AGREKON

Vol 40 Number/Nommer 2
June/Junie 2001

Published by the
Agricultural Economics
Association of South Africa

Gepubliseer deur die
Landbou-ekonomievereniging
van Suid-Afrika

WORLD BANK. (1993). World Tables. A World Bank Publication, Washington D.C.

PRODUCTION RISK ADVICE AT WHOLE FARM LEVEL: REPRESENTATIVE VERSUS MEAN FARMS

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Farmers are often faced with research results that are inapplicable to their unique situations. However, using representative farms can change this. In this article representative and mean farms are compared on the basis of the number of farmers that can identify with the respective farms as well as the production risk associated with each. Risk was quantified by means of a whole farm simulation model and presented by means of cumulative distribution functions. Results confirm that a significantly larger number of farmers can identify with representative farms than with a mean farm for their area. Most results obtained with the mean farm procedure reflect more risk than those obtained with the representative farms procedure when compared by means of cash flow, farm profitability and own capital ratio variability, and the probability of realizing a negative value. Significant differences therefore occur despite representative and mean farms being formulated from the same data.

1. INTRODUCTION

Farmers do not always pay attention to the advice of experts, because they regard it as inapplicable to their situation. Much as agricultural economists would like to perform analyses for every individual, it is not practically possible. However, farm situations are so diverse in nature that only one mean analysis is mostly inapplicable for the majority of farmers within a specific group. The middle course is to formulate representative farms (Elliott, 1928). According to Swart (1989) representative farms can, among others, be employed to determine the position of farmers should they adopt a proposed practice. Representative farms also enable one to use research results as a guideline for actual farms in the study area (Meiring, 1994). Feuz and Skold (1991) regard representative farms as the proper tool for whole farm level analyses. Elliott (1928) corroborates that representative farms provide a basis for comparing the relative profitability of different enterprise combinations at varying yields and product and input prices.

It is often assumed that the population is normally distributed with respect to the variable in question. Plaxico and Tweeten (1963) consider this to be a somewhat brave assumption. Besides, large variation exists within agriculture. Elliott (1928) comes to the conclusion that a mean farm is obviously not representative, nor does it accurately describe the whole

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distribution. In spite of the latter source dating back to 1928, it is referred to several times in consequence of the pioneer work done by the author. Both Elliott (1928) and Meiring (1994) point out that an actual farm of the same area and set-up as the mean farm seldom exists.

A representative farm is the mode of a frequency distribution of farms (Elliott, 1928). According to Plaxico and Tweeten (1963) representative resource situations is a more descriptive name. Meiring (1994) defined a representative farm in accordance with the purpose of his study. Hence a representative farm is a resource situation with which a reasonable number of farmers can identify themselves and of which the economical and financial results are expected to differ significantly from that of other resource situations. Either a hypothetical or actual farm can be used. According to Feuz and Skold (1991) the choice depends on the purpose of the study and the preference of the researcher. It is generally agreed that the criteria used for formulating representative farms are to a large extent determined by the purpose of the study. However, including all relevant variables will result in an unmanageable number of representative farms. Diversity within the study area as well as the purpose of the representative farms determines the number (Meiring, 1994). Swart (1989) found that the width and boundaries have a large effect on the frequency in a class. According to Meiring (1994) the class widths and boundaries of a variable are determined by the purpose for which this variable was included. A representative farm should represent as many actual farms as possible. Representative farms provide information regarding typical sizes, the most general enterprise systems, capital good combinations required for production, and financial measures of economic welfare (Meiring, 1994). Elliott (1928) comes to the conclusion that recommendations by virtue of a representative farm undoubtedly have direct applications. Meiring (1994) follows a four-step procedure for formulating representative farms. Firstly, alternative fixed resource situations are identified. The importance of each situation in terms of the number of farmers that can identify with it is also determined. Step two involves determining the variable resource situation of each representative farm. In step three the liability structure is determined. Lastly, alternative management strategies are identified for each representative farm. Only then can economical analyses be carried out.

A single mean farm is generally assumed to be representative of all the farms within a specific area. Elliott (1928) argues that homogeneous groups describe this area more accurately. Consequently the main objective of this paper is to determine whether advice differs for results of a mean farm and representative farms procedures respectively. Two sub-objectives result from this. Firstly, the extent to which farmers can identify with specific

representative and mean farms is determined. Sub-objective two deals with the relative riskiness of these hypothetical farms.

Subsequently the procedures followed in order to arrive at the results are set forth. The latter is dealt with in section three on the basis of two subsections. Firstly formulated representative and mean farms together with their different asset and liability structures are discussed. In subsection two the financial performance of these farms is quantified and presented by means of cumulative distribution functions. Finally a conclusion is made.

2. METHODOLOGY

Anonymous farm level data for the Danielsrus and Reitz area were obtained from the Economic Services Department of Vrystaat Koöperasie Beperk (VKB). Since data for the 1999/2000 season were not available by the time the study was carried out, 1998/99 data were used. All data records for this season were used in the analysis. The fixed resource situation of representative farms was defined by means of frequency distributions. First own and thereafter leased land was dealt with. The assumption of a 150 ha interval results in a deviation of no more than 75 ha from the class middle value. Consequently a farmer falling within a specific interval can identify with the area concerned. For the sake of simplicity the class median is now also a round number. Whether own or leased land, land uses must add up to the total area. Consequently land uses with the least peaky frequency distributions were adjusted, if necessary. The fixed resource situation of the mean farm was calculated as the mean area of own and leased land, added together. Both own and leased mean land use areas were proportionally adjusted to ensure that they add up to the corresponding total area. The only livestock enterprise included is beef cattle. In this manner veld, crop residues and artificial pasture were utilized.

A crop rotation trial is carried out at the Agricultural Research Council - Small Grain Institute (ARC-SGI) in Bethlehem. It is a joint effort by this Institute and the Agricultural Research Council - Grain Crops Institute (ARC-GCI). A dry beans-wheat-fallow-maize (Db-W-F-M) crop rotation system is amongst others being evaluated. An assumption was made that this system is followed on each representative as well as the mean farm. As for the variable resource situation, a typical mechanization system which can accommodate all crops commonly grown in the study area was included. A sufficient number of labourers were employed.

The co-operative's data were used to identify asset and liability structures. Like fixed resources, the total liabilities : total assets ratios of representative and mean farms were defined by means of frequency distributions and mean values respectively. Frequency distributions were analysed by means of 10% intervals of which the class median is divisible by 10. The percentual contribution of long- intermediate- and short-term liabilities towards the total, for representative and mean farms respectively, was calibrated like land use areas were previously.

A whole farm simulation model which can take account of risk, developed by Meiring (1994), was employed for the analyses. This short-term stochastic model employs cumulative distribution functions of key variables to generate distribution functions of various important economic criteria by means of Monte Carlo simulation. Production inputs and quantities of the trial were used in crop enterprise budgets. Trial yields were used for the simulation of production risk. Simulations of 50 iterations were executed.

3. RESULTS

3.1 Representative and mean farms with accompanied asset and liability structures

Hundred and twenty-six data records were suitable for the analysis. The variation coefficient for area own land is approximately 116 and for leased land 145. Areas under dry land, artificial pasture and veld have coefficients of 66, 123 and 132 respectively. The variation coefficients for long-, intermediate- and short-term assets respectively are 116, 96 and 280. Total assets have a coefficient of approximately 99 and total liabilities a coefficient of 139. The variation coefficients for long-, intermediate- and short-term liabilities are 178, 207 and 150 respectively.

Table 1 depicts three representative farms as well as a mean farm, formulated for the study area. A frequency distribution of own land revealed peaks at 0 ha, 300 ha, 500 ha and 850 ha. The situation of farmers owning 500 ha land was not analysed further to guard against results differing insignificantly. Approximately 48% of farmers in the study area can identify with the remaining three intervals, 24%, 13% and 12% with the 0 ha, 300 ha and 850 ha intervals respectively. A frequency distribution of leased land for farmers owning no land, revealed peaks at 0 ha and 350 ha. Of these farmers, approximately 23% can identify with 350 ha leased land. Approximately 63% and 47% of farmers owning 300 ha and 850 ha land respectively, lease no land.

Table 1: Three representative farms and an alternative mean farm formulated from 1998 data for the Danielsrus and Reitz area

Land use	Land (ha)	RF1	RF2	RF3	MF
Dry land	Own	0	200	500	319
	Leased	200	0	0	159
	Total	200	200	500	478
Artificial pasture	Own	0	0	50	49
	Leased	0	0	0	16
	Total	0	0	50	65
Veld	Own	0	100	300	329
	Leased	150	0	0	120
	Total	150	100	300	449
Total	Own	0	300	850	697
	Leased	350	0	0	295
	Total	350	300	850	992

RF: Representative farm
MF: Mean farm

Too little data were available regarding land uses of the 350 ha land leased. Consequently the land uses of 300 ha own land, only with a 50 ha upwards adjustment to veld, were used. Thus representative farm one (RF1) consists of 200 ha dry land and 150 ha veld of which both are leased. Representative farm two (RF2) consists of 200 ha dry land and 100 ha veld, whereas representative farm three (RF3) consists of 500 ha dry land, 50 ha artificial pasture and 300 ha veld. Everything is owned in the case of RF2 and RF3.

The 992 ha mean farm (MF) consists of 697 ha own and 295 ha leased land. If these values are assumed to be the class median of a 150 ha interval, the methodology pursued in the case of representative farms, only 9% of the farmers can identify with the area own land and only 11% with the area leased land. In its turn, the 697 ha own land consists of 319 ha dry land, 49 ha artificial pasture and 329 ha veld. The corresponding areas for leased land are 159 ha, 16 ha and 120 ha respectively. Area-wise the MF is considerable larger than the largest representative farm. Investment in land is approximately R 476 000 for RF2, R 1 349 000 for RF3 and R 1 106 000 for the MF.

The asset and liability structures of representative and mean farms for the study area are shown in Table 2. A frequency distribution of the different total liabilities : total assets ratios revealed peaks at 20% for representative farms one and two, and 30% for RF3. Approximately 26%, 19% and 40% farmers of RF1, RF2 and RF3 respectively can identify with the corresponding intervals.

The 20% debt capital of RF1 consists of only short-term liabilities while that of RF2 consists of 30% long-, 10% intermediate- and 60% short-term liabilities. Fifty percent, 20% and 30% long-, intermediate- and short-term liabilities respectively make up the 30% debt capital of RF3. The 33% debt capital of the MF consists of 25% long-, 17% intermediate and 58% short-term liabilities. Not only does the MF cover the largest area, it also has the largest total liabilities : total assets ratio.

Table 2: The 1998 asset and liability structures of representative and mean farms formulated for the Danielsrus and Reitz area

Asset and liability structure		RF1	RF2	RF3	MF
Liabilities : assets (%)		20	20	30	33
Percentual contribution to total liabilities	Long term	0	30	50	25
	Intermediate term	0	10	20	17
	Short term	100	60	30	58

RF: Representative farm
MF: Mean farm

3.2 Financial implications

In Figure 1 the simulated own capital ratios for these representative and mean farms are presented by means of cumulative distribution functions. Representative farms one, two and three have own capital ratio ranges of approximately 28% (100 - 72), 22% (96 - 74) and 8% (92 - 84) respectively. The range of RF3 is smaller than that of RF2, which in turn is smaller than the range of RF1. Larger variability in own capital is expected in the case of a bigger owned farm. However the larger asset value of representative farms two and three overshadows this possible larger variability, resulting in smaller own capital ratio range. Compared to RF3, the MF consists of a smaller area own land and consequently also has a smaller asset value. Hence the own capital ratio range of approximately 35% (95 - 60) for the MF. This range is considerable larger than that of any representative farm. Therefore, if own capital ratio variability is assumed the criterion of risk, the MF is the most risky. Besides, an approximate 19% probability exists that the MF will realize an own capital ratio smaller or equal to the minimum realized by any representative farm, in this case RF1.

Farm profitability, simulated for the different representative and mean farms, is presented by means of cumulative distribution functions in Figure 2. The MF has the second largest farm profitability range, approximately 72%. Representative farms one, two and three have ranges of approximately 82%, 56% and 42% respectively. The MF holds the greatest risk to realize a negative.

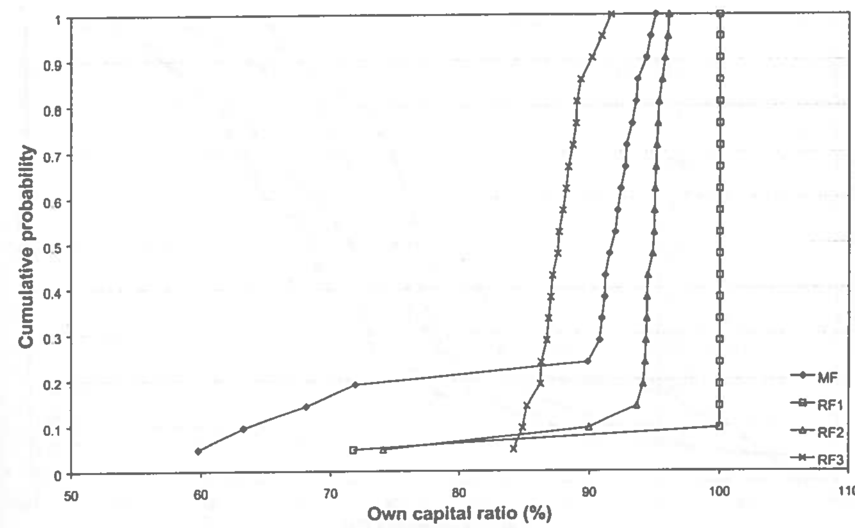

Figure 1: Cumulative distribution functions of simulated own capital ratios for representative and mean farms formulated during 1998 in the Danielsrus and Reitz area

farm profitability. Representative farm one, RF2 and the MF reveal probabilities of 8%, 9% and 19% respectively that a negative farm profitability will be realized

End of the period cash flow was simulated for the different representative and mean farms. Simulation results are presented by means of cumulative distribution functions in Figure 3. Representative farms one, two and three have cash flow ranges of R 1 017 989, R 869 108 and R 2 044 124 respectively. The MF with a cash flow range of R 2 805 371 is therefore the most risky in this respect. As a consequence of this large range, an approximate 21% probability exists that a cash flow smaller or equal to the minimum of any representative farm, in this case RF2, will be realized. A slight probability (1%) also exists that the MF will realize a cash flow larger or equal to the maximum of RF3. The MF is also the most risky with respect to the probability of realizing a negative cash flow. An approximate 24% probability exists for the MF to realize a negative flow. The corresponding percentages for representative farms one and two, are approximately 9% and 13% respectively.

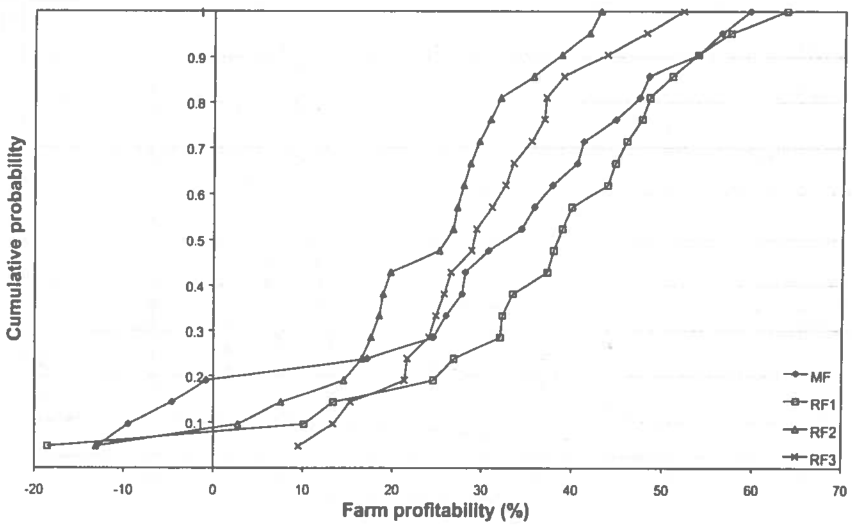

Figure 2: **Simulated farm profitability cumulative distribution functions for representative and mean farms formulated during 1998 in the Danielsrus and Reitz area**

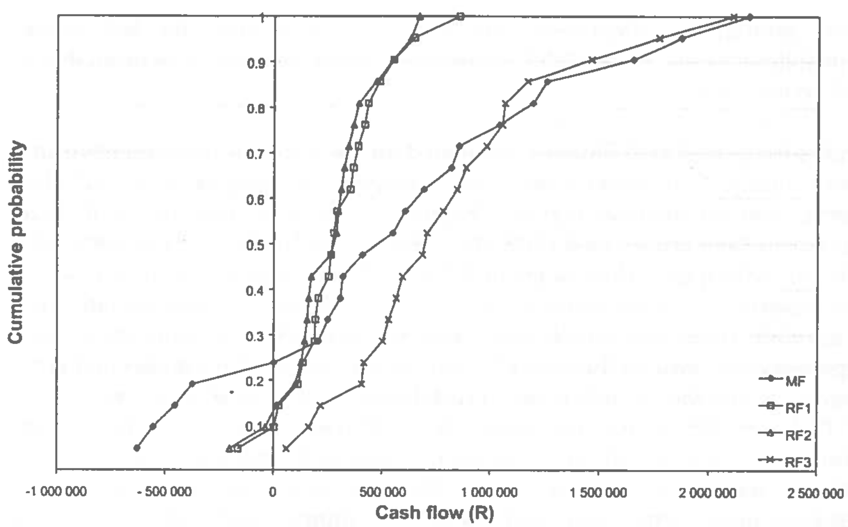

Figure 3: **Cumulative distribution functions of simulated cash flows for representative and mean farms formulated during 1998 in the Danielsrus and Reitz area**

4. CONCLUSION

By employing the representative farm theory, 48% farmers in Danielsrus and Reitz could identify with the area own land of three representative farms. Alternatively only 9% farmers could identify with the area own land of a mean farm. Contrary to the case of a mean farm, when compiling a representative farm the interdependence between fixed resource variables is taken into account. It is therefore impossible to extend this comparison even to leased land.

In comparison with representative farms, the MF has the largest own capital ratio and cash flow ranges. Consequently a considerable probability exists that the MF will realize corresponding values smaller or equal to the minimum realized by any representative farm. The MF also reveals the largest probability of realizing either a negative farm profitability or cash flow. Although representative and mean farms are based on the same data, the latter appears to be the most risky. Representative farms bear a larger computation burden. Even so, more farmers can identify with research results based on these farms, and consequently results are more true to life.

5. ACKNOWLEDGEMENTS

Financial support by the Water Research Commission (WRC) and Agricultural Research Council Group for Development Impact Analysis (ARC-DIA) is hereby acknowledged.

Co-operation with VKB and their willingness to make data available are also recognised. These three organisations do not necessarily share the opinions expressed by the authors.

REFERENCES

AVENANT, L. (1999). Personal communication. Officer, Land and Agricultural Bank of South Africa, Bloemfontein.

ABSA BANK LTD., BLOEMFONTEIN (1999). Personal communication. Adviser: credit. 1999.

BAYER SOUTH AFRICA (PTY) LTD., POTCHEFSTROOM. (1999). *Personal communication*. Representative. 1999.

BONSMARA CATTLE BREEDERS' SOCIETY OF SOUTH AFRICA. (1999). *Personal communication*. Manager. 1999.

BOOYENS, F.C. (1999). *Personal communication*. Manager: grain marketing, Senwes Ltd., Klerksdorp.

BOTHA, S.D. (1999). *Personal communication*. Regional officer (Mpumalanga/Gauteng), Dry Beans Producers' Organization, Pretoria.

COMPUTUS MANAGEMENT BUREAU CC. (1999). *Personal communication*. Member. 1999.

DIRECTORATE OF COMMUNICATION. NATIONAL DEPARTMENT OF AGRICULTURE. (1997). *Guide to machinery costs, March 1997* compiled by J.C.N. Mentz and X.D. Nqaba. Pretoria: Directorate of Communication.

DIRECTORATE OF COMMUNICATION. NATIONAL DEPARTMENT OF AGRICULTURE. (1999). *Guide to machinery costs, June 1999* compiled by J.C.N. Mentz, G.S. Müller and D. Hartzenberg. Pretoria: Directorate of Communication.

ELLIOTT, F.F. 1928. The "representative firm" idea applied to research and extension in agricultural economics. *Journal of farm economics*, 10(4):483-498.

FEUZ, D.M. & SKOLD, M.D. (1991). Typical farm theory in agricultural research. *Journal of sustainable agriculture*, 2(2):43-58.

GEBRUIKTE-TREKKER PRYSGIDS. (1999). *Agfacts*, October-December 1999, Vol 11, No. 4.

GROBBELAAR, P.J. (1999). *Personal communication*. Senior grain marketer, OTK Ltd., Bethlehem.

HORN, H. (1999). *Personal communication*. Manager: SAFEX broker's service. NWK Ltd., Lichtenburg.

KLEYNHANS, L.J. (1999). *Personal communication*. Representative, Voermol Voere, Heilbron.

DICKINSON, E.B., HYAM, G.F.S. & BREYTENBACH, W.A.S. (1990). *Die Kynoch weidingshandleiding waarby sekere aspekte van diereproduksie ingesluit is.* Cape Town: CTP (Pty) Ltd. Printers.

MEIRING, J.A. (1994). *Die ontwikkeling en toepassing van 'n besluitnemingsondersteuningstelsel vir die ekonomiese evaluering van risikobestuur op plaasvlak.* Ph.D. thesis. University of the Orange Free State.

MULLER, P.J. (1999). *Personal communication*. Marketer, Lovwid Auctioneers CC., Frankfort.

PLAXICO, J.S. & TWEETEN, L.G. (1963). Representative farms for policy and projection research. *Journal of farm economics*, 45(5):1458-1465.

REPUBLIC OF SOUTH AFRICA. DEPARTMENT OF AGRICULTURAL DEVELOPMENT, 1991. *An evaluation of the application and potential of agricultural land and production stability of dry land crops in the magisterial districts of the Highveld Region, Technical communication No. 224* compiled by B.P. Ludick and J.G. Wooding. Pretoria: Government Printer.

REPUBLIC OF SOUTH AFRICA. DEPARTMENT OF AGRICULTURE AND FISHERIES. (1982). *C.3 Klassifikasie van plaasdiere en wild om weidingskapasiteit te beraam* compiled by H.H. Meissner. Pretoria: Government Printer.

SOUTH AFRICAN RESERVE BANK. (1999). *Quarterly Bulletin, December, No. 214*. Pretoria: South African Reserve Bank.

SWART, T., 1989. *Die effektiwiteit van rentesubsidies op oorlaatskuld en nuwe produksiekrediet aan boere in die Noordwes-Vrystaat.* M.Sc. dissertation. University of the Orange Free State.

THAKE, G.D. (1999). *Personal communication*. Grain buyer, Louis Dreyfus Africa (Pty) Ltd., Harrismith.

VAN DER WATT, D.J. (1999). *Personal communication*. Commodity trader, Farmwise Grains Pty. Ltd., Johannesburg.

VAN ZYL, L.C. (1999). *Personal communication*. Senior commodity trader, Free State Maize (Pty) Ltd., Welkom.

VRYSTAAT KOÖPERASIE BPK. REITZ. (1999). *Personal communication*. Commercial shop.