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# PRODUCTION ECONOMICS AND PROBLEMS OF ANIMAL PRODUCTION

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SUMMARY

This paper presents a brief survey of the discipline of farm management. It is suggested that at the present time in New Zealand the most profitable field is likely to be farm surveys supported by simple budgets. As more factual information becomes available, and as some of the more tractable problems can be classified as simple extension-adoption problems, so the scope for more sophisticated management techniques will be increased. It is suggested that farm management workers have a legitimate interest in the design of applied experiments, and the design of small farm experiments. Finally, the author's doubts about the usefulness of certain traditional lines of farm management research work, are expressed.

THIS PAPER will be concerned with farm management as a research or post-graduate discipline.

## DEFINITION OF MANAGEMENT

Management may be loosely defined as "the process which determines whether a hard day's work will, or will not, be a good day's work". Good management ensures that a hard day's work is a good day's work.

The need for management arises from the fact that there is not a one-to-one relationship between effort expended and achievement. Exactly the same effort and expense may be involved in putting a fence in one of two places. In one place the fence may greatly facilitate running the farm, in the other it may hinder it. We say that the man who puts his fence in the right place is "a good manager".

## FARM MANAGEMENT RESEARCH

The first major characteristic which divides all management problems is whether the problem arises as a result of changing technology. In a dynamic agriculture most farm management research should be concerned with problems arising from changing technology. Problems arising from this source concern, for example, the herringbone shed, platform feeding of silage, high stocking rate per acre, high rates of fertilizer usage, the Te Awa type of hill country development, the use of sheep and surface drainage in Northland, and whey feeding of pigs, to mention just a few. From the point of view of farm management research strategy, it is important to realize that there can be no question of ever catching up with technological change, since technological change is a continuous dynamic process.

Knowledge of new techniques may be provided from either:

1. *Experimental results*—whey feeding of pigs, or response to fertilizer and trace elements.
2. *Farm innovation*—the herringbone shed, and high fertilizer rates in Taranaki.
3. *Small farm experiments*—No. 2 dairy at Ruakura, or Massey College small farm.

Farm management research may properly concern itself with each of these sources of information. Thus Heady and Dillon (1960) have reviewed the problem of designing experiments to give the maximum amount of information of use to farm management research workers. Farm surveys may be the best, indeed the only way of collecting information on the success of new practices at the farm level. The use of small farm experiments as a farm management research tool is discussed in the last section of this paper.

## TECHNOLOGICAL CHANGE

The first question to be asked in evaluating a farm management research project is: Is this an attempt to adjust farm operations optimally to a given technology, or is it an attempt to adjust to a change in technology? (These two alternatives are not exhaustive since the study may be an attempt to improve the methodology of farm management.) The distinction is epitomized in this type of research report: "Records were collected for the past five years from sixty-five farms. Six farms had to be excluded from the study because their farm plans had changed markedly in the five years." Given the philosophy that technical change should be the prime concern of farm management research workers, the above report would read: "Records were collected for the past five years from sixty-five farms. Fifty-nine farms had to be excluded because their farming pattern had remained essentially the same over the entire period."

The attitude to changing technology determines the sort of problem that will be tackled. Thus the research worker who is interested in studying adjustments to a given technology will look for an area of uniform soil type, farm size and farming system, so that "between-farm differences" will be a minimum. The research worker interested in adjustment to changing technology will attempt to foresee a new farming practice which will be profitable and have a major impact on farm organization. If the impact is on an area of different soil types and farm sizes, this makes the analysis correspondingly more difficult, but not necessarily less worth while.

The research tools used are no guide to the basic philosophy of the research worker, linear programming can be used either to analyse the optimum rotation within a fairly stable farming system, or to examine the likely impact of a new crop, or a new management practice. Because superficially similar survey methods may be used with entirely different objectives in mind, it is useful to distinguish between the collection of farm records and farm surveys.

## FARM RECORDS AND FARM SURVEYS

In the following discussion the term, "farm survey", is used to mean a series of interviews with farmers to gain information about some one management practice. Usually all interviews will be conducted by the research worker himself and particular attention will be paid to the way the farm practice has fitted into each farmer's overall management system. In short, the farm survey is a procedure for interviewing farmers to test the hypothesis that a particular management practice is profitable. At the same time, the research worker attempts to define exactly what are the pre-conditions necessary for success, and what associated management changes are necessary.

By contrast, the term "collection of farm records" is used to mean collection of records with the aim of establishing, statistically or otherwise, some guides or standards for successful management. Some of the weaknesses in this approach to research have been analysed by Candler and Sargent (1962). In large measure, record collection implies a total disregard for the research worker's technical knowledge of agriculture. It is assumed that records from, say, sixty farms in an area can indicate the key to successful farming in the region, but no knowledge of agriculture is required to collect the data, analyse it, or interpret it. The apparent simplicity of this procedure, which can be followed without any *a priori* hypothesis as to the key to successful farming, should make one suspicious. In the past, the majority of the rather limited funds available for farm management research in New Zealand have been spent on the collection of records.

By contrast, the farm survey procedure does require a hypothesis, and it does require the research worker to use his technical knowledge of agriculture. The distinction between the farm survey and record collection can perhaps be best illustrated by two examples. Appendix A is a report on a 150 acre farm in Southern Taranaki where over an eight-year period there have been the following major changes in management.

Cow numbers: an increase of 68,

Fertilizer: an increase of 40 tons in the annual dressing,

Butterfat: an increase of 24,500 lb in annual production.

Allowing 5% interest on the fixed investment in stock, the extra annual expenditure on fertilizer realizes a return of 200%. As can be seen from the Appendix, the full analysis of this farm has not yet been completed. The costs of extra fencing, drainage, etc., have not been taken into account, but equally it is quite clear that though on a full analysis the rate or return may fall to 150% yet the picture will not be substantially altered. The point which requires emphasis is that because this is a farm survey (and because Appendix A refers to a particular farm) a full analysis is possible. It is possible to say exactly how much was spent on fencing on this farm. If the data from this farm had been aggregated and averaged, no such analysis would have been possible. A farm record approach might tell us that on average (as a farm standard) fertilizer is applied in the district at 3 cwt (or the "top" 10% of farmers apply 3.5 cwt acre) but all the information about the effect of a drastic increase in stock numbers and fertilizer would be lost.

The second example, given in greater detail in Appendix B, is less satisfactory since it refers to the development of a hypothetical farm, since it has proved impossible to obtain the research funds necessary to replace the hypothetical example with an empirical one. However, Appendix B shows that the hypothetical development of 600 acres of hill country following essentially the Te Awa pattern will increase carrying capacity 74%; increase taxable income 94%; increase taxation 258%; and increase net income 37%.

This analysis shows us that the lion's share of the benefit from this hill-country development programme goes to the Inland Revenue. Again this sort of result is simply not available from the farm record type of analysis. Farm records may possibly show that "the top 10% of farmers" carry 74% more stock than the average. They will not show that the average farmer has, in this case, a very good reason for remaining average—to wit, the Inland Revenue Department.

## BLIND ALLEYS

It is pertinent at this stage to review four types of farm management research activity which seem to hold little promise of being useful.

Doubts about these types of research are particularly pertinent since they have all been carried out many times before without yielding much valuable information.

The farm management research techniques which appear to be blind alleys stem from the use of farm records, where the records are used without reference to the farm on which they were collected. The blind alleys are farm standards, farm costs, two-way tables and production functions.

### Farm Standards

These take the form of ratios, such as milk production per cow, or per acre, or aggregates such as per cent. of farm in cash crops; or weighted averages such as a yield index, which reduces to a single index the yields from a range of crops. Standards may be calculated for the average of all farms and/or the average of, say, the "top" 10% of farmers.

There are a number of obvious difficulties with these standards. First, it is by no means clear which farmers *are* "the top 10%". Certainly, there are many farmers who would consider that a high taxable income indicates incompetence rather than competence. Secondly, there are an infinite number of ratios that can be calculated, and there is no *a priori* way of telling which ratios are important and which unimportant. Most farm standards are of the output per unit of input type, though there is no reason why equal attention should not be given to the ratio of outputs (ewe equivalents per cattle beast) or the ratio of inputs (tons of fertilizer per labour unit). Certainly, there are many situations as with butterfat per cow and butterfat per acre where an improvement (or increase) in one ratio may involve a decline in the other. Thus butterfat per acre can generally be increased simply by having a higher stocking rate and lower production per cow. Thirdly, where a ratio really is important, as butterfat per cow, there should be no need to make a special effort to collect farm records to calculate the ratio.

These really important ratios can be easily calculated and extension personnel and farmers know the average and range for their district without being told to the third decimal place. The real case against farm standards is that an extension officer should know the important ratios for his district without the aid of a farm management record service.

### Farm Costs

This information is often requested by farmers' organizations. Costs can be calculated for farming, but to give them any serious meaning is extremely difficult.

To take a particular example, consider town milk production. The information which is operationally meaningful is the quantity of town milk which would be offered for sale at a wide range of prices. The higher the price, the more milk will be offered for sale, and this price/quantity schedule gives the price necessary to ensure the production of the different quantities of milk. Now, note that this approach to cost of production does not require any information about individual farm costs, it merely requires an estimate from individual farmers of how much milk they would be willing to sell as prices changed.

The difficulty of deducing meaningful farm costs can be approached in another way. Suppose that the price of town milk is markedly increased while cash costs remain much as before. Then the profitability of the town milk farm would be greatly increased, and farmers would be justified in paying more for town milk farms. That is, an increase in the price of milk should be reflected in higher land values, and higher prices for the factors of production which cannot be increased rapidly. But the price of land and of other factors of production have to be used in calculating production costs. In short, the cost of production and price can differ only if farmers have not made intended adjustments or the costing formula assumes rates of return to capital and labour out of line with the rates actually demanded by farmers.

Putting this another way, the discovery that the cost of production exceeds price can be interpreted as meaning either that price should be raised or that some of the farmer's assets are over-valued.

Farm costings have almost always been designed to come out with a unique figure, or range of figures. They have not been designed to predict how supply would respond to different prices.

### Two-way Tables

Two-way tables or scatter diagrams are usually designed to show casual relationships. If the information being tabulated or graphed has been collected to test a particular hypothesis (if in the terminology of this paper, the data were collected from a farm survey), then it is possible that a two-way table would suffice to demonstrate useful results. If the records were collected before deciding the hypothesis to be tested, and hence the two-way tables to be constructed, then it is extremely unlikely that anything useful would be shown.

On general grounds one would not expect a cross-tabulation of butterfat production per acre by cows per acre, or butterfat production per acre by fertilizer per acre, or butterfat production per acre by fodder consumed per acre, to show very much, since high fat production depends on a combination of stocking rate, fertilizer, fodder conservation and management.

### Production Functions

Such analyses would appear to be much more promising than the two-way table, since any number of variables may be allowed for. In practice, the most that can be claimed is that, on occasion, production function results have tended to confirm the beliefs of investigators.

The relative lack of success of production function analysis to date is probably due to:

1. Wrong specification of the production function. Typically the production function used is of the form

$$Y = aX_1^{b1} X_2^{b2} X_3^{b3} E$$

where $Y$ is gross (or net) income,

$X_1$, $X_2$ and $X_3$ are the quantities used of the first, second and third resources.

$E$ results in a normally distributed error term.

This is, of course, a Cobb-Douglas production function.

This function will be unsatisfactory if:

(a) There is more than one product,

(b) Any of the resources are not homogeneous,

(c) The relation amongst the resources is not multiplicative.

(d) There are any major discontinuities in the productivity of resources,

2. Failure to test the estimated function. To date none of the workers in the field of production functions seem to have realized that the calculated production function is merely a hypothesis as to the production relationships in the area being studied. To test the hypothesis (to test the production function) would be a simple matter. The function states that a given increase in factor use will result in a specific increase in gross (or net) income. To test this hypothesis it would only be necessary to visit a number of farms in the area being studied, and to budget the result of increased factor use.

It is a commonplace among research workers that research involves the formulation and testing of hypotheses. It is equally clear that the publication of a numerical estimate (even with appropriate indices of statistical significance) is merely the formulation of a hypothesis. Completion of such a research project must include an attempt to apply the results to farms to which they are thought to be applicable.

It is worth emphasizing that the calculation of a production function is merely the formulation of a hypothesis about the production relations in the area being studied. Occasionally, the hypothesis is so ridiculous that it does not need testing. It may be wrong to describe production function analysis as a blind alley, rather it is an alley along which research workers always fail to proceed more than the first few steps.

## SIMPLE AND COMPLEX DECISIONS

With either changing or constant technology the decisions farmers have to make may be simple or complex. Relatively simple decisions (there is no hard and fast distinction between simple and complex) would be whether to make hay or silage, whether to use a new weedicide, or whether to use an electric or permanent fence. Where there are a few clearly defined alternatives, the appropriate analytical technique is still the partial, or whole farm budget. Where there is uncertainty with respect to one or more of the prices or technical coefficients used, a parametric budget (Candler, 1959), gives rather more insight than can be achieved by a series of conventional budgets.

Complex decisions may be complex either by virtue of the wide range of alternatives available, or owing to probability and elements of risk. A classification of complex problems on the basis of the presence or absence of risk is not entirely satisfactory, since there are few farm decisions which are entirely free from risk. Nevertheless, this classification permits one to suggest linear programming, dynamic programming or replacement theory if the variability of the outcome can be ignored, and to suggest queuing theory, inventory analysis, quadratic programming or Monte Carlo methods if outcome variability is the essence of the problem. A very brief review of the situations in which each of these aids to complex decision-making would be used would be:

*Linear Programming*: This is applicable where there are a wide range of alternatives to be considered simultaneously. This might be in a mixed cropping farm in Canterbury or the Hastings area, or it might be in deciding simultaneously how many sows to run, when to mate them, and what ration to feed in each month, given a supply of skim milk, and the price of barley meal. A situation in which linear programming would assist in adjusting to new technology would be in finding the optimum farm plan given the possibility of using a new, high yielding and rust resistant wheat in a mixed farm.

*Dynamic Programming*: This is no kin to linear programming. It is useful where the decision problem can be analysed into a series of sequential steps. Thus it is possible that the "optimum" hill country development programme may, eventually, be analysed in this way. The problem of the optimum culling policy for a poultry flock has been analysed using this method (White, 1959).

*Replacement Theory*: This concerns equipment (say poultry) which wears out and can be replaced. A rather unsatisfactory analysis of the optimum culling policy for a poultry flock has been made using replacement theory (Candler and Ward, 1961).
*Queueing Theory*: This is applicable where a service facility (say, a freezing works or pea harvesting and processing system) is subject to a demand (for killing space or harvesting peas) which can be predicted only in terms of probability.

*Quadratic Programming*: This handles the same sort of problems as linear programming except that allowance can be made for yield variability. This permits selection of the programme which gives minimum income variance for any given mean income.

*Inventory Analysis*: This method has been used to analyse optimum stocking rates and fodder reserves in drought prone environments (Dillon and Mauldon, 1959).

*Monte Carlo Method*: This is a method of simulating a stochastic relationship, where the relationship is too complex to permit a normal analysis of the problem. It may develop into a useful tool for the analysis of grazing management.

The work which has been done on these seven modern analytical techniques should be described as methodological rather than empirical. The studies quoted have shown the usefulness and applicability of these methods to typical agricultural problems, they have not in fact solved real probems. Thus, these new methods could be criticized for failing to test the hypothetical optimum plan in the same way that production functions were criticized above. In this case the criticism is of the research workers rather than the methods since solutions have not been claimed.

## SMALL FARM EXPERIMENTS

Small farm experiments, such as the No. 2 Dairy at Ruakura are, in a sense, the ultimate farm management research tool. On a small scale, under closely comparable conditions, two or more management systems may be compared physically, without the demoralizing list of assumptions which inevitably precedes a theoretical analysis.

The usefulness and validity of such experiments cannot easily be related to the usual demands for the statistical significance of experimental results.

Small farm experiments are characterized by:

(a) Interaction amongst almost all factor inputs.

(b) At least a year between definition of treatments and the first results.

(c) The high cost of additional plots (or additional small farms).

If interaction is present, then there is no point in attempting to vary only one factor, since the level at which other factors are held constant will affect the response to the factor being varied.

If the time between definition of the treatments and obtaining results is small, then some form of sequential analysis is indicated. This allows the later years of the experiments to benefit from the information gained in earlier years. Regardless of the time taken to obtain results, if experiments are conducted sequentially, then, clearly, later experiments (or years) should take advantage of the result available at their inception.

The high cost of each small farm severely limits the number of treatments and the amount of replication possible.

These considerations mean that the main value of small farm experiments is likely to be in testing new farm management systems—that is to say, small farms are likely to be of most use in thoroughly applied research. Indeed, whether or not experiment, trial or demonstration is the correct term for small farm work is an open question. It is, however, probable that, even where small farms are established on experiment stations, their main value is likely to be as an extension technique.

Small farms may be of use for purely experimental purposes when the research worker is interested in the difficulties which would be encountered in a new management system. Thus, if the worker is interested in the problems of high stocking rates, he may suspect that this will lead to quite a different pattern of feed shortage and availability as compared to moderate stocking. A small farm could be used to find these periods of feed shortage, and one would only claim to have a new management system when the high stocking rate had been integrated with means of providing the required feed at all times of the year.

A management system may be defined as a set of decision rules, which defines the action to be taken for every conceivable contingency. Thus, a management system is, by its very nature, a fairly complex concept, where there will be considerable interaction between ways of handling different contingencies.

In comparing management systems the objective should be to find the most profitable system. The best way to do this would seem to be to have one small farm as the base, or average, management system (cf. the control plots in normal experimental design) which should reflect prevailing farm practice in the district. The management of the other small farms would be defined as "similar to the base farm except . . .". The exception defines the difference, and this could be high stocking rate, extra fertilizer, purchase of hay if necessary, and such other changes as would appear to give a sensible and profitable way of running the farm.

It is not necessary that only one thing should be varied between farms. It is essential that the between-farm differences should be defined in advance. These differences may, of course, be conditional. For example, the use of nitrogen fertilizer in spring may be permitted if necessary.

Because of the time lag between the definition of treatments and obtaining the results, and because the economic conditions which define the optimum farm plan are continually changing, there is no point in attempting to approach the optimum by a series of small logical management changes. Rather, the attempt should be to use all available information (including the management system used last year) to estimate the most profitable management system for the district.

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## APPENDIX A
(Due to John Graham)

### A CASE FARM WHERE HIGH RATES OF FERTILIZER ARE A FEATURE OF THE INPUT

The farm of 150 acres is situated in the Kapuni area of South Taranaki with an evenly distributed 50 to 60 in. rainfall being a feature of the climatic conditions. The soil is a light, friable, free-draining yellow-brown loam highly resistant to winter pugging except where it overlies a clay-ironstone pan as it does on about 50 acres of this farm. Phosphate and potash are the chief soil deficiencies.

The present owner took possession of the farm in 1953, the following table presenting stock and production figures for the 1953-1961 period:

| *Season* | *Cows* | *lb Butterfat* | *lb/acre* | *lb/cow* |
|---|---|---|---|---|
| 1953 | 82 | 22,000 | 140 | 270 |
| 1953/54 | 90 | 27,000 | 180 | |
| 1954/55 | 107 | 32,000 | 210 | |
| 1955/56 | 112 | 35,000 | 235 | |
| 1956/57 | 117 | 36,500 | 245 | |
| 1957/58 | 122 | 43,000 | 286 | |
| 1958/59 | 127 | 43,000 | 285 | |
| 1959/60 | 140 | 42,000 | 280 | |
| 1960/61 | 150 | 46,500 | 310 | 310 |
| 1961/62 | 170 | | | |

Inputs associated with this development have been as follows:

1. Fertilizer

From a total input of 7 tons phosphate and 10 tons slag in 1953 the annual input has now risen to 47 to 50 tons of 33% potassic superphosphate. Two dressings of DDT-superphosphate have also been applied over the same period. Grazing records are maintained by the farmer and are used as a guide to the time and rate of application of fertilizer to each paddock.

Indications that this high rate of fertilizer input has been an important factor in development are:

(a) The lengthening of the winter growth period which is reflected in the later closing of a reduced area for winter feed (June compared with March).
(b) The reduced area of summer and winter supplementary crops.
(c) Elimination of regrassing.
(d) Reduced effect of drought periods although this is partly a result of increased cow numbers.
(e) Increased cow numbers. (The increased cow numbers mean that the extra feed is better utilized. To ask "whether it is cows or fertilizer which have given the increased production?" is to confuse the issue. It is probably cows *and* fertilizer.)

2. Drainage

Diversion of several streams and the cleaning of others has enabled several wet paddocks to be brought into full production.

3. Subdivision

Closer permanent subdivision has enabled closer control of grazing to be obtained and has acted as a substitute for labour in reducing the number of electric fences required.

4. Regrassing and Cropping

All paddocks, except four, on the farm have now been regrassed since 1953. The farmer now considers that he could have increased his production by a greater amount in the same period by applying the same amount of fertilizer as used in the regrassing programme to established pastures. In the initial stages of development a winter crop was a useful insurance against overstocking if increases in stocking exceeded increases in other inputs.

5. Increasing Cow Numbers

Increased cow numbers have contributed to output in two ways:

(a) The direct butterfat return from added cows using the extra feed.
(b) An indirect return from improved pasture utilization, winter treading of pastures, increased fertility cycle, maintenance of a tighter, shorter sward more resistant to drought and pugging.

Provision of extra cows has been the most costly item in the development programme; either the direct cost of buying additional stock or the opportunity cost of the grazing and whole milk used in the rearing of replacements.

6. Stock Quality

Improvements in the genetic merit of the herd through the exclusive use of A.B. will have made some contribution to increased output. Rapid increase in cow numbers, however, has reduced the opportunities for selection.

7. FEEDING PLAN

Increased winter growth has enabled all cows to be wintered on the farm while *reducing* the quantity of hay and silage required. Later autumn growth permits later calving to be carried out which allows herd requirements to be "fitted in" with the feed supply.

In recent years bloat has been a major problem on this farm, although it appears that with increased fertility and stock numbers the problem will be almost eliminated as a result of better pasture balance.

8. OTHER INPUTS

Smaller items which have required changes are shed expenses, tractor expenses, cartage expenses, and veterinary expenses.

9. BUDGET ANALYSIS OF THIS DEVELOPMENT

Between 1952/53, and 1960/61, there were the following major changes in management:

Cow numbers .... an increase of ........ 68
Fertilizer ............ an increase of ........ 40 tons/yr
Butterfat ............ an increase of ........ 24,500 lb/yr.

At £30 per cow, the extra stock represent a capital investment of about £2,000. Allowing 5% interest on capital, this is an annual charge of £100.

Allowing £20 per ton for 33% potassic superphosphate, including a liberal allowance for spreading, the extra fertilizer costs £800, so that extra fertilizer and stock represent an annual outlay of £900.

Allowing 30d. per lb butterfat (next season's price) the extra butterfat represents a gross increase of about £3,000. Thus *as a rough estimate* the rate of return on the development expenditure has been about 200%, *or* for every £1 spent, *net* income increased £2. Even allowing for the other deductions which will have to be made in the final analysis of this farm (*i.e.*, costs of drainage, re-fencing, etc.) it is clear that the development programme has been highly profitable.

## APPENDIX B

(Due to Alan Wright)

## AN EXAMPLE OF THE DEVELOPMENT OF UNPLOUGHABLE HILL COUNTRY

This hypothetical example concerns the development of a 600 acre hill country farm using the Te Awa type of development programme.

1. THE DEVELOPMENT OF 60 ACRES

Assuming that the decision to develop is made at the beginning of the farming year (July), then the programme for development would be as follows:

*First Year*

Put in tracks where necessary, fence the area into shady and sunny faces, and clean up the pastures with heavy stocking. This can be done with the ewes and cows after weaning, and by using a heavy concentration of stock for a short period it should be possible to avoid deterioration due to lax grazing of pastures over the rest of the farm. The area is topdressed twice at 3 cwt/acre, once in spring and again in the autumn. Oversowing with clovers will be done in March and April.

A 74% increase in carrying capacity will result in the 60 acres carrying an extra 110 ewes, 40 ewe hoggets and 2 rams. These stock increases will be spread over two years, and will be achieved by withholding from sale two-tooth ewes and the tops of the 5-year-old ewes. (In the development of the whole farm, stock increases are based on two-tooth ewes throughout. For the short-term policy of developing only 60 acres, it is considered that using both extra two-tooths and 5-year ewes is a more practical approach.) Financially, the first year will be the worst, as capital expenditure is heavy, running expenses are increased, and income from sales of ewes and lambs will be reduced.

### *Second Year*

Maintenance topdressing is applied at 2 cwt/acre, instead of the 1 cwt/acre used prior to development. A further 60 ewes are lambed so that by the second winter stock increases are completed. Running expenses will again be higher but there is no further capital expenditure, and gross income will be increased by the sale of extra lambs and wool.

### *Third Year*

This represents a stabilizing period. The last of the 5-year ewes which have been held in the flock are disposed of, and there are further increases in wool and lamb sales. From this point on, net income should be relatively stable apart from seasonal fluctuations.

Each year's income and expenditure are summarized below:

| | *Carrying capacity Ewe equiv./acre* | *Taxable* | *Taxation* | *Net income* |
|---|---|---|---|---|
| Initial position | 3.1 | £2,000 | £400 | £1,900 |
| First year | 4.4 | £1,310 | £178 | £1,266 |
| Second year | 5.4 | £2,340 | £532 | £1,809 |
| Final position | 5.4 | £2,240 | £501 | £2,039 |

When these streams of future incomes and payments are discounted to present worth, the results of developing 60 acres are:

An increase in carrying capacity of the 60 acres of 74%.
An increase in taxable income from the whole farm of £190 per year (9½%).
An increase in taxation of £83/year (20%).
An increase in net income of £86/year (4½%).

The increase in assets is £959 made up as follows:

| | |
|---|---|
| Fencing | £350 |
| Topdressing | £225 |
| Oversowing | £60 |
| Tracks | £24 |
| Stock | £300 |
| Total | £959 |

This represents an increase of 4.6% on the original £20,705 investment.

The £86/year increase in net income is equivalent to a capital sum of £1,720, which, if invested at 5% interest, would yield £86/year.

If instead of developing out of revenue the farmer had decided to borrow money at 5% so that his net income remained constant during development, then he would incur a maximum debt of £757 in the second year and it would take another seven years to pay this off.

2. THE DEVELOPMENT OF THE WHOLE FARM

This results in the whole farm being developed in 10 years. Each year a block of 60 acres is developed as described previously except that stock increases are made up of extra two-tooth ewes, and the expenditure on fencing decreases towards the end of the development period, as some fencing material will be used twice. It is considered that it will take 11 years for the net income to stabilize.

When the costs and returns of development are analysed as previously the result of developing the farm is:

An increase in carrying capacity of 74%.

An increase in taxable income of £1,877/yr (94%).

An increase in taxation of £1,034/yr (258%).

An increase in net income of £714/yr (37½%).

An increase in assets of 41%.

The £714/yr increase in net income is equivalent to a capital sum of £14,280 invested at 5% interest.

If money was borrowed for development as before, then there would be a maximum debt of £2,721 after 6 years, which would take a further 6 years to pay off.

## DISCUSSION

Q: *Would Professor Candler elaborate on the method of selecting farms for farm surveys, and the use which is made of the information obtained?*

PROFESSOR W. V. CANDLER: In the case of the Te Awa hill country development survey, we aim to select about ten hill country farms at random to give us a "bench-mark" from which the performance of improved farms can be measured. Other than this we are attempting to interview any farmer who is in the right area, and has successfully or unsuccessfully attempted to develop his property along the general lines suggested by Te Awa. In the high fertilizer study we have a definite hypothesis that high fertilizer and high stock numbers lead to high production. Of the 40 farms to be interviewed, eight have been selected at random (to provide a bench-mark), eight have been suggested by Mr S. A. MacKenzie, Dairy Board Consulting Officer in South Taranaki, as representing "maximum possible", eight have been selected on the basis of having greatly increased production, eight have been selected on the basis of having greatly increased stock numbers, and eight have been selected on the basis of having greatly increased fertilizer usage. We hope, in this way to pick up any farmers who have increased production without fertilizer or stock, or who have increased fertilizer or stock without increasing production.

The information obtained will be analysed, in the context of the individual farm, to attempt to find which practices are essential for increased production and which are incidental. Clearly, this approach requires the research workers to have a thorough technical knowledge of agriculture.

Q: *Where it is wished to study, and to disentangle, the effect of factors such as level of stocking, or level of fertilizer application, is it not necessary first to conduct an analysis of farm records derived from a survey, to find the farmers who are carrying out these practices at different levels?*

PROFESSOR CANDLER: Where appropriate records have been kept they are useful in locating farmers to be interviewed. Thus, in Taranaki, the Dairy Board's census of cows in milk has been useful to us in locating farmers who have increased their stock numbers. The absence of records of fertilizer application makes it rather more difficult to locate the farmers you want; it does not make it impossible. Stock and station agents, State Advances personnel, extension officers, and leading farmers, all have a fair idea of the innovations going on in their areas.

Frequently, there is no question of disentangling the effects of stock and fertilizer. There may be no effect of stock or fertilizer unless both stock and fertilizer are present. I am concerned to find farm management systems which increase farm profits, not to impute these profits to one factor or another.

Q: *Professor Candler considers "farm standards" and "farm costs" are "blind alleys", yet he recommends that extension services in farm management should use simple budgets. On what basis would he compile budgets in the absence of such standards, and how would he convince both the farmer and his bank manager that such budgets were reasonable?*

PROFESSOR CANDLER: If there is a genuine demand by extension personnel for farm standards to use in budgets, then this reduces the blindness of the alley. At the same time, I would think that most extension workers know essentially what figures to use in a budget, without reference to a table of average figures. Certainly, regardless of whether the original budget was constructed on the basis of average values or judgment, I would substitute the figures suggested by the farmer or bank manager if they felt the original figures were unrealistic. Where standards are calculated to show what can be achieved, I feel the same point can be made by the extension officer, with respect to some case farm.