 059	36 820	46 708	261 922
Circulating capital	115 463	16 180	24 644	30 730	49 207	61 212
Farm capital	79 931	96 978	88 814	153 191	171 068	460 663
Crop production (ha)						
Sugar beets	2 40 *	2 12 *	4 37	4 80 *	5 55	7 58
Wheat	6 40 *	5 63	12 80	12 80 *	25 60 *	25 60 *
Barley	1 50	0 81	10 56 *	2 88	20 00	15 70
Clover	3 95	3 53+	-	8 00	-	9 46
Fodder maize	1 75	2 04	1 36	3 52	2 41	5 67
Cattle pasture	4 00 °	5 87	6 81	8 00 °	16 00 °	16 00 °
Rape seed			2 91		9 43	
Grass and fallow pasture			1 18			
Livestock production (N°)						
Dairy cows	16 00	18 50	11 80	32 00	30 47	51 64
Heifers	4 70	5 46	5 28	9 55	8 96	15 18

(1) Wages of 500 DM per cow per year are to be added. When the cowman is fully employed, the wages are around 25,000 DM.

* Maximum possible

° Set Minimum

INTERROGATIONS OF THE BAYERN MODEL
Systems : Mixed cropping, cattle and pigs
Prices : Autumn 1973)

Listing N°	PV 201	PV 202	PV 402
U. A.A. (ha)	20	20	20
M.W.U.	1	2	2
I - ECONOMIC RESULTS 50m)			
Total gross output	74 060	78 090	148 120
Gross output of crops	7 987	9 573	15 974
Gross output of livestock	66 079	68 517	132 147
Partial costs	20 998	22 670	40 469
Gross farm income	53 062	55 420	107 651
Purchases of goods and services	28 622	31 073	54 469
Net farm income	45 437	47 018	93 652
(Purchased animal feed)	(3 447)	(4 877)	(6 894)
Rent	4 600	4 600	9 200
Interest on farm capital	4 510	5 165	8 575
Casual labour wages	739	-	1 478
Full-time labour income	35 588	37 253	74 400
Labour income/MWU	35 588	18 627	37 200
Wages of full-time worker (1)	15 000	15 000	15 000
II - PRODUCTION SYSTEM			
Full-time labour (h)	2 300	4 600	4 600
Casual labour (h)	106	-	211
Labour efficiency	1	0.63	1
Livestock	49 872	53 995	99 745
Dead stock	23 714	31 944	39 928
Circulating capital	16 611	17 337	31 835
Farm capital	90 197	103 276	171 508
- Crop production (ha)			
Wheat	1 94	1 79	3 88
Barley	5 28 *	5 28 *	10 56 *
Sugar beets	0 78	1 75	1 55
Maize paste seeds	8 00 *	6 05	16 00
Pasture young cattle	0 02	0 02	0 05
Pasture beef	2 35	3 98	4 70
Mown grass pasture	1 63	-	3 25
Feeder maize		1 12	
- Livestock production (n°)			
Dairy cows	3 11	11 83	6 25
Heifers purchased	1 39	purchased	2 78
Sows	11 04	8 9	22 08
Fattening pigs	187	151	375

(1) Wages of 500 DM per cow per year are to be added. When the cowman is fully employed, the wages are around 25,000 DM.

* Maximum possible

° Set maximum

B A Y E R N M O D E L

I. - PRODUCTION POLICY

1. Choice of lines of production

On most farms livestock production predominates and makes the biggest contribution to gross output. Only the 40 ha/1 mWU farm shows a crop production which is higher than 60 % of the total gross output. Sugar beet is grown to the maximum extent on farms where labour is plentiful. Rape seed appears only on 40 ha/1 MWU and 80 ha/2 MWU farms.

2. Gross output of land.

The gross output levels of the land are high and vary between 600 and 750 u.a. per hectare where there are no pigs, and 900 and 1,000 u.a. where there are pigs.

II. - ECONOMIC RESULTS

1. Productivity of labour.

This is good and higher than the wages of a full-time worker on all farms save on those of 20 ha/2 MWU. It should be noted that the effect of introducing pigs is to raise the income per worker by 30 to 40 %. Where fodder cereals are purchased, the economic result and labour efficiency for the 20 ha/2 MWU farm are perceptibly improved by an increase in production.

2. Net results.

These are positive for most farms in view of the additional wages paid to the cowman. They are particularly high in farms of over 40 ha and 40 ha/1 MWU farms.

A N N E X B

DEFINITIONS RELATING TO FARM MODELS

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→ Definitions relating to farm models :

(1) PRODUIT BRUT TOTAL:	Ventes des produits végétaux et animaux - Achats d'animaux.
(1) GROSS OUTPUT :	Sales - Livestock purchase
(2) CHARGES PARTIELLES :	Dépenses d'approvisionnements (charges variables) + Frais généraux.
(2) PARTIAL COSTS :	Variable costs + general charges.
(3) Revenu BRUT D'EXPLOITATION :	PRODUIT BRUT TOTAL - CHARGES PARTIELLES = (1) - (2)
(3) GROSS FARM INCOME :	GROSS OUTPUT - PARTIAL COSTS
(4) ACHATS DE BIENS ET DE SERVICES:	CHARGES PARTIELLES + AMORTISSEMENTS
(4) PURCHASE OF GOODS AND SERVICES :	PARTIAL COSTS + DEPRECIATION
(5) REVENU NET D'EXPORTATION :	REVENU BRUT D'EXPLOITATION - AMORTISSEMENTS = PRODUIT BRUT TOTAL - ACHATS DE BIENS ET DE SERVICES = (1) - (4)
(5) GROSS OUTPUT - PURCHASE OF GOODS AND SERVICES = (1) - (4)	
(6) FERMAGE :	LOYER DE LA TERRE
(6) RENT	
(7) INTEREST ON FARM CAPITAL	
(8) CHARGES DE TEMPORAIRES :	Rémunération des travailleurs non permanents
(8) CASUAL LABOUR WAGES :	
(9) REVENU DU TRAVAIL PERMANENT :	REVENU NET D'EXPLOITATION - FERMAGE INTERET DU CAPITAL - CAPITAL SALAIRES DE TEMPORAIRES = (5) - (6) - (7) - (8)
(9) FULL-TIME LABOUR INCOME :	NET FARM INCOME - RENT - INTEREST ON FARM CAPITAL - CASUAL LABOUR WAGES = (5) - (6) - (7) - (8)
(10) RESULTAT NET D'EXPLOITATION :	REVENU DU TRAVAIL PERMANENT - REMUNERATION DE LA MAIN D'OEUVRE PERMANENTE.
(10) NET FARM RESULT :	FULL-TIME LABOUR INCOME - FULL-TIME LABOUR WAGES.

A N N E X C

LOCATION OF REGIONS WHERE
MODELS FOR MIXED CROP AND
CATTLE ARE SITUATED

Locations of regions where models for mixed crop
and cattle are situated

