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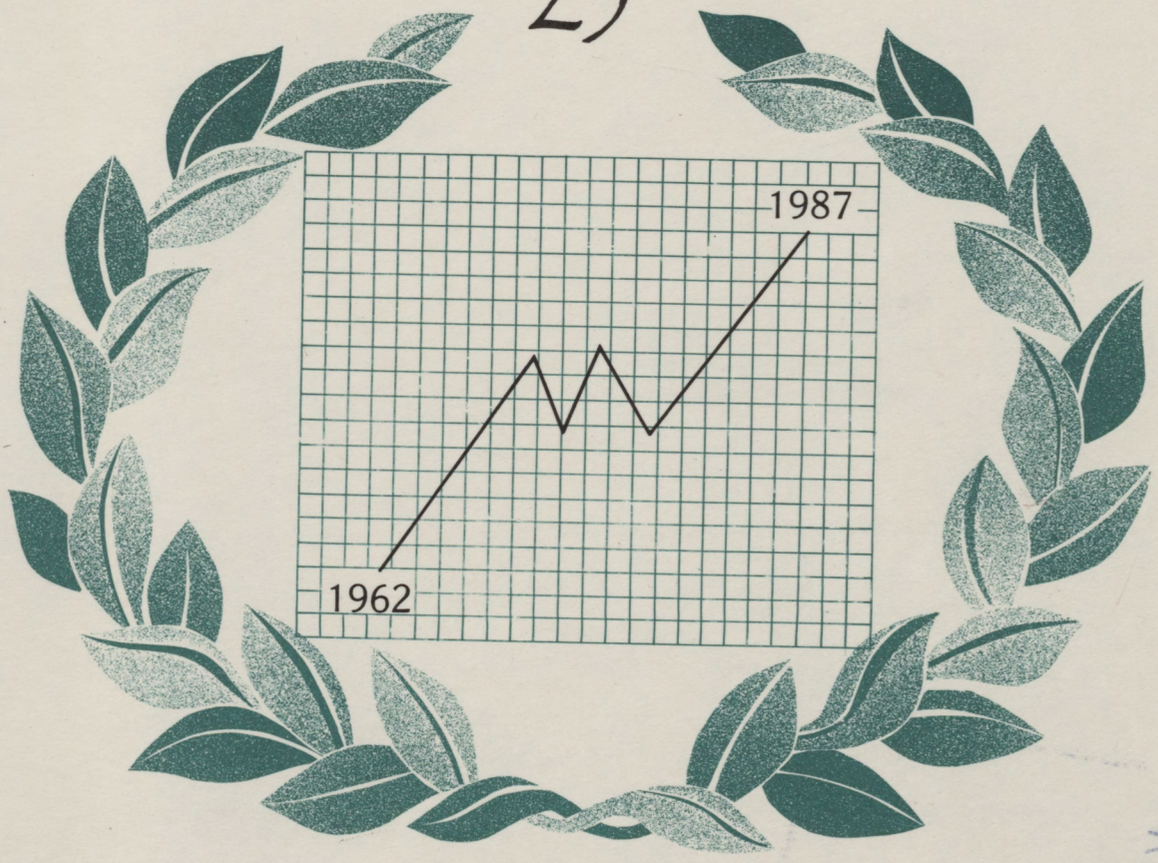




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# STRUCTURAL CHANGES UNDER CONDITIONS OF CHANGING RELATIVE PROFITABILITY OF ENTERPRISES

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## ABSTRACT

The striving for higher profit in farming, or at least the maintaining of profit, sometimes requires drastic changes in the existing farming system. On exceeding the marginal values of a parameter, the relative profitability between enterprises changes in such a way that structural changes are necessary to comply with this effort. These structural changes result in a shift in emphasis in the importance of enterprises in the farming composition. When the marginal values of a parameter are therefore exceeded and these structural changes in the farming composition are not made, this leads to sub-optimum allocation of resources in farming. Such action runs counter to the aim for higher profit, or maintaining profit in the agricultural organisation. The farmer is required to be aware of the importance of the respective parameters for the relative profitability of enterprises and to react to medium to long-term price trends by making necessary adaptations in the farming system.

## INTRODUCTION

Adaptability within a rapidly changing environment is what is required today of the South African farmer in order for him to maintain or to improve his financial position.

Adaptations in any farming system are continually necessary owing to the relatively rapid change in product and input prices with which the farmer has to contend. For the farmer it is therefore important to be aware of the effect of price changes on the relative profitability of the enterprises with an eye to adaptation within the farm set-up.

Such an adaptation may be a relatively small change in the size of the enterprise, or it may include a real structural change in an existing farming system. The latter may be justified if the relative profitability of enterprises change substantially on the basis of significant changes in input and/or product prices, and such price changes are of a longer-term nature.

The purpose of the investigation is to indicate the necessity of a drastic change in the farming structure in cases where input prices and product prices exceed certain critical values as parameters which determine the relative profitability of enterprises. For the purpose of the investigation, the Mid-Swartland was used as the field of research. This area is traditionally a mixed farming area where wheat production is the most important enterprise, combined with livestock, which consists mainly of sheep.

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## ANALYSIS METHODOLOGY

The technique of parametric linear programming was used to represent the effect of change in the value of parameters which determine the relative profitability of the most important alternative enterprises, mainly wheat and sheep (Table 1). This technique is known as the variable resource or variable price programming (Barnard and Nix, 1982; Beneke and Winterboer, 1973). The influence of the change in the value of each parameter on enterprise composition, resource utilisation and the total gross farming margin (TGFM), *ceteris paribus*, was investigated.

**TABLE 1 - Price ranges of various parameters**

| Critical parameters | Price and interest rate levels | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Wheat (R/t) | 300 | 325 | 350 | 375 | 400 |
| Mutton (R/kg)* | 2,65 | 2,95 | 3,25 | 3,55 | 3,85 |
| Wool (R/kg) | 2,85 | 3,35 | 3,85 | 4,35 | 4,85 |
| Fuel (R/ℓ) | 0,44 | 0,54 | 0,64 | 0,74 | 0,84 |
| Interest rate (%) | 12 | 15 | 18 | 21 | 24 |

*Price on the hook

The choice of parameters depends on them among the most important determinants of income and cost in these enterprises and therefore of the relative profitability. Yield is left out of account as an important determinant of income since yield levels are not known at the start of the production season and can also not be predicted with any reasonable accuracy. Yield is therefore not treated as a decision-making parameter. The values of the respective parameters are determined on the basis of possible price and interest rate expectations over the medium term (two to three years), where the size order of change is taken into account over the past few years.

The farming systems which produced the highest TGFM for the different values of the parameters were determined by the optimum combination of the activities below, subject to the set of limitations mentioned below:

### Production activities

The following alternative activities were considered in the investigation:

| | | |
|---|---|---|
| Winter crops | : | wheat; oats (grazing, seed, hay); lupins; medic grazing (annual, self-seeding) |
| Double-purpose stock | : | S.A. Mutton merino |
| Self-produced means of production | : | Oats seed; oats hay; lupin seed; ammoniated wheat straw |
| Purchased means of production | : | Oats seed; oats hay; lucerne hay; barley seed |
| Addition of minerals | : | Lick blocks |

Winter crops are grown in certain crop rotation systems according to soil potential (Table 2).

The purpose of applying a certain rotation system on soil of a certain potential is to achieve maximum physio-biological and financial advantages over the long term. According to Barnard and Nix (1982, p. 451), this approach has the further advantage that results are expressed in terms of efficient rotation farming systems which have practical application values.

### Resource limitations

Only those limitations whose availability had a real limiting influence are indicated.

| Relevant resource limitations | | Ways in which dealt with in simplex model |
|---|---|---|
| Land | : | Average size of farm is 650 ha, where high potential land = 50%, medium potential = 35%, low potential = 12% and waste = 3% of total farm area |
| Own capital available for trade | : | Available = R50 000 |

The influence of the change in values of the various parameters (*ceteris paribus*) on the following facets of agriculture were investigated, namely:

- the land use pattern of wheat,
- the change in the livestock enterprise and supplementary feed,
- the short-term loan capital use and
- total gross farming margin (TGFM).

Short-term loan capital use indicates only the financing of production inputs and not the purchase of mechanical equipment.

The possible occurrence of clearly distinguishable systems on the basis of clear groupings of enterprise compositions according to the changing values of the respective parameters was particularly noted. The enterprise compositions of the farming systems which follow as the values of the parameters change will therefore be compared relatively. Attention will also be paid to the extent of correspondence between various farming systems which are the result of different values of the parameters.

## RESULTS

According to the analyses it seems that clearly distinguishable farming systems can be identified by changing the values of the parameters. These parameters each have an influence on the relative profitability of the alternative main enterprises, namely wheat and sheep. Each parameter has marginal values which, if exceeded, result in a drastic change in the farming structure. This results in a substantial structure change in the farming system and not only a relatively small change in the enterprise composition, like the results of the transitions between the other (non-marginal) values of the parameters. (Structure change implies a change in the rotation farming system and the size of the flock.) The structure change is reflected in the clear change in the area under wheat production and flock size. Where wheat is the most important enterprise, System A will be referred to, while a more diversified system where the stock factor is prominent will be called System B.

The fixing of the marginal values, where a clear change between branches of the industry occurs, is illustrated using a series of mutton prices (Table 3).

In Table 3 the influence of different mutton prices on the change in farming structure and profitability can be seen. There are only two values for the given series of mutton prices in which a clear change in farming structure may be seen on the transition from the one to the other with regard to the area under wheat, flock size and short-term use of loan capital, without the TGFM being materially influenced. A relatively low mutton price of R2,95 per kg allows for greater extension of wheat production (Sytem A), while a structural change to System B occurs on a transition to R3,25 per kg.

The change between enterprises at the marginal values of the other parameters is illustrated as follows: A wheat price of R325 per ton represents a farming system where wheat production is the most

**TABLE 2 - Rotational systems on soils of different potentials**

| Soil potential | Wheat mono-culture | WWO1 | WWO2 | WWO3 | WWO4 | WG | WOL | WLO1 | WLO2 | WLO3 | WLO4 | WGGG |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| High | X | X | X | X | X | X | | | | | | |
| Medium | X | X | X | X | X | X | X | X | X | X | X | |
| Low | | | | | | | X | | | | | X |

WWO1 = wheat-wheat-oats grazing; WWO2 = wheat-wheat-oats seed; WWO3= wheat-wheat-oats hay; WWO4 = wheat-wheat-oats-grazing-oats seed; WG = wheat-grazing; WOL = wheat-old land-lupins; WLO1 = wheat-lupins-oats grazing; WLO2 = wheat-lupins-oats seed; WLO3 = wheat-lupins-oats hay; WLO4 = wheat-lupins-oats-grazing-oats seed; WGGG = wheat-grazing-grazing-grazing.

TABLE 3 - The influence of various mutton prices on the change in farming structure and profitability

| Mutton price (R/kg) | % of arable area under wheat | % difference | Flock size (SSU)* | % difference | Short-term loan capital (R) | % difference | Total gross farming margin marge | % difference |
|---|---|---|---|---|---|---|---|---|
| 2,05 | 70,2 | - | 456 | - | 87 201 | - | 149 292 | - |
| 2,35 | 70,3 | 0,1 | 523 | 14,7 | 89 795 | 2,9 | 152 186 | 1,9 |
| 2,65 | 70,6 | 0,3 | 535 | 2,3 | 90 635 | 0,9 | 154 755 | 1,7 |
| 2,95 | 70,6 | 0 | 568 | 6,2 | 91 210 | 0,6 | 157 818 | 1,9 |
| 3,25 | 47,5 | 23,1* | 1 054 | 85,6 | 54 883 | 39,8* | 161 883 | 2,4 |
| 3,55 | 43,5 | 4,0* | 1 110 | 5,4 | 47 132 | 14,1* | 168 613 | 4,2 |
| 3,85 | 43,2 | 0,3* | 1 142 | 2,8 | 48 043 | 1,9 | 175 655 | 4,2 |
| 4,15 | 40,0 | 3,2* | 1 142 | 0 | 48 078 | 0,1 | 184 321 | 4,9 |

*Percentage decrease with regard to previous value
**Small stock unit (SSU) equals 1 breeding ewe + 0,2 replacement ewe + 1,1 weaned lamb

important enterprise (System A), while the transition to R300 per ton results in a structural change in favour of the more diversified System B. The change in the wool price from R3,85 per kg to R4,35 per kg leads to a structural change in favour of System B. The production of wheat is relatively more profitable at a relatively low fuel price of R0,44 per $\ell$, with consequent extension in System A, while a rise in fuel price to R0,54 per $\ell$ causes a structural change to System B. The interest rate of 21 per cent per year favours System A, while a transition to 24 per cent per year results in a structural change in favour of System B, since the financing costs of production inputs of grain cultivation then rises, which lowers the relative profitability of this.

The nature of the structural change in the farming system which is the result of exceeding the marginal values of each parameter is discussed under the following headings:

## Land use pattern of wheat

In Table 4 the influence of the marginal values of the various parameters are indicated on the land use pattern of wheat. Soils are classified according to soil potential into high, medium and low. The largest change in area under wheat has occurred throughout on high potential land when the marginal values of the various parameters have been exceeded. As Table 4 shows, the change in value of wheat from R325 per ton (System A) to R300 per ton (System B) resulted in a difference of 49,3 per cent in area under wheat on high potential ground. In contrast to this the difference in area under wheat on medium potential soil amounted to only 1,7 per cent, with no change on low potential soil. The reasons for this may be found in Table 5B, from which it is clear that a change in rotation farming systems has occurred on high potential soil, while the same rotation farming system(s) are mostly applied on medium and low potential soil. Wheat monoculture (System A) was largely replaced by a WG system in System B on high potential soil.

The difference in area under wheat on high potential soil for all the parameters except wool price was of the same size order (approximately 45 per cent). The wool price, on the contrary, showed a difference of only 36,0 per cent. The explanation for this deviation may be found in the fact that at a marginal value of R4,35 per kg (System B) approximately 26,0 per cent of the high potential soil was still under a wheat monoculture system. This deviates slightly from the other parameters where a WG system in System B replaced the wheat monoculture system (System A) on approximately 90 per cent of the high potential soil (Table 5B).

On medium potential soil the marginal values of the various parameters resulted in a relatively small difference in area under wheat. The difference for the wool price, fuel price and interest rate in area under wheat was of the same magnitude as the marginal values of wheat price (approximately 2 per cent). Only in the mutton price was the difference 5,7 per cent. The explanation for this deviation lies in the fact that the WOL system replaced the WG system to a greater extent than in the other parameters (Table 5B).

On low potential soil at the marginal values for

TABLE 4 - The influence of exceeding the marginal values of the various parameters on the land use pattern of wheat on a Mid-Swartland farm

| Parameters | Value of parameter | | Percentage of land under wheat according to potential | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | High | | | Medium | | | Low | |
| | A | B | A | B | % difference | A | B | % difference | A | B % difference |
| Wheat price (R/t) | 325 | 300 | 99,6 | 50,3 | 49,3 | 45,3 | 43,6 | 1,7 | 25,0 | 25,0 - |
| Mutton price (R/kg) | 2,95 | 3,25 | 99,7 | 58,1 | 41,6 | 46,1 | 40,4 | 5,7 | 25,0 | 25,0 - |
| Wool price (R/kg) | 3,85 | 4,35 | 99,3 | 63,3 | 36,0 | 45,3 | 42,6 | 2,7 | 25,0 | 25,0 - |
| Fuel price (R/$\ell$) | 0,44 | 0,54 | 99,3 | 50,2 | 49,1 | 45,3 | 43,4 | 1,9 | 25,0 | 25,0 - |
| Interest rate (1%) | 21 | 24 | 99,3 | 57,3 | 42,0 | 45,3 | 43,2 | 2,1 | 25,0 | 25,0 - |

Land division: High potential = 49,2%; medium potential = 35,4%; low potential = 12,3%; waste = 3,1% of total farm area of 650 ha

TABLE 5 A and B - Short-term need for loan capital and land use pattern at marginal values for the various parameters

| ITEM | WHEAT PRICE | | MUTTON PRICE | | WOOL PRICE | | INTEREST RATE | | FUEL PRICE | |
|---|---|---|---|---|---|---|---|---|---|---|
| | R300/t | R325/t | R2,95/kg | R3,25/kg | R3,85/kg | R4,35/kg | 21% p.a. | 24% p.a. | R0,44/ℓ | R0,54/ℓ |
| GROSS MARGIN | 145 622,2 | 158 626,1 | 157 81,2 | 161 883,09 | 158 626,1 | 160 162,69 | 158 100,89 | 156 889,6 | 158 626,1 | 156 200,27 |
| **A. SHORT-TERM LOAN CAPITAL** | | | | | | | | | | |
| (a) Short-term loan capital: | | | | | | | | | | |
| February | – | 38 157,35 | 38 443,4 | – | 38 157,35 | 5 288,97 | 38 157,35 | – | 38 157,35 | – |
| March | 2 971,21 | 7 400,64 | 7 526,41 | 8 316,14 | 7 400,64 | 7 911,81 | 7 400,64 | 8 799,25 | 7 400,64 | 3 248,00 |
| April | 5 419,02 | 3 390,88 | 3 252,32 | 5 669,32 | 3 390,88 | 5 055,99 | 3 390,88 | 14 038,32 | 3 390,88 | 5 508,91 |
| May | 10 161,71 | 12 902,35 | 12 585,4 | 11 960,66 | 12 902,35 | 11 302,37 | 12 902,35 | 10 818,62 | 12 902,35 | 10 536,20 |
| June | 17 826,72 | 24 870,8 | 24 811,1 | 19 214,43 | 24 870,8 | 19 785,09 | 24 870,8 | 18 895,62 | 24 870,8 | 17 910,80 |
| July | 1 699,75 | 1 382,72 | 1 188,72 | 2 459,58 | 1 382,72 | 1 865,21 | 1 382,72 | 1 813,05 | 1 382,72 | 1 751,53 |
| August | 1 531,98 | 1 730,02 | 1 317,61 | 3 332,65 | 1 730,02 | 2 116,62 | 1 730,02 | 1 899,02 | 1 730,02 | 1 646,45 |
| September | 3 883,75 | 2 164,86 | 2 085,94 | 3 930,51 | 2 164,86 | 3 526,42 | 2 164,86 | 3 699,65 | 2 164,86 | 3 947,23 |
| (b) Repaid short-term capital debt: | | | | | | | | | | |
| October | 18 139,42 | 10 414,42 | 9 837,54 | 19 298,0 | 10 414,42 | 19 329,85 | 10 414,42 | 17 494,35 | 10 414,42 | 18 279,69 |
| November | 25 354,73 | 81 585,19 | 81 373,31 | 35 585,28 | 81 585,19 | 37 522,65 | 81 585,19 | 33 669,99 | 81 585,19 | 26 269,43 |
| **B. LAND USE – hectares** | | | | | | | | | | |
| (a) High potential: 320 ha | | | | | | | | | | |
| Wheat monoculture | – | 316,18 | 316,82 | 49,19 | 316,18 | 83,38 | 316,17 | 45,24 | 316,18 | – |
| Wheat-wheat-oats hay | 5,16 | 3,82 | 3,18 | 7,69 | 3,82 | 5,87 | 3,83 | 5,5 | 3,82 | 5,33 |
| Wheat-grazing | 314,84 | – | – | 263,12 | – | 230,75 | – | 269,26 | – | 314,66 |
| (b) Med. potential: 230 ha | | | | | | | | | | |
| Wheat-grazing | 142,34 | 164,9 | 175,94 | 97,93 | 164,9 | 128,72 | 164,9 | 136,56 | 164,9 | 136,4 |
| Wheat-old land-lupins | 87,66 | 65,1 | 54,1 | 132,1 | 65,1 | 101,28 | 65,1 | 93,44 | 65,1 | 90,6 |
| Wheat monoculture | – | – | – | – | – | – | – | – | – | – |
| (c) Low potential: 80 ha | | | | | | | | | | |
| Wheat-grazing-grazing-grazing | 80,0 | 80,0 | 80,0 | 80,0 | 80,0 | 80,0 | 80,0 | 80,0 | 80,0 | 80,0 |

all the parameters there was no difference in area under wheat. The explanation lies in the fact that the WGGG system was applied throughout in both Systems A and B (Table 5B).

The above discussions confirm the clear differences that exist between Systems A and B in the marginal values of the various parameters, as reflected in the area under wheat. These differences may be attributed to the extension or inclusion of certain rotation farming systems (e.g. WG and WOL systems). The complementariness between these rotation farming systems and the farming industry should have an influence on the extension of the sheep flocks. This aspect will accordingly be discussed.

### Size of the sheep flock

The influence of the marginal values of the various parameters on the size of the flocks and the amount of supplementary feeding that is needed is shown in Table 6. Table 6 also shows that exceeding the marginal values of the various parameters shows a difference of approximately 73 per cent in flock size between Systems A and B throughout. The change in interest rate of 21 per cent per year (System A) to 24 per cent per year (System B) shows a difference of 67,6 per cent in the number of small stock units (SSU) , which largely corresponds with that of the wool price (65,1 per cent). (SSU consists of 1 breeding ewe + 0,2 replacement ewe + 1,1 weaned lamb.) The wheat price and fuel price showed a difference of approximately 74 per cent. Mutton prices, on the other hand, showed a deviation of 85,6 per cent compared with approximately 70,3 per cent of the other parameters.

Exceeding the marginal values of the mutton price therefore had a greater influence on the extension of the number of SSU and that of the wool price (85,6 per cent compared with 65,1 per cent). The explanation for this lies in the fact that both mutton and wool make a contribution to the fixing of the gross margin (GM) of sheep. Income per SSU is determined by the *price* and *quantity* of mutton and wool respectively. The income from mutton makes a relatively larger contribution to income per SSU than the contribution of wool to price levels comparable with the marginal values. In spite of the higher wool price, the contribution of mutton to income per SSU was approximately 40 per cent more than that of wool. Mutton, therefore, had a greater effect on the relative profitability of sheep than wool at this price of R3,25 per kg. This is therefore the reason for the greater extension in SSU at the marginal values of mutton prices. In contrast to this, the marginal values of wool price influenced the relative profitability of sheep to such an extent that the flock size in System B is the smallest of all the marginal values of the parameters. A consequence of this is the larger area under wheat (wheat monoculture) on the high potential land (Table 5B). The differences that exist between the number of SSU at the marginal values of the mutton price and wool price in System B, may be brought more into accordance with each other, as well as with the other parameters, by minor adaptations in marginal values of both mutton and wool.

The extension in flock size of Systems A and B will necessarily also have an effect on the amount of supplementary feeding which has to be made available to late-bearing and lambing ewes. A change in the value of the wool price from R3,85 per kg to R4,35 per kg resulted in a difference of 47,3 per cent in supplementary feeding. The difference for the wheat price, fuel price and interest rate was approximately 40 per cent. The explanation for these differences between the latter parameters and the wool price may be found in the larger area under wheat on high potential land in System B (Table 5B). The result of this is less grazing in System B which therefore means that sheep have to receive supplementary feeding for longer periods. The marginal values of mutton prices, however, resulted in a difference of 81,5 per cent in supplementary feeding. This deviation may be explained by the increase of 85,6 per cent in the number of SSU, as well as the WOL system, which has largely replaced the WG system on medial potential land (Table 5B). More lupin seed food is harvested, which is used as raw material in supplementary feeding to be made available in periods when grazing is restrictive.

### Short-term need for loan capital

Table 7 shows the influence of exceeding the marginal values of the various parameters on the short-term need for loan capital. This aspect is discussed on the basis of total working capital which is needed yearly in Systems A and B, the interest rates related to this and the repayment of debt. The

**TABLE 6 - The influence of exceeding the marginal values of the various parameters on flock size and feeding practices**

| Parameters | Value of parameter | | Sheep | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Flock size (SSU)* | | | Supplementary feeding (t) | | |
| | A | B | A | B | % difference | A | B | % difference |
| Wheat price (R/t) | 325 | 300 | 568 | 986 | 73,6 | 114,9 | 154,8 | 34,7 |
| Mutton price (R/kg) | 2,95 | 3,25 | 568 | 1 054 | 85,6 | 114,9 | 208,6 | 81,5 |
| Wool price (R/kg) | 3,85 | 4,35 | 568 | 938 | 65,1 | 114,9 | 169,3 | 47,3 |
| Fuel price (R/ℓ) | 0,44 | 0,54 | 568 | 994 | 75,0 | 114,9 | 160,0 | 39,3 |
| Interest rate (%) | 21 | 24 | 568 | 952 | 67,6 | 114,9 | 164,9 | 43,5 |

*Small stock unit (SSU) = breeding ewe + 0,2 replacement ewe + 1,1 weaned lamb

exceeding of the marginal value of the fuel price of R0,44 per ℓ (System A) to R0,54 per ℓ (System B) showed a difference of 51,6 per cent in the need for working capital. The difference for the wheat prices and interest rate was approximately the same as the marginal value of the fuel price (differences lie between 45 and 52 per cent). The difference in the short term need for loan capital between Systems A and B at the wool price and mutton price was the lowest at approximately 39 per cent. The explanation for the difference in the wool price may be found in the larger area under wheat on high potential land in System B (Table 4). This larger area under wheat needs more working capital, as is clear from the R56 852 in System B (Table 7). There is therefore a strong positive correlation between the area under wheat and the need for short-term loan capital. The difference in the need for short-term loan capital between Systems A and B in the mutton price may be explained by the larger area under wheat on high potential land in System B (Table 4), together with the larger amount of supplementary feeding which has to be made available (Table 6).

As expected, the interest rates show large differences between Systems A and B, although these differences and differences in the need for working capital differ throughout. The change in marginal value of the fuel price between Systems A and B showed a difference of 51,6 per cent in the need for working capital, compared with a difference of 66,1 per cent in interest rates. Since the enterprise composition between Systems A and B clearly differ from each other (Table 4 and 6), this means that the need for short-term loan capital and the *periods* when these funds are needed may show differences. Of all the parameters, System A shows a greater need for short-term loan capital throughout , which is mainly needed at the beginning of the production year (Table 5A). At a compound interest rate of 0,054 per cent per day (20 per cent per annum), this therefore means a larger annual interest rate related to System A. The explanation for these differences between the short-term need for foreign capital and annual interest rates of Systems A and B therefore lies in the user pattern of money in the respective systems, at the period value of the money.

As expected, the difference in the enterprise composition between Systems A and B had a definite influence on the ability to repay loan capital. Of all the parameters, System B throughout, even in October, the month of the earliest repayment, paid off a larger portion of outstanding debt than System A. The advantages of the faster repayment of debt obligations are the saving on interest rate. By October System B had already paid off 42 per cent of the outstanding debt on wheat, compared with 11 per cent in System A. This trend applied to all the parameters, so that the differences between Systems A and B throughout were of the same size order (approximately 26 per cent). The explanation for the faster repayment of debt in System B may be found in the advantages of diversification, namely, the larger flock, which increases liquidity and therefore improves cash flow so that debt obligations may be fulfilled faster.

**Total gross farming margin**

Findings indicate clearly identifiable differences between Systems A and B with regard to the land use pattern of wheat, flock size and short-term need for loan capital. These clear differences between Systems A and B arose when the marginal values of the respective parameters were exceeded. In sharp contrast to the earlier findings, Table 7 shows no clear differences between Systems A and B of the various parameters with regard to TGFM. On changing the marginal values of the wheat price from R325 per ton (System A) to R300 per ton (System B), the difference TGFM was approximately 8,2 per cent, while it amounted to approximately 2,6 per cent in the mutton prices. The difference for the other parameters was still smaller than the meat price (approximately 1,0 per cent). This small change in TGFM as a result of a transition from System A to System B should not be seen in isolation, because it creates the impression that such structural changes are not necessary. Column C (Table 7) indicates the effect if such structural changes (transition to System B) are not carried through. A maintenance of the original system (System A) at the marginal values would then result in a sub-optimum allocation of resources which is reflected in a drop in TGFM.

The difference in TGFM between the original System A at the marginal value and System B was originally small, as is apparent from the values in column C (Table 7). As price and/or input costs move further to the benefit of System B, these differences in TGFM will get larger. This is illustrated by a mutton price of R3,85 per kg which increases the TGFM of System B to such an extent that the difference between Systems A and B now amounts to approximately 12,2 per cent (compared to 2,6 per cent at the marginal value of R3,25 per kg). By retaining System A at this higher mutton price of R3,85 per kg, the difference in TGFM between the latter system and System B amounts to approximately 6,7 per cent (compared with 2,2 per cent at the marginal value of R3,25 per kg).

These results emphasise the necessity of a timely adaptation in the farming structure. As production and input price movements continually lower the profitability of the existing farming system compared with the adapted system over the medium and long term, this implies that the contingency costs related to the delay in the adaptation increase with time.

## EXPLANATION OF FINDINGS

The explanation may be found in the fact that one is working in terms of systems and that rotation farming systems (e.g. WG and WOL) are evaluated against one another on the basis of the value (TGFM) of the purpose function of the respective systems. When a certain critical value of parameters which determine the relative profitability of enterprises is exceeded, it causes a drastic reallocation of resources between enterprises, which results in a transition to a new system. With the

TABLE 7 - The influence of exceeding marginal values of the various parameters on short-term loan capital and total gross farming margin

| Parameters | Value of parameter | | Short-term need for loan capital | | | | | | | | | Total gross farming margin (TGFM) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Loan of funds @ 20% p.a. | | | Interest rate (R) | | | Repaid (%) October* | | | | | | | |
| | A | B | A | B | %difference | A | B | %difference | A | B | %difference | A | B | %difference | C** | %difference |
| Wheat price (R/t) | 325 | 300 | 92 000 | 43 494 | 52,7 | 12 697 | 4 186 | 67,0 | 11 | 42 | 31 | 158 626 | 145 622 | 8,2*** | 138 818 | 4,7 |
| Mutton price (R/kg) | 2,95 | 3,25 | 91 210 | 54 883 | 39,8 | 12 675 | 5 596 | 55,9 | 10 | 35 | 25 | 157 818 | 161 883 | 2,6 | 158 312 | 2,2 |
| Wool price (R/kg) | 3,85 | 4,35 | 92 000 | 56 852 | 38,2 | 12 697 | 6 381 | 49,7 | 11 | 34 | 23 | 158 626 | 160 162 | 1,0 | 158 890 | 0,8 |
| Fuel price (R/ℓ) | 0,44 | 0,54 | 92 000 | 44 549 | 51,6 | 12 697 | 4 309 | 66,1 | 11 | 40 | 29 | 158 626 | 156 200 | 1,5[3] | 154 361 | 1,2 |
| Interest rate (%) | 21 | 24 | 92 000 | 51 164 | 44,5 | 12 697 | 6 579 | 48,2 | 11 | 35 | 24 | 158 100 | 156 889 | 0,8[3] | 155 916 | 0,6 |

* Month of earliest repayment
** Column C contains the gross margins of agricultural systems where the marginal values of the parameters concerned have been exceeded, but structural changes have not been made
*** Percentage decrease of TGFM in System B compared with System A

maximising of profit as objective, the systems should therefore be changed, owing to the inflexibility which accompanies systems as a result of certain fixed relationships between crops within a system. A large jump should therefore be made. This may therefore mean that large changes are made for the individual crops when the rotation farming system is changed. Wheat comprises 100 per cent, for example, in a wheat monoculture system, but only 50 per cent of the surface that should be worked in accordance with the optimum solution in a WG system.

## CONCLUSION

Results show that if certain marginal values of one or more parameters are exceeded, drastic changes are justified within the existing farming system. This results in a real structural change in farming organisation and not only a relatively small change in enterprise composition, which is the result of the transition between the other (non-marginal) values of the parameters. This structural change therefore implies a definite transition to an alternative farming system. The necessity for drastic action as a reaction to changes in values of parameters where certain marginal values are exceeded is therefore emphasised. With this the primary purpose of the investigation has been reached.

One may therefore deduce from the investigation that when marginal values of a parameter are exceeded and only limited changes are made in enterprise composition, this leads to a sub-optimal allocation of resources in the farming system. The effect of a structural change in the farming system of possible variations in income as a result of risk has not been investigated. On a decision as to which structural changes should be carried through, this factor should be thoroughly taken into consideration.

For the farmer as producer, however, it is difficult to determine these marginal values precisely. This implies that the farm manager should therefore react to medium to long-term price trends rather than momentary prices and that drastic changes in the farming system, when justified, are necessary. This, however, requires that the farmer should be aware of the importance of the specific parameters and the influence of these on the relative profitability of his farm.

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