# AN ANALYSIS OF FACTORS CONTRIBUTING TO THE USE OF AN INCOME EQUALISATION DEPOSIT SCHEME BY COMMERCIAL FARMERS IN SOUTH AFRICA[1]

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**Abstract**

*Recent research suggests that an Income Equalisation Deposit (IED) scheme could be a feasible new risk management tool for commercial farmers in South Africa. This prompted a study of practicing consultants' (tax experts) views on determining what types of farmers would be likely to use the scheme. During 2000, a postal survey of 24 consultants was conducted mainly in KwaZulu-Natal, and in the Maize Triangle and surrounding areas. Each consultant was to review nine scenarios (eight plus a control, giving 192 observations) and decide whether they would recommend an IED scheme for each scenario. A statistical experimental design was used to structure the scenarios, allowing for main and interaction effects between variables that could influence the potential use of an IED scheme. Discriminant analysis revealed that, ceteris paribus, farmers with higher annual net farm incomes (>R300,000), lower debt/asset ratios (<15%), more variable net farm incomes, and less off-farm income would most likely use an IED scheme. In terms of ranking, ceteris paribus, high risk maize farmers, intermediate risk maize farmers and high risk livestock farmers are more likely to use an IED scheme than are low risk maize farmers, low and intermediate risk livestock farmers and diversified farmers. These results support the use of an IED scheme as a risk management tool as higher risk farmers are more likely to make use of the scheme.*

## 1. INTRODUCTION

Farmers operate and make decisions in an uncertain environment characterised by business and financial risk (Gabriel & Baker, 1980). More variable product prices following agricultural marketing deregulation, drought, and more variable nominal interest rates, are recent examples of such risks in South Africa. These risks lead to income variability, especially in the grain sectors where widespread droughts are common. Past South African government response to drought mainly involved providing drought relief,

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culminating in R3.8 billion worth of assistance - mostly to maize farmers - in 1992/93 (Willemse, 1992:15). Since 1994, the South African government has changed this policy and has encouraged farmers to manage risks themselves, in order to reduce demands on government funds. One option currently being proposed to the National Department of Agriculture (NDA, 1997) is an Income Equalisation Deposit (IED) scheme. An IED could provide a reserve fund in which farmers invest part of their income during "good" years, and then are taxed on this income only when they withdraw the money for use in "bad" years. In this way, the IED would operate as a risk management tool to help stabilise farm incomes.

In a progressive income tax structure, taxpayers with fluctuating incomes are more likely to have a greater tax liability than taxpayers with relatively stable incomes. Thus, taxpayers with comparable incomes over a time period may not be treated similarly and tax equity may not be achieved. Because of this, South African farmers can elect to be taxed at a rate that is based on a moving average income. However, this tax instrument does not promote better cash flow and better risk management as the farmer is not provided with additional incentives to save in good years and to be better prepared for the "lean" years. The drought relief provision (paragraph 13A of the First Schedule of the Income Tax Act) provides some drought relief to livestock farmers, but no scheme is available to crop farmers who are more vulnerable to droughts.

The establishment of an IED scheme is not a new issue in South Africa since it was first considered in 1951, put forward again in 1960, and later proposed in 1979 and 1987 (RSA, 1951; 1979 and 1987). The scheme was seen as a means of stabilising farm incomes, acting as a risk management tool. The recommendation was rejected in all cases. The government and all commissions involved were not convinced of the feasibility of the proposed scheme stating it was open to serious objections. Criticisms included (1) it leads to tax deferral, (2) the current income averaging scheme also allows farmers to provide for poor years via tax savings in good years, and (3) the scheme may be misused in conjunction with the current income averaging scheme that has an in-out option, to destabilise income and reduce tax (Lamont, 1990:410).

More recently, the use of an IED scheme as a tax instrument to promote improved cash flow and risk management has been considered by many, focusing primarily on the tax implications (Lamont, 1990; NDA, 1997 and Fuchs, 1999). Nieuwoudt & Howell (2000), however, perceived that the economic feasibility of such a scheme had not been fully researched and the economic environment had changed considerably over the years making the scheme more attractive. Most crop insurance schemes had collapsed, deregulation had lead to an increase in uncertainty and real interest rates became positive creating more of an incentive to save. In light of these events, the economic feasibility of introducing an IED scheme in South Africa was evaluated by Nieuwoudt & Howell (2000). They suggested that the proposed scheme could be feasible in the South African situation, promoting better cash flow and risk management over time. This study reports on a postal survey which was conducted amongst 24 South African tax consultants (experts) in 2000. It complements Nieuwoudt and Howell's study by researching whom practicing tax consultants consider as the likely beneficiaries of an IED scheme for commercial farmers in South Africa. Discriminant analysis was conducted to identify and rank factors that distinguish between potential adopters and non-adopters of an IED scheme.

## 2. BACKGROUND HISTORY OF IED PROPOSALS FOR SOUTH AFRICA

This section provides an overview of past IED scheme proposals in South Africa.

### 2.1 Past reviews of IED schemes in South Africa

The establishment of an IED scheme in South Africa was initially considered by the Steyn Committee in 1951 (RSA, 1951). The Committee recommended against its introduction as other forms of the industry were also subjected to income variations. In 1960, the De Swart Study Group on Agricultural Credit recommended IED's as a means to counter excessive capital expenditure and consequent financial difficulties of farmers. The principle was not accepted. In 1979, the Jacobs Committee supported IED schemes in principle, but did not consider themselves to have the expertise to evaluate the practical implications of the proposal (RSA, 1979). The proposal was referred to the Standing Commission of Taxation and the Commission for Inland Revenue who found the IED scheme was open to serious objections. The government (RSA, 1982) accepted the recommendations of the Standing Commission that the scheme be rejected. Finally, the Margo Commission recommended against the use of IED's in 1987 (RSA, 1987), commenting that an IED scheme, whether as a complement to or a replacement of the current averaging scheme, should not be implemented.

The main advantages of IED schemes in the past were (Lamont, 1990:409; RSA, 1987):

a) **Stability**. Greater stability in the agricultural sector will be promoted, as this sector is subject to income and production variations from year to year.

b) **Voluntary**. Farmers will be able to overcome setbacks and crises on their own.

c) **Welfare**. If farmers are more able to help themselves, it will reduce the dependence on State assistance during adverse rimes.

d) **Efficiency**. Income fluctuations and bunching of investment expenditure will be smoothed.

e) **Administration**. If funds are deposited at a bank, the scheme will be easy to administer.

Major criticisms of IED schemes in the past are presented below, with recommendations provided by Nieuwoudt & Howell (2000):

1) An IED scheme will favour the rich (Hattingh, 1986) and indications are that a small percentage of farmers would be able to use an IED scheme (RSA, 1987).

   Current deposits in the drought relief scheme for livestock sales (paragraph 13A) are estimated at just over R200 million and the number of investors has increased three-fold since the Margo Commission enquiry. This indicates that deposits will not be insignificant if an IED scheme is adopted and caters for both crops and livestock.

2) The scheme impinges on the sound principle that revenue should be taxed in the year in which it accrues (RSA, 1987).

   Farmers cannot benefit from deferred taxes while the funds are deposited as they cannot access these funds. Tax deferral can also be limited by specifying a time limit on holding deposits. This principle has already been ignored under the drought relief measure provided by the Land Bank.

3) There are many other sectors of the economy which suffer vagaries of fluctuating markets, sales and income. To make an exception for farming would be indefensible if others were refused (Lamont, 1990:409).

Agricultural risk has different components, which distinguish it from risk in other sectors. The first component is the risk arising from adverse weather, which affects vast areas simultaneously. This is common in South African agriculture. The second component is the severity of the risk when compared to North America and Europe where a 30% decline in corn production is seen as a disaster. A decline of more than 60% in maize production is not uncommon in South Africa. Lastly, the farmer has little control over his environment and often has little scope to diversify. This is especially true in the cropping areas of South Africa. Other sectors may experience risk, but more opportunities are available to spread business risks.

4) Current averaging schemes lend themselves well to enable farmers in good years to make provision for poorer years by means of a tax saving (Lamont, 1990:409).

   These concessions, [paragraph 15 (3) (plantation farming) and paragraph 19 (2) (average taxable income) of the First Schedule of the Income Tax Act No. 58 of 1962 (Huxham & Haupt, 2000)], provide the farmer with some tax relief and removes some of the incentives to overcapitalise in "good" years. However, these concessions provide no incentive to the farmer to make provision for "bad" years.

5) An excessively high tax burden could result on the death of a taxpayer (RSA, 1987). Since it is only logical that a person cannot continue to be a taxpayer after his death, the Income Tax Act requires that a deceased person shall be taxed on all income received by or accruing to him up to and including the date of his death. The total amount to his credit on that date in the proposed reserve fund and not yet taxed, would therefore have to be taxed at that stage and, if it was a large amount, an excessively high tax burden could result.

   This tax burden has also been ignored as livestock farmers are given the same concession under the drought relief measure provided by the Land Bank.

6) The scheme offers considerable scope for tax sheltering and can be misused. There is nothing preventing a farmer depositing non-farm income into IED's and withdrawing it as part of farm income (RSA, 1987 and Lamont, 1990:410).

   If a rule is applied that no funds may be deposited in an IED scheme if current taxable income is below the moving average taxable income, misuse of the scheme for tax sheltering purposes could be avoided.

Nieuwoudt & Howell (2000) emphasized two determining factors pertaining to the feasibility of introducing an IED scheme in South Africa. One factor, briefly discussed in the criticisms, relates to the misuse of an IED scheme and the second factor relates to the implementation of an IED scheme.

If farmers have access to both an in-out tax provision (whereby, in a year when current farm income is below the moving average, farmers who elect income averaging are taxed on the current income at a rate that corresponds to that income, rather than the higher rate derived from averaging) and an IED scheme, they may use the scheme to deliberately destabilise income to obtain tax advantages. The problem arises when funds are deposited in low-income years to bring down the tax rate even further. This practice could be avoided by enforcing a rule that funds cannot be deposited in an IED scheme in the current year if actual taxable income in that year is below the moving average taxable income. This rule would require no additional information for tax purposes as the current income averaging concession uses information on both average and current taxable income (Nieuwoudt & Howell, 2000).

It may be possible to replace the livestock drought relief scheme (paragraph 13A, that allows livestock farmers to deposit income from the forced sales with the Land Bank and only be taxed on withdrawal of the funds) with an IED scheme and have one scheme that caters for both livestock and crop farmers. This implies that deposits can be made only if current taxable income is above the moving average taxable income. This will still allow livestock farmers to make deposits into this fund during drought conditions as incomes will be above the moving average (Nieuwoudt & Howell, 2000).

Internationally, use is being made of schemes similar to the proposed IED acting as risk management tools. These schemes are designed to help producers deal with uneven income streams by stabilising their farming income. The Australian scheme, which operates in a similar way to the proposed IED scheme, will briefly be discussed.

### 2.2 Present (2000) IED provisions in Australia

The Australian Government introduced IED's in 1976 with the aim of encouraging farmers to stabilise their incomes. They were intended to provide farmers with a "self-help" means of handling income instability. Besides the small usage, a number of developments reduced the attractiveness of IED's, which resulted in the introduction of a new scheme in 1983. The new scheme was intended to provide an incentive for farmers to set aside in good years money for use in bad years. The introduction of the in-out option and the lifting of the deposit limit had a number of consequences, which contributed to the repeal of the IED scheme. Reasons for the repeal will be discussed.

1) The interaction of the averaging scheme and the IED scheme produced anomalous results whereby a tax benefit could be gained by farmers deliberately destabilising their taxable income by lodging deposits in low-income years and withdraw them in high income years (RSA, 1987; Lamont, 1990:369).

2) Since monies deposited in the IED scheme could be derived from any source (other than investment income), methods existed that enabled some weaknesses in the averaging scheme to be exploited.

The present IED scheme in Australia is called a Farm Management Deposit Scheme (FMD). FMD's have the same purpose as IED schemes, namely to encourage farmers to save money in "good" years for use in "bad" years. FMD's provide an important risk management tool to help farmers deal with uneven income streams common in Australian agriculture due to climate and market risks. Deposits into an FMD are not regarded as taxable income in the year of deposit, but are taxable when money is withdrawn. FMD's provide a tax linked savings tool for farmers, which can complement other risk management strategies such as forward selling and futures contracts. Deposits can be made at a financial institution that meets the government's prudential requirements and interest is paid at the commercial rate offered by the institution. On withdrawal, a tax is deducted at marginal rates. It is expected that the scheme will result in an increase in savings levels by farmers, at the same time reducing the tendency to financially over-gear farming operations. It is also expected that farmers holding deposits in FMD's will be regarded as having better risk profiles, which could have a beneficial impact on borrowing costs. Significant tax savings from the use of FMD's may be comparatively rare (Neilson, 1999:3-4).

## 3. RESEARCH METHODOLOGY

A pilot survey was conducted with two consultants from different accounting firms to confirm the clarity and realism of the questions and the scenarios before the survey was posted to participating consultants. Consultants were approached as they deal directly with farmers, and farmers will most likely rely on their advice. Fifty-two consultants based mainly in KwaZulu-Natal (KZN), and in the Maize Triangle and surrounding areas (North-West Province, North-Eastern Free State and Mpumalanga), were surveyed. These areas were selected to obtain the views of consultants that dealt with tax matters for a range of farm situations, from relatively low risk livestock and diversified farmers in KZN (less variable net farm incomes), to relatively high risk maize farmers (more variable net farm incomes) in the Maize Triangle and adjacent regions. Discriminant analysis was conducted on data collected to determine which explanatory variables best differentiate between potential adopters and non-adopters of an IED scheme.

The respondents were divided into the following strata:

**Table 1: Strata of consultants (tax experts) who reported on the potential viability of an IED scheme, 2000 (n=24)**

| | Consulting Firms | Accounting Firms | University Lecturer | Total |
|---|---|---|---|---|
| Maize Triangle | 5 | 4 | - | 9 |
| KZN | 5 | 4 | - | 9 |
| Bloemfontein | 2 | 1 | - | 3 |
| Ficksburg | 2 | - | - | 2 |
| Cape Town | - | - | 1 | 1 |
| Total | 14 | 9 | 1 | 24 |

### 3.1 Experimental design and scenarios

The scenarios were compiled to determine what types of farmers are most likely to use an IED scheme. Each consultant was asked to review nine scenarios of typical farms in the study regions and to decide whether they would recommend an IED scheme for each scenario. Scenarios one to eight used in the analyses were constructed using a statistical experimental design, with the ninth scenario serving as a control to measure the consistency between consultants. These scenarios (farms) were depicted using four variables that showed different levels (high, low and intermediate) of farm business leverage (debt/asset ratio), net farm income, business risk (net farm income variability), and off-farm income, based on representative livestock, maize and diversified farm record data supplied by the NDA (1999).

Debt/asset ratios ranged from under 15% to over 40%, while net farm income ranged from a low of less than R50,000 per annum to a high of over R300,000 per annum. Net farm income was defined as gross farm income less farm operating costs, excluding any rent, management salary and interest on debt (foreign factor costs). Net farm income variability was used as a measure of risk. For construction of the scenarios, net farm income variability was measured as an index of net farm income variability. This index was shown for each year during 1995-1999 by expressing annual net farm income in each year as a percentage of the average net farm income over the five-year period. In this way, the index for high risk (high net farm income variability) maize farmers (ranging from -30 to 276 around a mean of 100) showed far more net farm income variability than the index for low risk livestock farmers (ranging from 58 to 124 around a mean of 100). Annual off-farm incomes typically ranged from zero to a high of over R20,000 on the study area farms.

The high, low and intermediate values of the four variables used in the survey are depicted below in Table 2.

**Table 2: Respective values of variables used in the scenarios**

| Variable | High | Low | Intermediate |
|---|---|---|---|
| Debt/Asset ratio | > 40% | < 15% | 30% |
| Annual off-farm income | > R 20 000 | 0 | R 10 000 |
| Annual net farm income | > R300 000 | < R50 000 | R175 000 |
| **Index of variation in NFI** | | | |
| 1995 | 28 | 58 | 119 |
| 1996 | 201 | 116 | 89 |
| 1997 | -30 | 124 | 111 |
| 1998 | 276 | 91 | 83 |
| 1999 | 25 | 111 | 97 |

To enhance the simplicity of the survey, livestock net farm income variability was depicted using a typical livestock farmer with a low index of net farm income variability. Likewise, maize net farm income variability was depicted using a typical maize farmer with a high index of net farm income variability. For analysis purposes, in order to cover all combinations of net farm income variability with farming type, other than livestock and maize farmers with low and high levels of net farm income variability respectively, the coefficient of variation in net farm income variability was calculated using the original representative livestock, maize and diversified farm record data supplied by the NDA (1999). In the analysis, high net farm income variability for a maize farmer was measured using an index of net farm income variability but coded according to its coefficient of variation of net farm income. Likewise, low net farm income variability for a livestock farmer was measured using an index in net farm income variability, but coded according to its coefficient of variation in net farm income. The function obtained separating potential IED scheme adopters from non-adopters could then be used to determine the outcome of different enterprise combinations with various levels of debt, off-farm income and net farm income.

Thus, for survey purposes, risk was measured in terms of an index in net farm income variation. For analysis purposes, risk was measured as an index of net farm income variability, but coded according to the coefficient of variation in net farm income in order to determine the function and to exploit all possible combinations of net farm income variability with farming type.

Coefficients of variation calculated for selected enterprise and net farm income variability combinations are presented in Table 4.

**Table 3: Coefficients of variation calculated for selected enterprise and business risk combinations, data extrapolated from farm financial records supplied by the NDA, 1999**

| Enterprise combination | Coefficient of variation |
|---|---|
| Maize farmer - high net farm income variability | 2.630 |
| Livestock farmer – high net farm income variability | 1.886 |
| Maize farmer – intermediate net farm income variability | 1.963 |
| Livestock farmer – intermediate net farm income variability | 0.947 |
| Maize farmer - low net farm income variability | 1.453 |
| Livestock farmer – low net farm income variability | 0.523 |
| Diversified farmer | 0.303 |

The scenarios to each consultant were constructed using the $2^5$ factorial treatment set as presented by Cochran & Cox (1957:235). There were 32 different combinations for the five different variables under consideration, each at two levels. These variables were:

A = Debt/asset ratio (low or high)
B = Annual off-farm income (low or high)
C = Annual net farm income (low or high)
D = Index of variation in net farm income (low or high)
E = Type of farming (livestock vs maize)

Three replications of the design were considered with four blocks (consultants) per replication. In other words, each consultant was presented with a set of eight different "financial record scenarios" with the set of scenarios (blocks) being different for each consultant. The choice of a block size of eight permitted the partial confounding of 3-factor and 4-factor interactions with different effects being confounded in each replication. The confounded effects in each of the three replications used are summarised in Table 4.

**Table 4: Confounded effects over three replications**

| Replication | Effects confounded in each replication |
|---|---|
| I | ABC, ADE, BCDE |
| II | ABD, BCE, ACDE |
| III | ACE, BCE, ABDE |

By partially confounding 3-factor and 4-factor interactions, it was assumed that such interactions would be less important than "main effects" and "2-factor" interactions. By presenting each consultant with a different set of "financial record combinations", considered "blocks" in experimental design terminology, possible differences between blocks (consultants) could be eliminated statistically in the subsequent analyses. Halfway through the study it became apparent that more data was required to separate the product effect (maize or livestock) from the risk effect. It is to be noted that as additional consultants became available the sets of questionnaires were repeated, with four consultants per replication. The desired response was to cover all sets at least once (12 responses). If additional responses were received, it would be optimal to cover all sets completely i.e. 12 responses to 24 responses to 36 responses etc.

Analysis of the original data showed that the blocking effect of the design was not necessary and therefore could be analysed as a simple random design based on the $2^5$ factorial treatment factor. In the analysis of the augmented data the design structure was ignored.

### 3.2 Econometric technique employed in the empirical analysis

One econometric technique was employed in the data analysis. Discriminant models were estimated to determine which explanatory variables best differentiate between potential adopters and non-adopters of an IED scheme. The object of this multivariate analysis was to generate information for policy purposes. This section provides a brief overview of the technique followed by an explanation of the variables considered in the models.

#### *3.2.1 Discriminant analysis*

Discriminant analysis is a statistical technique used to predict group membership. Linear combinations of the independent, or predictor, variables are formed and serve as the basis for grouping cases. In order to distinguish between these groups, the researcher must assemble a set of explanatory or discriminating variables on which the two groups are expected to differ. On selecting the discriminating variables, the mathematical objective is to weight and linearly combine the variables so that the groups are forced to be as statistically distinct from one another as possible (Klecka, 1980:7; Norusis, 1994:1).

The discriminant function is of the form:

$$D_i = B_1X_1 + B_2X_2 + ... + B_pX_p \tag{1}$$

Where:

$D_i$ is the i-th respondent's discriminant score on the function
$X_1 ... X_p$ are the values of the independent variables
$B_1 ... B_p$ are standardised coefficients estimated from the data

The coefficients are computed so as to maximise the ratio of the variance of D between the two groups relative to the variance of D within groups. The index D is an optimum linear discriminator between the groups. The relative contribution of each discriminating variable to the discriminating function is determined by the magnitude of its associated coefficient. The standardised coefficients ($B_p$) reflect the relative importance of the independent variable ($X_p$). Independent variables with relatively large ($B_p$) contribute most to the discrimination between the two groups (Klecka, 1980:15-16; Norusis, 1994:7). The sign of the coefficient indicates whether the variable is positively or negatively related to D.

Upon the estimation of the discriminant function it is necessary to assess its discriminating power. There are a number of statistics available for this estimation with the most important being the eigenvalue, Wilks' Lambda, Chi-square, canonical correlation and F-statistic. The eigenvalue is a direct measure of the function's discriminating power; the larger the value the better the discriminating power of the function. The Wilks' Lambda provides a basis for verifying the statistical significance of this function. With a range of between zero and one, a value closer to zero denotes a high level of discriminating power. Both the Chi-square and F-statistic indicate the way in which the independent variables differentiate significantly between groups (ie: potential adopters vs non-adopters), with a high value indicating a high level of significance. The canonical correlation is a measure of the degree of association between the discriminant scores and group membership. With a range of between zero and one, a value closer to one denotes a good predictive model. The explanatory power of a discriminant function can also be gauged by comparing its classification of sample cases with actual group membership.

Analysis refers to the interpretation of the original data, and to the interpretation of the discriminant function. The F-test can be used to check whether or not the individual discriminating variables contribute to the separation of groups (potential adopters and non-adopters). This test is valid only if the explanatory variables are multivariate normally distributed (Truett *et al*, 1967:521). According to Klecka (1980:61), the assumption of a multivariate normal distribution (normality assumption) is important for tests of significance. In these tests, a statistical computed from a sample is being compared to a theoretical probability distribution for that statistic. A theoretical distribution can be computed by making some convenient mathematical assumptions, such as requiring that the population meet the normality assumption. If the sample population does not satisfy this requirement, the true sampling distribution for the statistic will be different from the theoretically derived distribution. The difference between the two distributions may be very small or very large, depending on the degree of deviation from the assumption.

The normality assumption is violated in the study by the dichotomous nature of the independent variables. In practice, however, discriminant analysis is a rather robust which can tolerate some deviation from the normality assumption. Violation of the assumption does not render the analysis useless. Lachenbruch (1975:40-50) reviewed numerous discriminant studies and showed that the discriminant function performs fairly well on such non-normal data. In practice, this assumption can also be checked by observing the distribution of the discriminant scores ($D_i$) estimated for each group. If the distribution is approximately normal, the test is considered valid. According to Klecka (1980:62), in the interest of developing a mathematical model which can predict well or serve as a reasonable description of the real world, the best guide is the percentage of correct classifications. If this percentage is high, the violation of any assumption was not very harmful. Efforts to improve the data or use alternative formulas can give only marginal improvements.

### *3.2.2 Variables considered and hypotheses*

The variables that were expected to distinguish potential IED scheme adopters from non-adopters are presented in Table 5 and discussed in this section. A dependent variable **Y_N** was constructed using (1) for farmers for whom the consultant would recommend investing in an IED scheme and (0) for farmers he would not recommend investing in an IED scheme.

**Table 5: Definition of variables considered for discriminant analysis**

| Variable | Definition |
|---|---|
| **Y_N** | = yes/no (1 for potential adopter; 0 for potential non-adopter) |
| **DA** | = debt/asset ratio (dummy variable scoring 1 for high; 0 for low) |
| **OI** | = off-farm income (dummy variable scoring 1 for high; 0 for low) |
| **NFI** | = net farm income (dummy variable scoring 1 for high; 0 for low) |
| **RISK** | = index of variation in net farm income (dummy variable scoring 2.630 for high; 0.523 for low) |
| **ENT** | = enterprise (dummy variable scoring 1 for livestock farmer; 0 for maize farmer) |
| **R_DA** | = index of variation in net farm income multiplied by debt/asset ratio (interaction variable) |

Independent variables with their expected signs were as follows:

i) Debt/asset ratio (-). This ratio was used as a measure of solvency. The critical issue relating to leverage is the farm's ability to generate the cash to meet all expenses and service the debt with an acceptable margin of safety. Due to the cost of borrowing being higher than the interest rate earned on investing in an IED, it was expected that farmers with debt would redeem debt first before investing in an IED scheme.

ii) Off-farm income (-). The off-farm income of a farming business serves as an additional source of funds, which can be used in the farming operation or invested outside of agriculture. It was hypothesised that higher levels of off-farm income may indicate clients that have diversified investments and so would be less likely to need an IED. It was also hoped that farmers with relatively higher off-farm incomes would not use the scheme as a perceived tax shelter.

iii) Net farm income (+). The net farm income of a farm business is a reflection of how well the business has performed. According to Barry *et al* (1995), the level of net farm income reflected in the income statement is a meaningful absolute measure with which to monitor profitability of the business from year to year. It was postulated that adopters would have higher net farm incomes (higher profits) as they would have the means to save.

iv) Index of variation in net farm income (+). This variable reflects the business risk inherent in a particular enterprise. It was hypothesised that an IED scheme would suite farms having a higher index of variation in net farm income variability as they are exposed to more business risk. The introduction of an IED scheme is primarily as a risk management tool and it is therefore expected that farmers with a higher variation in income will make more use of such a scheme. The conventional dummy variable scoring (1; 0) was weighted using a coefficient of variation which provided a score of 2.630 for a high index of variation in net farm income and a score of 0.523 for a farmer with a low index of variation in net farm income.

v) Enterprise (+). This variable was considered to capture the effects of relatively lower risk livestock farmers (less variable net farm incomes) compared to relatively high risk maize farmers (more variable net farm incomes). It was postulated that both livestock and maize farmers would adopt an IED scheme, with the scheme being more valuable to the higher risk maize farmers. Due to the design of the scenarios (maize farmers-high net farm income variability, livestock farmers-low net farm income variability), the business risk experienced by maize and livestock farmers is captured in both the **ENT** and **RISK** variable. As a result of this relationship, perfect multicollinearity was expected between these two variables.

vi) Risk - debt/asset ratio. This variable was constructed to determine what the combined effects of risk and debt/asset ratio would have on the potential use of an IED scheme. The relationship between the interaction effect **R_DA** and an IED scheme was not clear and for this reason no hypotheses were presented. Farmers with a high combination of risk and debt may be advised to first reduce their debt before investing in an IED scheme. This situation would imply a negative relationship between the variable and an IED scheme. However, a high debt/asset ratio (financial risk) coupled with a high variation in net farm income (business risk) would increase a farmer's total risk. In this situation, a consultant may advise the client to invest in an IED scheme thus implying a positive relationship.

Due to the nature of the multiplicative term, multicollinearity was anticipated between the variable **R_DA** and its component variables **RISK** and **DA**. The next section provides a brief background to the problems associated with the use of multiplicative terms and how the multicollinearity problem was addressed.

### 3.3 Multicollinearity issues

The use of multiplicative terms in discriminant analysis focuses on the issue of multicollinearity. Critics have noted that multiplicative terms usually exhibit strong correlations with the component parts. Because multiplicative terms can introduce high levels of multicollinearity, critics have often recommended against their use (Jaccard *et al*, 1990:30). According to Gujarati (1999), in cases of perfect and high multicollinearity, estimation and hypothesis testing about individual discriminant coefficients in a multiple regression are not possible.

The partial correlation coefficient technique is commonly used in quantifying the strength of association between two variables. By using this technique, multicollinearity between two variables can successfully be detected and preliminary results can be extracted. Table 6 presents the partial correlations between main and interaction variables. The enterprise variable **(ENT)** was retained to determine its relationship with the index of variation in net farm income variable **(RISK)**.

**Table 6: Partial correlation matrix using standardised variables, sample of SA consultants, 2000 (n=192)**

| | ENT | DA | OI | NFI | RISK | E_DA | R_DA | Y_N |
|---|---|---|---|---|---|---|---|---|
| **ENT** | 1.000 | | | | | | | |
| **DA** | 0.266* | 1.000 | | | | | | |
| **OI** | 0.022 | -0.033 | 1.000 | | | | | |
| **NFI** | -0.225 | 0.339* | 0.028 | 1.000 | | | | |
| **RISK** | 1.000 | 0.266* | 0.022 | -0.225 | 1.000 | | | |
| **E_DA** | 0.673* | 0.621* | -0.005 | 0.055 | 0.673* | 1.000 | | |
| **R_DA** | 0.673* | 0.621* | -0.005 | 0.055 | 0.673* | 1.000* | 1.000 | |
| **Y_N** | 0.388* | -0.535* | -0.052 | 0.472* | 0.388* | -0.103 | -0.103 | 1.000 |

*Note*: *Signifies statistical significance at the 1% level of probability.

From Table 6 it is clear that multicollinearity exists between the interaction variable **R_DA** and its component variables **RISK** and **DA**, with coefficients of 0.621 and 0.673 respectively. Cronbach (1987) suggested centring the independent variables, prior to forming the multiplicative term, as a means of addressing the problem of multicollinearity (as cited by Jaccard *et al*, 1990:31). Following this technique, the independent variable scores were centred (ie. deviation scores were formed) and the product of the centred scores was computed for each subject. Table 7 presents the partial correlations between main and interaction variables using centred scores.

**Table 7: Partial correlation matrix using centred scores, sample of SA consultants, 2000 (n=192)**

| | ENT | DA | OI | NFI | RISK | E_DA | R_DA | Y_N |
|---|---|---|---|---|---|---|---|---|
| **ENT** | 1.000 | | | | | | | |
| **DA** | 0.266* | 1.000 | | | | | | |
| **OI** | 0.022 | -0.033 | 1.000 | | | | | |
| **NFI** | -0.225 | 0.339* | 0.028 | 1.000 | | | | |
| **RISK** | 1.000* | 0.266* | 0.022 | -0.225 | 1.000 | | | |
| **E_DA** | 0.013 | -0.020 | -0.002 | 0.017 | 0.013 | 1.000 | | |
| **R_DA** | 0.013 | -0.020 | -0.002 | 0.017 | 0.013 | 1.000* | 1.000 | |
| **Y_N** | 0.388* | -0.535* | -0.052 | 0.472* | 0.388* | -0.031 | -0.031 | 1.00 |

*Note*: *Signifies statistical significance at the 1% level of probability.

From Table 7 it is evident that the multicollinearity that existed between the multiplicative term **R_DA** and its component variables **RISK** and **DA** has been eliminated, with coefficients of 0.013 and -0.020 respectively. For the purpose of discrimiant analysis, non-centred scores were used to produce the results of the main effects model (Model 1) and centred scores were used to produce the results of the interaction model (Model 2). As anticipated, the variables **RISK** and **ENT** were perfectly correlated. The results obtained by substituting **RISK** for **ENT** and vice versa in the subsequent discriminant analysis would therefore be consistent, allowing one variable to be excluded from the analyses. This would effectively remove the effects of perfect collinearity. The enterprise variable **ENT** was subsequently dropped and the index of variation in net farm income variable **RISK** was retained for analysis purposes.

### 3.4 Preliminary results

Preliminary results can be extrapolated from the coefficients of variation calculated in Table 3 and the partial correlation matrix presented in Table 7. According to Barry *et al* (1995:31), the coefficient of variation serves as an indicator of the amount of risk relative to the amount of expected return. It is a measure of the amount of risk inherent in a particular venture or enterprise. The higher the value, the more risky the venture/enterprise. The coefficients of variation calculated from the original representative livestock, maize and diversified farm record data indicate that maize farmers carry more risk (high of 2.630, low of 1.453) relative to livestock farmers (high of 1.886, low of 0.523), with diversified farmers carrying the least risk (0.303). It is worth noting that a maize farmer with an intermediate value (1.963) is above a livestock farmer with a high value (1.886). These results indicate the relative proportions of risk maize farmers experience relative to livestock and diversified farmers, making the scheme more valuable to maize farmers relative to livestock and diversified farmers.

The correlation coefficients for **Y_N** with **DA**, **NFI** and **RISK** were all statistically significant at the 1% level of probability, while the coefficient for **OI** and **R_DA** was not statistically significant. The signs of the coefficients all agree with *a priori* reasoning. The relative contribution of the **DA** variable overshadows the relative contribution of the **RISK** variable, resulting in a negative coefficient of the interactive term **R_DA**. The non-significant sign of the coefficient indicates that, *ceteris paribus*, the study consultants would advise farmers to first reduce their debt before investing in an IED scheme. In the study consultants' view, farmers with less leverage (debt/asset ratio), higher net farm incomes and more variable net farm incomes are more likely to use an IED scheme. The relative size of the explanatory coefficient estimates indicate that statistically, **DA** is the most important determinant of an IED scheme, followed by **NFI** and then **RISK**. An in-depth look at the research results is presented in the following chapter.

## 4. RESULTS

This section presents the results obtained in discriminant analysis. Two models are presented in the discriminant analysis section, followed by a brief discussion on the results obtained. The discriminant function obtained separating potential users and non-users of an IED scheme is then presented and used to predict the potential membership of specific cases (samples) selected from the original data set. These results are then tabulated and briefly discussed. The section ends with an assessment of the discriminant analysis due to the violation of the normality assumption.

### 4.1 Discriminant analysis results

#### *4.1.1 Discrimination between potential adopters and non-adopters of an IED scheme*

All 24 tax consultants perceived the nine farm scenarios considered to be realistic, implying that their views were a good representation of what they would advise their clients. This, together with a consistency rate of 91% achieved through the control scenario, ensured a realistic and consistent data set for analysis purposes. Two discriminant models are presented in Table 8. Model 1 consists of the main effects and Model 2 consists of the main effects with the interaction effect.

The overall Chi-square value (significant at the 1% level of probability) in both models indicates that, collectively, the explanatory variables in each model distinguish significantly between potential adopters and non-adopters of an IED scheme. The Wilks' Lambda in both models indicates a high level of discriminating power. In addition, the Eigenvalue (ratio of between-groups to within-groups sum of squares) and the Canonical correlation (measure of degree of association between the discriminant scores and group membership) indicate good predictive models. Both models correctly classified 94% of overall cases. Due to the restrictions imposed by the statistical model, no holdout sample was used in determining classification rates.

**Table 8: Results of the discriminant models identifying the characteristics of potential adopters and non-adopters of an IED scheme, sample of SA consultants, 2000 (n=192)**

| | **Model 1** | | **Model 2** | |
|---|---|---|---|---|
| **Explanatory variables** | **Standardised coefficient** | | | |
| DA | -0.955* | | -0.956* | |
| NFI | 0.879* | | 0.880* | |
| RISK | 0.756* | | 0.756* | |
| OI | -0.111 | | -0.111 | |
| R_DA | | | -0.067 | |
| **Discriminant function statistics** | **Statistic** | | | |
| Chi-square | 203.871* | | 203.878* | |
| Wilks' Lambda | 0.338 | | 0.338 | |
| Canonical correlation | 0.814 | | 0.814 | |
| Eigenvalue | 1.958 | | 1.966 | |
| **Overall classification** | **Potential Adopter** | **Potential Non-adopter** | **Potential Adopter** | **Potential Non-adopter** |
| % Correctly classified | 100.0 | 89.7 | 100.0 | 89.7 |
| Overall % correctly classified | 94.3 | | 94.3 | |

*Note*: *Signifies statistical significance at the 1% level of probability.

The relationships (coefficient signs) between dependent and independent variables were in accordance with a *priori* expectations and supported the preliminary results obtained from the partial correlation matrix in Chapter 3. In Model 1, the debt/asset ratio **(DA)** was found to be the most important variable (highest standardised coefficient) distinguishing between potential adopters and non-adopters of an IED scheme. The negative sign of the variable indicates that, *ceteris paribus,* farmers with lower debt/asset ratios are more likely to make use of an IED scheme. Farmers with a high debt/asset ratio will most likely be advised to reduce their debt before investing in an IED scheme. It is in any case a recommended strategy that farmers with high debt first repay their debt. The second most important distinguishing variable was net farm income **(NFI)**. The sign was positive which confirms that, *ceteris paribus,* farmers with higher annual net farm incomes are more likely to invest in an IED scheme. Farmers with a high net farm income are more likely to have the resources to firstly, cover any existing debt, and then invest in an IED scheme. This supports the view expressed by Hattingh (1986:22) that wealthier farmers are more likely to make use of an IED scheme.

The third most important variable was that of the index of variation in net farm income **(RISK)**. The sign was positive indicating that, *ceteris paribus,* maize farmers with a high variation in net farm income are more likely to invest in an IED scheme than livestock farmers with a low variation in net farm income. This indicates that an IED scheme could act as a potential risk management strategy. The fourth distinguishing variable listed was that of off-farm income **(OI)**. Even though the standardised coefficient was found to be non-significant, it was retained in the model as the sign of the coefficient and its magnitude are of significance to the adoption of an IED scheme. The non-significant coefficient estimate indicates that, *ceteris paribus,* off-farm income will most likely not be invested in an IED. This implies there are no gains to be made in the misuse of the scheme as a tax shelter. Alternative investment avenues outside agriculture (diversified investments) could be a use of off-farm income where more gains could be made to provide the farmer with better risk spreading.

In Model 2, the interaction variable was tested with the main variables. The main variables were all in accordance with the results obtained in Model 1. The standardised coefficient of the interaction variable **(R_DA)** was found to be non-significant but retained in the model to reveal its contribution to the decision to adopt an IED scheme. The relative contribution of the debt variable **(DA)** overshadows the relative contribution of the net farm income variability variable **(RISK)**, forcing the sign to be negative. The negative sign of the variable indicates that, *ceteris paribus*, maize farmers with a high index of variation in net farm income carrying high debt are less likely to invest in an IED. In the consultants' views, high variability in net farm income (business risk) coupled with high debt (financial risk) may increase a farmer's total risk but the farmer should first redeem the debt before investing in an IED.

The discriminant function, obtained from Model 1, using unstandardised coefficients that separate potential users and non-users of an IED scheme is presented below.

$$D_i = - 0.978 - 2.249DA + 1.984NFI + 0.774RISK - 0.22OI \quad (2)$$

In Model 1, high risk maize farmers (high index of net farm income variability) were compared to low risk livestock farmers (low index of net farm income variability). The coefficients of variation for seven farming types were calculated from the actual data obtained from the Department of Agriculture (NDA, 2000) and presented to consultants. The following farming types were selected for different risk classes (high, intermediate and low): maize, livestock and diversified (one class) (see Table 9). By substituting the coefficients of variation for the **RISK** variable in the discriminant function, all possible combinations of net farm income variability with farming type could be exploited. Specific samples from the scenario data set were selected depicting different combinations and levels of the explanatory variables. With the use of the discriminant function, the potential membership of a specific case (sample) could be predicted based on the discriminant score. The off-farm income variable **(OI)** in Model 1 was statistically non-significant and was therefore retained with a low score (0) as it had no influence on the outcome of the discriminant scores. Additionally, as the interaction effect in Model 2 was also statistically non-significant, no predictions are presented for Model 2.

Table 9 presents selected samples with their respective discriminant scores ($D_i$). The group centroids were -1.241 and 1.562 for potential non-adopters and adopters respectively, yielding a cutoff point of 0.161. A sample case yielding a discriminant score of less than 0.161 would be classified as a potential non-adopter (N) and a discriminant score of greater than 0.161 would be classified as a potential adopter (Y).

**Table 9: Predicted membership of specific samples, as selected from a sample of SA consultants, 2000 (n=192)**

| | Farmer Type | D_A | OI | NFI | RISK | $D_i$ | Y_N |
|---|---|---|---|---|---|---|---|
| Block 1 | MH | 0 | 0 | 1 | 2.630 | 3.042 | Y |
| | MI | 0 | 0 | 1 | 1.963 | 2.525 | Y |
| | LH | 0 | 0 | 1 | 1.886 | 2.466 | Y |
| | ML | 0 | 0 | 1 | 1.453 | 2.131 | Y |
| | LI | 0 | 0 | 1 | 0.947 | 1.739 | Y |
| | LL | 0 | 0 | 1 | 0.523 | 1.411 | Y |
| | D | 0 | 0 | 1 | 0.303 | 1.241 | Y |
| Block 2 | MH | 0 | 0 | 0 | 2.630 | 1.058 | Y |
| | MI | 0 | 0 | 0 | 1.963 | 0.542 | Y |
| | LH | 0 | 0 | 0 | 1.886 | 0.482 | Y |
| | ML | 0 | 0 | 0 | 1.453 | 0.147 | N |
| | LI | 0 | 0 | 0 | 0.947 | -0.245 | N |
| | LL | 0 | 0 | 0 | 0.523 | -0.573 | N |
| | D | 0 | 0 | 0 | 0.303 | -0.743 | N |
| Block 3 | MH | 1 | 0 | 1 | 2.630 | 0.793 | Y |
| | MI | 1 | 0 | 1 | 1.963 | 0.276 | Y |
| | LH | 1 | 0 | 1 | 1.886 | 0.217 | Y |
| | ML | 1 | 0 | 1 | 1.453 | -0.118 | N |
| | LI | 1 | 0 | 1 | 0.947 | -0.510 | N |
| | LL | 1 | 0 | 1 | 0.523 | -0.838 | N |
| | D | 1 | 0 | 1 | 0.303 | -1.008 | N |
| Block 4 | MH | 1 | 0 | 0 | 2.630 | -1.191 | N |
| | MI | 1 | 0 | 0 | 1.963 | -1.708 | N |
| | LH | 1 | 0 | 0 | 1.886 | -1.767 | N |
| | ML | 1 | 0 | 0 | 1.453 | -2.102 | N |
| | LI | 1 | 0 | 0 | 0.947 | -2.494 | N |
| | LL | 1 | 0 | 0 | 0.523 | -2.822 | N |
| | D | 1 | 0 | 0 | 0.303 | -2.992 | N |

*Note*: MH = maize high risk; LH = livestock high risk
MI = maize intermediate risk; LI = livestock intermediate risk
ML = maize low risk; LL = livestock low risk
D = diversified

In Block 1 of Table 9, various levels of net farm income variability (risk) are depicted with a high level of net farm income, holding the remaining variables constant at low levels. The discriminant scores ($D_i$) suggest that all these types of farmers will most likely make use of an IED scheme. Farmers carrying little debt with a high net farm income have the resources to make use of the scheme. The relative size of the discriminant scores indicates which farmer would most likely make use of the scheme relative to other farmers. According to the results, more value is given to high risk maize farmers, followed by intermediate risk maize farmers and then high-risk livestock farmers. Least value is given to diversified farmers. This ranking was expected, as farmers facing more business risk are more likely to invest in an IED scheme.

Block 2 depicts farmers with various levels of net farm income variability, holding the remaining variables constant at low levels. The discriminant scores revealed that only high and intermediate risk maize farmers, and high-risk livestock farmers would most likely invest in an IED scheme. The risk associated with maize farmers carrying low levels of net farm income variability, livestock farmers carrying intermediate and low levels of net farm income variability, and diversified farmers is not sufficient to justify the use of an IED scheme. This again supports the use of an IED scheme as a risk management tool as higher risk farmers are more likely to make use of the scheme.

In Block 3, farmers with various levels of net farm income variability are depicted with a high level of net farm income and debt. According to the discriminant scores, the only likely users of an IED scheme under these conditions are high and intermediate risk maize farmers, and high-risk livestock farmers. The positive effect of the net farm income and risk variable offsets the negative effect of the debt/asset variable in these particular samples. In the remaining samples, the combined effect of the risk and net farm income variable is too low to offset the debt/asset variable. Block 4 depicts farmers with various levels of net farm income variability with a high level of debt, holding the remaining variables constant at a low level. The discriminant scores suggest that all the farmers depicted will most likely not make use of an IED scheme. The negative effect of the debt/asset variable offsets the positive effect of the risk variable.

The results indicate that maize, livestock and diversified farmers carrying large amounts of debt (>40%) are less likely to invest in an IED scheme. Amongst the high debt farmers, only high and intermediate risk maize farmers, and high risk livestock farmers are most likely to make use of an IED scheme. The relative contribution of the debt variable in the analyses indicates the importance of this variable in distinguishing between potential adopters and non-adopters of an IED scheme. Several studies revealed the leverage (debt/asset) ratio to be the most important determinant of maize farm bankruptcies between 1970 and 1994 (Leslie & Darroch, 1993; De Jager & Swanepoel, 1994; Swanepoel *et al,* 1996). A later study by Swanepoel *et al* (1998) indicated that the leverage ratio was the most important determinant of extensive beef farm bankruptcies over the same period (1970 to 1994). From these studies, it is evident that profits and cash flow could be of concern in the key livestock and crop sectors of South Africa. The extent of this problem in the grain sector has been addressed in a recent study where the financial position of the Northern and Southern grain regions of South Africa was reviewed by Du Toit (2001). It was reported that since 1998, 694 farmers in these regions have been sequestrated, with a further 271 farmers being sequestrated in 2001. Another study conducted by Esterhuizen *et al* (2001) revealed the financial position of the agricultural business sector. Bankruptcies almost doubled (0.4% in 1998 to 0.74% in 2000), 59% more loans have been rejected by agribusinesses since 1998, the debt recovery account has grown by 22%, clients against whom action was taken increased by 63% with money involved increasing by 255%, new entrants securing loans increased by 9% and the money involved in new loans increased by 99%, indicating that more agricultural producers are dependant on loans. Unfavourable and fluctuating climatic conditions, primarily in the summer crop areas of South Africa, were identified as possible causes of this situation.

### 4.2 Assessment of the discriminant analysis results

Since the multivariate normality assumption was violated by the dichotomous nature of the independent variables, the discriminant scores for the main effects model and interaction model were estimated and presented using frequency tables and histograms. The discriminant scores estimated for the main effects potential non-adopter model and the interaction potential non-adopter model appeared to be approximately normally distributed, while the scores for the main effects potential adopter model and the interaction potential adopter model were slightly positively skewed. In combination, the discriminant scores for potential adopter and non-adopter groups appear to be approximately normally distributed, thus, according to Lachenbruch (1975), rendering the test valid. The estimates can thus be accepted with reasonable confidence. A classification rate of 100% for potential adopters and 89.7% for potential non-adopters in both models, according to Klecka (1980), indicates that the violation of the normality assumption was not very harmful, thus suggesting that good predictive models were developed.

## 5. CONCLUSIONS AND POLICY IMPLICATIONS

Discriminant analysis supported the preliminary results, confirming that, in the study consultants' view, farmers with less leverage (debt/asset ratios in the 15%-30% range), higher net farm incomes (>R300,000), and more variable net farm incomes, are more likely to invest in an IED scheme. The significance of these variables indicates the value of an IED scheme as a risk management tool, with the debt/asset ratio being the primary indicator when considering investing in such a scheme. Amongst the high debt farmers, high and intermediate risk maize farmers, and high-risk livestock farmers are most likely to make use of an IED scheme. Study data showed that maize farmers faced relatively more business risk than did livestock and diversified farmers, suggesting that maize farmers may more readily invest in an IED scheme. Since maize farmers have been the main beneficiaries of past government drought aid, this could mean reduced demands on government drought relief funds in future if an IED scheme is introduced.

The tax provisions available to commercial farmers can help reduce the impact of disasters on farm income, assist with abnormal receipts of farm income, assist in the purchasing of capital items which are extremely costly, and reduce the tax liability of livestock on hand, however, they do not provide an incentive for farmers to become more liquid and better prepared to handle risk. An IED scheme can be used to manage volatility at the total profit level, which is largely weather related, by providing an incentive for farmers to become more liquid and better prepared to handle risk. An IED scheme can potentially form an effective part of a risk management strategy, especially if it is used in conjunction with other strategies.

Results from the studies conducted on the causes of maize and extensive beef farm bankruptcies, and on the financial position of the Northern and Southern grain regions, suggest there may be an increase in debt in these sectors, but it is uncertain as to the extent of the problem. Bankruptcies and sequestrations could merely reflect inefficient farmers leaving the agricultural sector or, alternatively, the need for an alternative risk management tool. Farmers carrying large amounts of debt do not necessarily have profit or cash flow problems, as the returns on debt may be higher than the cost of debt. These farmers are, however, more prone to cash flow problems. What the results do indicate is that debt is concentrated in certain areas where cash flow may be a problem, and these areas appear to be predominantly in the high risk maize and livestock regions of South Africa. According to the results of the current study, it is these potentially high risk farmers (highly leveraged and high income variability) that need to make use of an IED scheme. In the short run, highly leveraged farmers with cash flow problems will most likely not be able to participate in an IED scheme. Consultants need to advise clients on the relationship between net farm income, interest costs and leverage levels for successful debt management. Only then can these farmers invest in an IED scheme, which can help manage the effects of a changing agricultural and macroeconomic policy environment.

Results from the discriminant analysis provided information regarding certain major criticisms of an IED scheme. Results from discriminant analysis indicated that farmers with various levels of income variability and a high level of net farm income, holding the remaining variables constant at low levels, would most likely make use of an IED scheme. Irrespective of the income variability (risk) of a farmer, the model predicted that all farmers in the study would most likely invest in an IED scheme. When various levels of farm income variability were depicted with the remaining variable held constant at low levels, only three of the seven farmers depicted would invest in an IED scheme. This supports the criticism that an IED scheme will favour farmers with high net farm incomes.

The non-significance of the off-farm income coefficient in the discriminant analysis indicates that off-farm income will most likely not be invested in an IED. This suggests that there are no gains to be made in the misuse of the scheme as a tax shelter. This finding does not support the criticism that an IED scheme offers considerable scope for tax sheltering in respect of depositing off-farm income into IED's.

Practicing consultants have provided valuable information regarding the viability of an IED scheme for commercial farmers in South Africa and the results have provided some information on the criticisms of such a scheme in the past. An area of future research could involve determining where the debt is predominantly concentrated in the commercial livestock and crop sectors of South Africa, whether cash flow is a problem in these areas, and the extent to which these farmers can make use of an IED scheme. This could give more scope as to the potential short run use of an IED scheme. Additional research could be to look at the possibility of commercial banks offering IED facilities. This could reduce administration costs for the Land Bank, and may encourage more IED use as farmers would have more choice as to where they invest. Lastly, a comprehensive evaluation of the Australian FMD scheme should be made as this scheme has been successfully implemented with little financial support from the government and could serve as a possible guideline to the implementation of an IED scheme in South Africa.

**REFERENCES**

BARRY PJ, ELLINGER PN, BAKER CB & HOPKIN JA (1995). *Financial management in agriculture*. Interstate Publishers, Danville, Illinois.

COCHRAN WG & COX G (1957). *Experimental designs.* Wiley and Sons. Plan 6.5, Report I, II and III.

DE JAGER F & SWANEPOEL V (1994). Factors associated with farm financial failure in the Northern Springbok Flats. *Agrekon* 33(4):242-247.

DU TOIT K (2001). *Finansiële posisie van produsente kommerwekkend*. In: Van Hoven L (ed), Die Boer/The Farmer 29(3):3-4.

ESTERHUIZEN D, VAN ROOYEN J & GREYLING J (2001). *SA Agriculture in financial dilemma*. In: Van Hoven L (ed), Die Boer/The Farmer 29(3):4-5.

FUCHS L (1999). *Potential use of agricultural taxation for encouraging drought mitigation by farmers*. Unpublished Report, Standard Bank.

GABRIEL SC & BAKER CB (1980). Concepts of business and financial risk. *American Journal of Agricultural Economics* 62:560-564.

GUJARATI DN (1999). *Essentials of econometrics*. McGraw-Hill, New York.

HATTINGH H (1986). *Skewe inkomeverdeling in die landbou se uitdaging aan landboubeleid*. Paper delivered at Agrocon, February 11, Pretoria.

HUXHAM K & HAUPT P (2000). *Notes on the South African Income Tax Act*. H&H Publications, Roggebaai.

JACCARD J, TURRISI R & WAN CK (1990). *Interaction effects in multiple regression*. Sage Publications, Inc. California, USA.

KLECKA WR (1980). *Discriminant analysis.* Sage Publications, Inc. California, USA.

LACHENBRUCH PA (1975). *Discriminant analysis*. Hafner Press, London.

LAMONT M (1990). *Implications of tax reform in selected countries for taxation of income in agriculture*. PhD Thesis, Department of Economics, University of Stellenbosch.

LESLIE JR & DARROCH MAG (1993). Financial characteristics of successful and unsuccessful farms in selected areas of South Africa: Management implications. *South African Journal of Agricultural Extension* 22:6-12.

NATIONAL DEPARTMENT OF AGRICULTURE (NDA) (1997). *Task team on drought and other agricultural disasters* Chapter 30. October 1997. Pretoria.

NATIONAL DEPARTMENT OF AGRICULTURE (NDA) (1999). *Farm record data*. Supplied by Mr ENC Whitehead, Cedara Agricultural Development Institute, Pietermaritzburg.

NATIONAL DEPARTMENT OF AGRICULTURE (NDA) (2000). *Abstract of agricultural statistics*. The Directorate Statistical Information. National Department of Agriculture. Unpublished information. Pretoria.

NEILSON G. (1999). Farm management deposits can improve farm finances. *Contribution to Rural Focus*. Autumn 1999. Australia.

NIEUWOUDT WL & HOWELL J (2000). Farming without drought relief: Time to revisit an IED scheme? *Agrekon* 39(3):332-356.

NORUSIS MJ (1994). *SPSS Advanced statistics 6.1 manual*. Marketing Department, SPSS Inc., Chicago, USA.

REPUBLIC (UNION) OF SOUTH AFRICA (RSA) (1951). *First report of the Committee of Enquiry into the Income Tax Act (Steyn Committee)*. Government Printer. UG No. 75-1951.

REPUBLIC OF SOUTH AFRICA (RSA) (1979). *Final report of the Committee of Enquiry into the economic position of the farmer and agricultural financing in general (Jacobs Committee)*. Government Printer, Pretoria.

REPUBLIC OF SOUTH AFRICA (RSA) (1982). *House of Assembly debates*. Government Printer.

REPUBLIC OF SOUTH AFRICA (RSA) (1987). *Report of the Commission of Enquiry into the tax structure of the Republic of South Africa (Margo Commission)*. Government Printer. RP 34/87.

SWANEPOEL DS, ORTMANN GF & DARROCH MAG (1996). Causes of maize farm bankruptcy in South Africa: 1970-1994. *Agrekon* 35(4):240-244.

SWANEPOEL DS, ORTMANN GF & DARROCH MAG (1998). Causes of bankruptcy among maize and extensive beef farmers in South Africa: 1970-1994. *South African Journal of Economic and Management Sciences* 1(1):52-72.

TRUETT J, CORJNFELD DJ & KANNEL LW (1967). A multivariate analysis of the risk of coronary heart disease in Framingham. *Journal of Chronological Heart Disease* 20:511-524.

WILLEMSE J (1992). Landbou kry minder subsidies as ander. *Landbou Weekblad* 748. 7 August.