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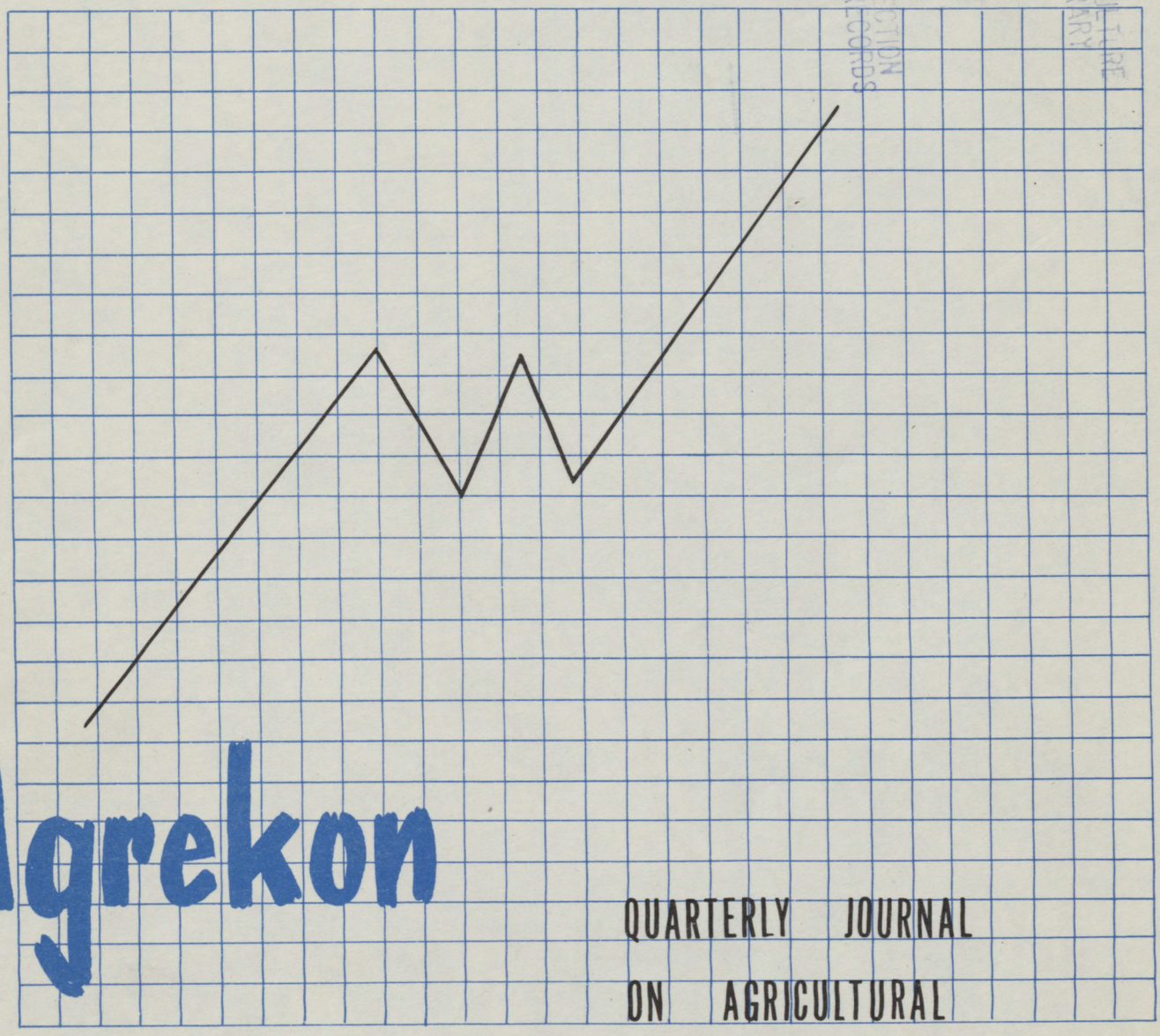

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BUSINESS GROWTH IN AGRICULTURE, III: DESCRIPTION OF DECISION-MAKING MODEL

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1. INTRODUCTION

A simulation model was used to determine the effect of various strategies on business growth. The fact that preceding and succeeding events are used to explain the growth process, makes simulation a suitable method of ascertaining business behaviour over time. Many problems cannot be solved satisfactorily with formal mathematical models. In situations where changes in inputs, probability distributions, changes over time, risk and uncertainty and non-linearity occur, pure mathematical models are not always satisfactory. According to Groenewald[1] it is ". . . here that simulation can be used to obtain optimal, near optimal or satisfactory solutions, by means of divided experimentation with the model of a real world situation".

2. THE SIMULATION MODEL

A simulation model similar to the model developed in the USA by Eisgruber[2] and further extended and refined by Patrick (see Patric & Eisgruber[3]) and Harsbarger[4], was used in this study. Amendments were made to the Patrick and Harsbarger models in order to reflect a typical South African situation. Inflation, various initial situations, managerial abilities, classes of leased land, rent paid in cash and the South African tax system were incorporated in the amended model.

2.1 Initial farm situation

For the purpose of this study information regarding farm management was used to synthesise a representative farm in the Western Transvaal.*

Two initial situations, namely the established and the beginner entrepreneur, were assumed. The differences are shown in Table 1.

TABLE 1 - Differences in initial situations

	Initial situations	
	Beginner farmer	Established farmer
Farm size	500 ha	500 ha
Net value	R74 471	R143 041
Liabilities: Equity capital ratio	1:2,9	1:1
Remaining period of long-term loan	18 years	9 years
Long-term loan redemption (first year)	R8 500	R5 000
Medium-term loan redemption (first year)	R8 200	R6 000

Two initial situations therefore differ in their original debt burden and initial net worths. The growth ability of the farmer on the one hand who possibly inherited a farm and began farming with a small debt burden and the beginner farmer on the other hand who began farming with little equity capital and a large debt burden, are therefore compared. The total resources available, crop plans and stock numbers were the same in both initial starting situations. No land was initially leased. The family incomes of the initial situations were also identical.

2.2 Flow diagram of the decision-making process

A general approach in which an attempt is made to incorporate the most important aspects of the decision-making process has been followed. The flow diagram in Figure 1 reflects the logic and decision-making procedures in the simulation model. These aspects are discussed in more detail later.

2.3 Goals of the firm

Long-term growth in net value and an increase in real disposable income were made the primary goals. Maximum profit is not the final goal. Various plans are evaluated from year to year and the plan which apparently contributes most to the income and net value of the firm is implemented.

* This information was obtained from:
1. Mail-in records data, Division of Agricultural Production Economics
2. Viljoen, P. (1977) *General farm management results, Western Transvaal,* 1975/76
3. Various collaborators
4. *The Farming Business Management Handbook,* Department of Agricultural Economics and Marketing, now the Department of Agriculture and Fisheries.

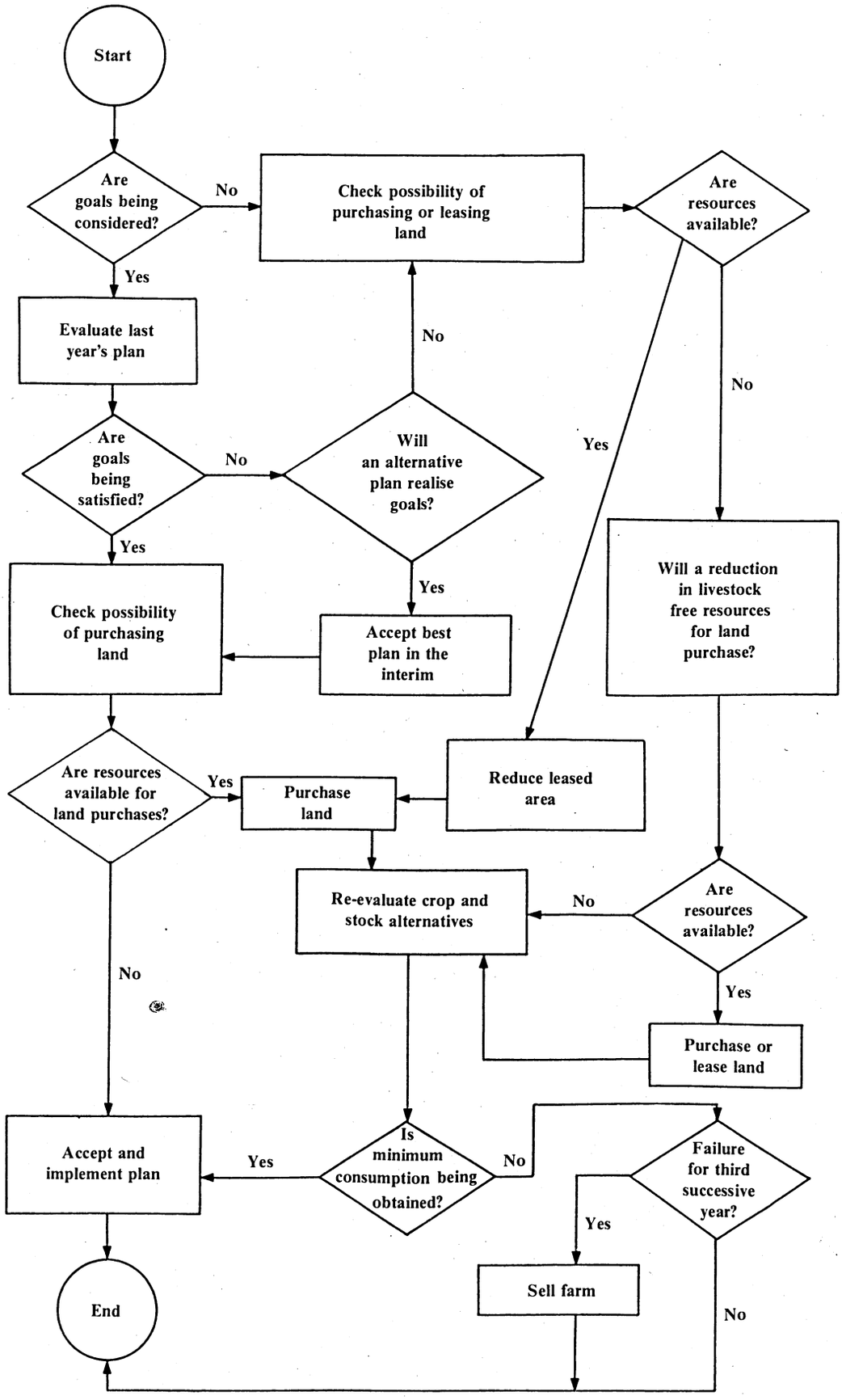

FIG. 1 - Flow diagram of decision-making process in model

2.4 Consumption

Consumption is considered a function of disposable income after provision has been made for income tax and repayment of debts. In case of inflation the necessary adjustments are made so that the real level of consumption is maintained. As consumption in farming is linked with disposable income in the past rather than in the future, the previous three years' consumption levels were also taken into account. The planned consumption level in the coming year is compared with the expected disposable income of a budgeted plan.

2.5 Price and yield expectations

An entrepreneur's price and yield expectations are used to calculate the expected results of a budgeted plan as well as of the plan with the highest satisfaction level. According to Patrick & Eisgruber[5] research has shown that entrepreneurs are inclined to project the recent past, with small adjustments, into the future. Both short and long-term price and yield expectations have therefore been included in this model by taking a weighted average of the previous three years.

Long-term price expectations are taken as a sliding average of prices of the past three years. The same approach is followed in respect of yield expectations.

2.6 Crop and stock enterprises in the model

Three different land classes were assumed. Class 1 type land, the high potential land, is used exclusively to cultivate row crops, class 2 to cultivate both row crops and forage crops and class 3 is intended exclusively for grazing. Two stock enterprises were considered, namely beef cattle and milk. As class 3 land is always available livestock enterprises usually form part of the planning process.

2.7 Planning process

The planning process consists of (1) the specification of a plan to be considered, (2) budgeting the proposal and (3) the evaluation of the results in relation to the goals set.

The first important consideration receiving attention in the model is whether additional land can be obtained. At the beginning of each decision-making period the possibility of purchasing additional land is investigated. If land is available it is first assumed that the same crop programme will be followed as in the previous year. Then, under this assumption, checks are carried out in respect of the availability of machinery, equipment, cash (after allowance has been made for the replacement of machines, buildings and minimum consumption) and long-term credit. If there are no shortcomings the additional land is purchased or leased.

The second decision concerns the selection of the best crop combination. The budgeted plan of the previous year (if land sizes have remained the same) or an amended plan (if additional land has been obtained) is used as a basis to compare alternative proposals. This therefore takes place on the basis of comparative budgets.

2.8 Evaluation process

The evaluation of the results of alternatives budgeted forms an integral part of the decision-making process. It is linked directly with the pre-set goals and the previous farm plans. All the alternative crop and stock plans are evaluated in terms of the pre-set goals, after which the best combination is chosen as the plan to be implemented during the coming year.

2.9 Results of the plan chosen

After the choice of a final plan the actual results are calculated by means of the model. In all probability the actual results will differ from the expected results, since expected figures for prices and yields realised during the past three years are used. Crop yields increase in proportion to the trend coefficients set. The final step in the model is to bring all the key planning variables needed for decision-making in the following period up to date. The necessary adjustments are made in respect of the purchase and depreciation of capital items, outstanding debts and debt repayments, consumption, cash available and other relevant factors. All adjustments for inflation are made, after which the information on the financial and physical structure of the firm is printed.

2.10 Deterministic and stochastic cases

The simulation programme is used to ascertain the results of various growth strategies under both deterministic and stochastic conditions. In the stochastic case a random number generator is used to choose a specific price or yield from a distribution of probabilities. The stochastic element can therefore widen the gap between expected and actual results in comparison with the deterministic case.

3. DESCRIPTION OF THE CONTROLLED VARIABLES IN THE MODEL

Although the number of variables controlled is relatively small in comparison with the variables which can affect the behaviour of the firm over time, the variables are chosen on the basis of their relative importance in the decision-making process.

3.1 Managerial ability

Only average and above-average managers are taken into account. The distinction is made in terms of technical transformation rates in that lower physical yields for both crop and livestock production are assumed in the case of the average farmer than in that of the above-average farmer. The yields obtained in the model are those of

above-average farmers and adjustments are made for average farmers.

3.2 Loan restrictions

The borrower controls the capital decisions and the quantity of money which can be borrowed. He therefore applies internal rationing of capital by placing restrictions on his loans himself. Long-term loans are here considered as loans for longer than ten years, while intermediate loans are for a period of two to ten years. It is assumed that an unlimited amount of credit is available for a one year period to cover current expenditure.

Two sets of loan restrictions are used. Under the high loan restriction up to 80 % of the value of long-term assets and 90 % of the value of medium-term assets may be borrowed. Under the conservative loan restriction up to 50 % of the value of long-term assets and 60 % of the value of medium-term assets may be borrowed.

3.3 Interest rates and inflation

Long, medium and short-term interest rates are taken into account. There are three sets of interest rates which vary in proportion to conditions of no, average and high inflation. In an inflationary period prices of inputs and products do not increase in proportion to one another. For this reason inflation rates for various commodities for the periods 1967/68 to 1973/74 and 1973/74 to 1978/79 were taken and divided into groups. The divisions were necessarily different for the different periods. No, average and high inflation conditions were identified.

The basic difference between the average and high nflation conditions flows from the fact that the period 1967/68 to 1973/74 (average inflation) is characterised by higher increases in product prices than in input prices. From 1973/74 to 1978/79 (high inflation) the condition was the opposite and cost-push inflation was experienced.

Although inflation rates actually vary over time a constant rate is nevertheless assumed for the simulation period. As a result of inflation all profits, assets and net worths will be inflated and a higher gross growth rate will have to be maintained in order to achieve the real growth rate contemplated. Inflation affects the model indirectly in that expectations of future prices of products are incorporated. In formulating price expectations for year t the price in year t-1 is weighted by 0,7 that in year t-2 by 0,2 and that in year t-3 by 0,1. Inflation in the past is therefore incorporated in expectations but is not anticipated.

3.4 Land acquisition strategies

Five different land acquisition strategies were investigated. Experimenting with the various strategies over a long enough period and with different restrictions, initial situations, inflation rates and interest rates will give an indication of which strategy will be the best under those conditions, bearing in mind risk and uncertainty. The various strategies largely reflect personal preferences, the availability of cash and the extent of internal capital rationing. A summarised description of the procurement strategies appears in Table 2.

TABLE 2 -Summarised description of land acquisition strategies

Land acquisition strategy	Description of strategy
1	Only lease land above fixed initial quantity
2	Only cash purchases of land. May however lease additional land
3	Purchase and lease land at every opportunity.
4	Purchase land only every fifth year. May however lease extra land.
5	Purchase land only when asset/liability ratio is less than 0,5. May otherwise lease additional

The first strategy only takes into account the leasing of units of 50 ha or multiples above the initial resource situation (cash, labour, machinery and equipment are important prerequisites).

The second strategy which may be followed is to purchase land only on a cash basis. If sufficient resources are available land may also be leased.

The third strategy for acquiring land is to purchase or lease land at any time. Only the normal resource and capital restrictions apply here. The entrepreneur's strategy is to try to grow at every opportunity, with due regard to monetary restrictions.

The fourth strategy is to purchase land only every fifth year if circumstances permit. This restriction is imposed to make provision for a practical situation where little land is available for purchase. Extra land may however be leased and there may therefore be an increased investment in machinery per unit of land owned.

The fifth strategy has to do with the debt : asset ratio of the firm. Only if this ratio is less than 50 per cent land is purchased.

3.5 Initial position

As it is to be expected that the favourability or unfavourability of the initial position will affect both the success of the growth strategy and the growth rate, these variables have been included. There differences have already been discussed.

4. PROCEDURE USED

A computer programme in Fortran IV was used and processed by the IBM 370 computer of the University of Pretoria. The programme was based on the programme developed by Eisgruber, Patrick and Harshbarger.

The simulation programme was used to ascertain the results of the various strategies under both deterministic and stochastic conditions. In the stochastic approach random prices and yields were

included which took into consideration the incomplete knowledge of the decision-maker regarding the future. Every situation was repeated 20 times in order to obtain a distribution of results. This was then used to evaluate the different strategies in terms of their average growth rate over the planning period as well as the average risk measured by the variation in final net worth.

Combinations of land acquisition strategies (5), loan restrictions (2), inflation and interest rates (3), initial positions (2) and managerial ability (2) were simulted for the deterministic analyses. For stochastic analyses only the strategies and results of the above-average manager were simulted. A total of 120 cases were therfore investigated in the deterministic situation and 60 cases in the stochastic situation. Comparisons were then made between the controlled variables for the different decisions in order to ascertain their effect on growth over time.

The results of the analyses will be discussed in subsequent articles.

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