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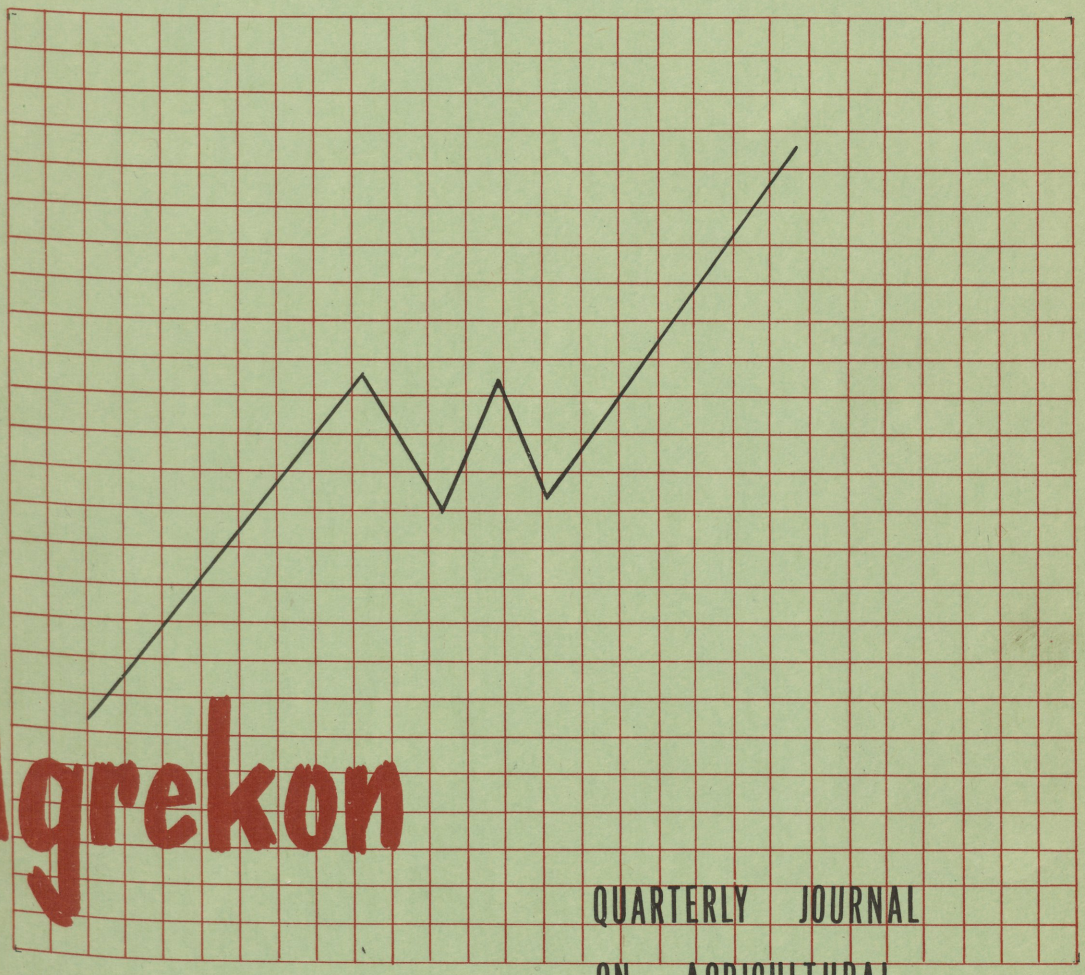

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# A Method for Farm-Enterprise Planning

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A considerable amount of interest has been shown lately by farmers and farm planners in farm-enterprise planning. Profits are normally the criterion of business success in farming; the method that is here outlined is suggested as a means of increasing profits.

An attempt will be made to show how farm-enterprise planning for maximum profits can be achieved, by means of a technique known as "Program Planning".[1] The theory and underlying logic of the technique are treated elsewhere.[2] In comparison with conventional budgetting, the technique of programme planning follows a logical procedure in the selection of rejection of enterprises; in the determination of the sizes of selected enterprises; and also of the production methods employed for them in order to secure a profit-maximising production plan for a specified combination of farm resources. However, the procedure may become complex, and in such cases it may be necessary to resort to more appropriate techniques, e.g. linear programming.

## THE METHOD OF PROGRAMME PLANNING

The technique will be illustrated with the aid of a simple example so that its method may become clear. Refinements and elaboration of the simplified methods and applications to be described are doubtless desirable and possible.

The resources at the farmer's disposal can be classified in four groups, viz. land, labour, capital and managerial ability. Thus, at any one time a farmer will have access to certain amounts of these production factors. If the object of planning farms is to help the farmer to apply his available resources to maximise profits, answers must be found to the question of what enterprises, how big and what methods to select to achieve this aim within the resource limits.

The next step would be to distinguish between fixed or overhead costs, such as depreciation, and variable costs such as fertilizers. Fortunately, it is possible to ignore the fixed costs in the planning procedure, because if gross profit (which is obtained by subtracting from gross income the variable costs) is maximised within the resources available, then net profit will also be at a maximum. The fixed costs, by definition, remain unaltered with a change in the level of production; and as such can merely be subtracted from the gross-profit figure in order to obtain the net profit.

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1) To be distinguished from the same term which is used in extension work in South Africa.
2) "A Theoretical Approach to the Profit Maximization Problems in Farm Management" by G.B. Clarke and I.G. Simpson, Jour. of Agric. Econ., Vol. XIII, No. 3.

TABLE 1 - Crop gross profits per acre per annum

| | Gross income | Variable costs | Gross profit |
|---|---|---|---|
| | R | R | R |
| Sweet potatoes | 250 | 160 | 90 |
| Sugar-cane(3) | 200 | 115 | 85 |
| Potatoes | 120 | 70 | 50 |
| Madumbis | 115 | 80 | 35 |
| Maize | 50 | 25 | 25 |
| Peas | 65 | 42 | 23 |
| Beans | 60 | 38 | 22 |
| Wattles(4) | 16 | 9 | 7 |

Table 1 contains a schedule of gross profits for crops from which a choice might reasonably be made on a farm in the Natal Midlands, more specifically in agro-economic region E.3. The data are partly hypothetical.

The variable costs which have to be deducted from gross income are for seed, fertilizer, fuel, minor maintenance of equipment and seasonal labour; regular labour costs are here assumed as fixed.

A comparable schedule of livestock gross profits can be drawn up by deducting from gross income the variable costs of fodder crops (which would not be marketable for cash), the cash value of any scale-crops which were retained for feed and any livestock depreciation. The livestock gross profits converted to an acreage basis, so that they may be compared with crops. They are shown in Table 2.

TABLE 2 - Livestock gross profits per annum

| Stock | Gross income | Variable costs | Gross profit | Acres reqd. | Gross profit per acre |
|---|---|---|---|---|---|
| | R | R | R | R | R |
| Cows & followers | 140 | 38 | 102 | 5.5(5) | 19 (approx.) |
| Beef | 100 | 60 | 40 | 5.5(5) | 8 " |
| Pigs (per unit) | 29 | 17 | 12 | - | - |
| Poultry (per 100 birds) | 120 | 70 | 50 | - | - |

3) Considering a two-year cycle.
4) Considering a ten-year cycle.
5) 5 acres grazing plus 0.5 acres maize silage.

These gross profit per acre figures represent the amount of cash which would be earned after paying for variable costs on each acre of the farm devoted to these crops or stock. Out of the total so earned, the fixed costs would have to be met; the remainder would be available to reward capital and provide the farmer's personal income. The aim is thus to maximise total gross profit.

It is assumed that "managerial ability" is adequate insofar that the farmer will be capable of managing a farm with any combination of the possible enterprises listed above. Management will not then be a limiting factor and need not be considered.

To start with, let us also assume that capital and labour are adequately available for all possible selections, so that land is the only restricting factor in the combination which precludes infinite gross profit. Maximum gross profit will then be obtained by ranking the possible enterprises in descending order of gross profit per acre, and selecting the maximum of each from the top downwards - depending upon what the farm acreage and technical considerations allow. Let us suppose the present organisation of the farm is as shown in Table 3.

TABLE 3 - The present farm organisation

| Enterprise | Acres | Gross profit per annum |
|---|---|---|
| | | R |
| Sweet potatoes | 20 | 1,800 |
| Sugar-cane | 150 | 6,375 |
| Wattles | 200 | 1,400 |
| Potatoes | 20 | 1,000 |
| Madumbis | 15 | 525 |
| Maize | 95 | 2,375 |
| Cows (on grazing only) | 100 | 1,400 |
| | 600 | 14,875 |

Assume that of the 100 acres of grazing, 30 acres are not arable nor are they suitable for afforestation.

Before one can proceed with the planning of a farm, a note has to be made of the various restrictions to be considered in the plan. Assume these to be the following:

1. Wattles - no more than 200 acres (quota limit).
2. Sugar-cane - no more than 150 acres (quota limit).
3. Potatoes - no more than 35 acres for soil fertility reasons, i.e. crop rotation.
4. Sweet potatoes - no more than 50 acres (limited market).
5. Potatoes, sweet potatoes and madumbis not to exceed 100 acres (for soil fertility reasons, i.e. crop rotation).

From the data given, the planning procedure is as follows:

Programme 1[6]

| | Acres | Gross profit |
|---|---|---|
| | | R |
| Choice No. 1 - as many acres of sweet potatoes as possible | 50 | 4,500 |
| Choice No. 2 - as many acres of sugar-cane as possible | 150 | 6,375 |
| Choice No. 3 - as many acres of potatoes as possible | 35 | 1,750 |
| Choice No. 4 - as many acres of madumbis as possible | 15 | 525 |
| Choice No. 5 - as many acres of maize as possible | 317 | 8,000 |
| Choice No. 6 - on non-arable land (30 acres) | | |
| keep 6 cows; | 30 | 420 |
| maize silage for 6 cows | 3 | |
| | 600 | 21,570 |

It is now possible to determine the labour and capital requirements of Programme 1 to reveal what resources, if any, are left to devote to the non-land-using enterprises of pigs and poultry. (In this particular example it is assumed that the farmer is not interested in pigs or poultry.)

So far it has been assumed that labour and capital were not limited. We shall continue to assume that the latter resource places no restriction on the planning, but that labour is limited to 20 regular workers and 40 seasonal workers.

It can be seen from Table 4 that labour requirements of the enterprise, actually selected on the basis of Programme 1, fall short of the supply in time-span VI[7].

If the labour "standards" employed are correct and strictly no additional labour can be obtained, then Programme 1 must be modified to keep within the available labour supply. It is now necessary to maximise the returns to the limiting resources (i.e. time-span VI labour) and this is illustrated in Table 5.

The sweet-potato acreage has to be reduced in favour of another enterprise which gives a higher return in time-span VI. The potato acreage cannot be increased as the limit of 35 acres has already been reached. We now have to select beef to replace some of the sweet-potato acreage. If we reduce the sweet-potato acreage by 16 acres, it would release enough labour hours in time-span VI without causing a labour shortage anywhere else. Since a beef animal requires 5 acres, the farmer might be advised to reduce the sweet-potato acreage by 15 acres and keep 3 beef animals (or he could keep 9 instead of 6 cows without losing very much - he might not think it worth-while to keep only 3 beef animals), or reduce it only by 10 acres and work overtime for a while during time-span VI.

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6) Wattles do not appear in the programme because they are eliminated on account of their low profitability. The planning procedure here assumes that the acres under wattle can be converted to arable land immediately. In practice it would take a number of years to fell all the wattle before replacing them with other enterprises.

7) Work cannot be postponed indefinitely, because in agriculture we are bound to certain periods or seasons. These periods are known as time-spans. The use of calender months is therefore not suitable.

TABLE 4 - Labour requirement (in man-hours) of Programme 1[1]

| Time-spans | | Sweet potatoes | | | Sugar-cane | | | Potatoes | | | Madumbis | | | Maize | | | Cows | | | Total required | Total available(2) regular and seasonal | Regular | Seasonal |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Per acre | No. of acres | Total | Per acre | No. of acres | Total | Per acre | No. of acres | Total | Per acre | No. of acres | Total | Per acre | No. of acres | Total | Per acre | No. of acres | Total | | | | |
| I[3] | 15.9 to 15.10 | 7.7 | 50 | 385 | 20.7 | 45 | 932 | 1.8 | 35 | 63 | 20.3 | 15 | 305 | 1.8 | 320 | 576 | 3.0 | 30 | 90 | 2,351 | 13,480 | 4,160 | 8,320 |
| II | 16.10 to 20.11 | 39.6 | 50 | 1,980 | 20.7 | 55 | 1,132 | 50.0 | 35 | 1,750 | 3.2 | 15 | 48 | 1.9 | 320 | 608 | 3.5 | 30 | 105 | 5,630 | 14,880 | 4,960 | 9,920 |
| III | 21.11 to 31.1 | 89.8 | 50 | 4,490 | 30.6 | 70 | 2,142 | 23.5 | 35 | 823 | 21.9 | 15 | 329 | 31.8 | 320 | 10,176 | 7.2 | 30 | 216 | 18,176 | 27,840 | 9,280 | 18,560 |
| IV | 1.2 to 15.3 | 25.8 | 50 | 1,290 | 30.6 | 30 | 918 | 80.8 | 18 | 1,454 | 10.8 | 8 | 86 | 2.2 | 160 | 352 | 4.5 | 30 | 135 | 4,235 | 17,760 | 5,920 | 11,840 |
| V | 16.3 to 30.4 | 26.0 | 50 | 1,300 | 18.6 | 100 | 1,860 | 80.8 | 17 | 1,374 | 10.8 | 7 | 76 | 2.2 | 160 | 352 | 4.5 | 30 | 135 | 5,097 | 17,760 | 5,920 | 11,840 |
| VI | 1.5 to 31.7 | 335.3 | 20 | 6,700 | 273.8 | 75 | 20,535 | - | - | - | 109.1 | 15 | 1,637 | 44.3 | 320 | 14,176 | 10.2 | 30 | 306 | 43,360 | 37,920 | 12,640 | 25,280 |
| VII | 1.8 to 14.9 | 335.3 | 30 | 10,059 | 273.8 | 25 | 6,845 | - | - | - | 1.4 | 15 | 21 | - | - | - | 4.5 | 30 | 135 | 17,060 | 18,720 | 6,240 | 12,480 |

(1) Similar calculations could be made for capital.

(2) Based on the number of available work days, allowances having been made for "rainy days", Sundays and holidays.

(3) From September 15th to October 15th a particular type of task is undertaken, e.g. soil preparation for summer crops. In the second time-span planting is the most important operation.

TABLE 5 - Enterprises in descending order of time-span VI labour productivity(8)

| Crop | Gross profit per acre per annum | Hours of time-span VI labour required per acre* | Product of one time-span per hour |
|---|---|---|---|
| | R | Hours | R |
| Potatoes | 50 | - | |
| Beef | 8 | 2.5 | 3.20 |
| Cows | 14 | 10.5 | 1.37 |
| Beans | 22 | 24.2 | 0.91 |
| Maize | 25 | 44.3 | 0.56 |
| Madumbis | 35 | 109.1 | 0.32 |
| Sugar-cane | 85 | 273.8 | 0.31 |
| Peas | 23 | 83.6 | 0.28 |
| Sweet potatoes | 90 | 335.3 | 0.27 |

*See Table 4.

The final programme might be as indicated below, assuming that he decides to keep 8 cows and to reduce his sweet-potato acreage by 10 acres. The cows require 0.5 acres silage each; therefore the maize acreage was reduced from 317 to 316 acres in order to increase the acreage of silage from 3 to 4 acres:

Programme 2

| Crop | Acres | Gross profit |
|---|---|---|
| | | R |
| Sweet potatoes | 40 | 3,600 |
| Sugar-cane | 150 | 6,375 |
| Potatoes | 35 | 1,750 |
| Madumbis | 15 | 525 |
| Maize | 316 | 7,900 |
| Cows | 40 | 760 |
| Maize silage | 4 | |
| | 600 | 20,910 |

In time-span VI the workers will have to work about 2,000 hours overtime. This means that with 79 days (adjusted number of work days - see footnote 2, Table 4) and 60 workers, each worker will have to work about ½ hour extra per day for the 79 days.

The gross profit with Programme 2 is R660 less than with Programme 1. In Table 4, 43,360 man-hours of labour are required for time-span VI, but only 37,920 are

8) Similar calculations could be made for capital should it prove to be a limiting factor.

actually available. If the farmer wishes to adopt the plan as indicated in Programme 1, he would have to secure 5,440 hours more labour. The lowest marginal-value product 9) of labour in time-span VI is R0.27 per hour, which means that it would be worth incurring appreciable expense (in comparison with the current wage rate which is about 30 cents per day) to obtain the additional labour.

Should the capital requirement of a programme seem unduly high, or the farmer be concerned over rising labour costs, another programme could be determined with a reduced regular labour supply. The farmer may want to know what level of gross profit could be expected if he operated with 15 instead of 20 regular labour and the same number (40) of seasonal workers.

Labour eventually became the limiting factor in time-span VI with 20 regular workers. A reasonable hypothesis from which to start would be that, with 15 men, labour in time-span VI would also in this case be the limiting factor, because the percentage reduction in the amount of available regular labour is the same in all time-spans. Selection could be made then of acceptable enterprises in descending order of gross profit per labour hour in time-span VI. (Table 5.)

Further programmes can be selected, for instance, on the basis that a rotation with 316 acres of maize is unacceptable. It may be argued that no more than 200 acres should be under maize.

A further aspect that could be handled is the question of selection when more than one technique of production is possible. For instance, one could consider the alternative techniques of harvesting either maize or sugar-cane mechanically instead of by hand. This will reduce the labour requirement, but will increase the fixed costs; however, other enterprises could be introduced to make use of the labour saved, or labour costs could be reduced.

Reference: "The Use of Programme Planning in Farm Advisory Work" by G.B. Clarke, EPA project No. 6/14-11.

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"As a science of choice between alternatives, economics is also based on maximizing and minimizing conditions. It is concerned with the choice of goods and services which define the conditions of maximum utility or satisfaction of consumers. It is concerned with the conditions which must exist if business profits are to be maximized. As a corollary, economics is concerned with the conditions which are necessary if a given amount of product or profit is to be produced with a minimum of costs or resources. It also inquires as to the conditions under which the consumer can attain a given level of utility with a minimum outlay of money".

- E.O. Heady in "Economics of Agricultural Production and Resource use".

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9) The value of product which an additional labour-hour would produce.