AN ECONOMIC EVALUATION OF A CROP INSURANCE PROGRAMME FOR SMALL-SCALE COMMERCIAL FARMERS IN SOUTH AFRICA[1]

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*Hail insurance is provided by the private sector in South Africa but crop insurance (drought insurance) programmes, after a promising start, failed to attract customers. A crop insurance programme (drought) for small-scale commercial farmers, who are not yet paying tax, has been recommended to government. The purpose in this research is to study the economic viability of such a programme drawing on the US experience. The US programme is well developed but heavily subsidised. During 1998 US growers paid $900 million in premiums while during 1995-98 the US government spent $1.2 billion per year on subsidies. An area insurance plan (farmers are insured **as a group**) is shown to be more appropriate for small farmers growing dryland field crops such as maize because risk is systemic (drought related) while adverse selection, moral hazard etc are overcome. Individual crop insurance will not be viable due to the cost of farm visits (verification of claims) and the non-availability of information. As a large part of the cost to government goes to administration of crop insurance it is recommended that an Income Equalisation Deposit (IED) scheme for small growers receive serious consideration with the government making a contribution as for example in Canada.*

'N EKONOMIESE EVALUASIE VAN 'N OESVERSEKERINGSKEMA VIR KLEINSKAALSE KOMMERSIËLE BOERE IN SUID AFRIKA

Boere in Suid Afrika kan verseker teen hael maar oesversekering teen droogte het gefaal. 'n Aanbeveling is aan die staat gemaak om gesubsidieerde oesversekering (droogte) aan kleinskaalse kommersiële boere wat nog nie belasting betaal nie beskikbaar te stel. Die doel met hierdie studie is om die ekonomiese lewensvatbaarheid van so 'n studie te ondersoek aan die hand van ondervinding in die VSA. Die program in die VSA word swaar gesubsidieer. Gedurende 1998 het boere in die VSA $900 miljoen aan oesversekeringspremies betaal terwyl die Staat se bydrae gedurende 1995-98 $1.2 biljoen per jaar beloop het. 'n Area-versekeringskema (boere word as 'n groep verseker) is beter as individuele versekering vir kleinboere wat droëland gewasse verbou soos mielies, omdat risiko sistemies (droogte bepalend) is terwyl dit ook die probleme wat normaalweg met oesversekering verband hou, oplos. Individuele oesversekering is nie haalbaar vir kleinboere nie weens die koste van plaasbesoeke (om eise te verifieer) en omdat inligting nie

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voldoende beskikbaar is nie. Omdat 'n groot deel van die koste van so 'n skema deur die Staat gedra sal moet word, word aanbeveel dat 'n Inkomste Gelykstellingsdeposito (IGD) skema ernstig oorweeg word, waar die Staat 'n bydrae maak, soos in Kanada.

1. INTRODUCTION

The purpose of this research is to study the economic feasibility of a crop insurance programme for small-scale commercial farmers who are not yet paying tax. The South African Government is currently considering crop insurance of small-scale farmers as a risk management strategy. A Bi-National Committee (BNC) has been established between South Africa and the USA regarding crop insurance and risk management education in South Africa. This research is part of a larger study on risk management as the economic feasibility of an Income Equalisation Deposit (IED) scheme for tax paying farmers is also being investigated as a risk management tool.

Uncertainty of crop yield is one of the most basic risks farmers' face. A great majority of farmers in most countries are unable to withstand such risks due to insufficient resources. The principal characteristic distinguishing agriculture from other industries is its dependence on nature. By offering protection to farmers against the physical failure of crops due to weather and other unavoidable natural hazards, crop insurance advances the process of stabilising the agricultural industry (Ray, 1981).

On a continuum of common risks, collective crop loss risk lies halfway between the polar extremes of purely diversifiable, independent risks (auto, life, fire) and purely systemic, correlated risks (prices and rates) (Miranda & Glauber, 1997). This defining characteristic of crop loss risk, provides a huge challenge to the crop insurance industry in designing and implementing feasible crop insurance schemes.

Failure of crop insurance markets has been primarily attributed to the problems of asymmetric information and systemic risk, both of which are found on such a large scale only in agriculture. Systemic risk undermines insurer attempts to provide affordable insurance to individual farmers as the cost of holding the reserves necessary to cope with widespread natural disaster is prohibitive. Asymmetric information raises insurer's costs to the extent that the premiums necessary to cover these costs become unaffordable to individual farmers.

There are new developments in the USA crop insurance programme while this topic has received considerable attention in the literature in recent years. Given the problems associated with crop insurance and the recent developments in the

crop insurance industry, the challenge in this study is whether this programme can be adapted to small-scale farmers in South Africa. A major problem with crop insurance in the USA has been the high cost of administration which would be larger per hectare of land for small scale farmers. Special attention will thus be given in this study to the economic feasibility of an area insurance programme as a way to reduce costs associated with administration, asymmetric information and systemic risk. The writer has benefited from discussions with Dr I van Rooyen, Sentraoes, Ficksburg who has experience in the provision of hail insurance to small scale wheat farmers and Mr C Oliver of Grocane, Durban which provides fire insurance to small scale cane farmers.

2. HISTORY OF PAST EXPERIENCE WITH CROP INSURANCE IN THE USA AND SOUTH AFRICA

The USA has best developed crop insurance programme in the world while South Africa's experience with crop insurance has been limited.

2.1 South African experience with crop insurance

2.1.1 Historical perspective

South Africa's one attempt to broaden access to drought-inclusive crop insurance was not particularly successful. A scheme was launched in 1979 whereby the SA Government subsidised 25% of the crop insurance premia for special comprehensive policies offered by Sentraoes and CUAS (previously AA Mutual Agricultural Services). The sum insured was based on 60% of the average yield and premia were set on a farm by farm basis after on-site evaluation. In the 1980's the SA crop insurance initiative was hailed in Washington as one of the best examples of a scheme largely managed by private enterprise as the Federal Crop Insurance Corporation (FCIC) Programme at that time was largely managed by government. The SA scheme failed after ten years.

2.1.2 Factors influencing crop insurance participation (a South African study)

The Task Team on Drought and other Agricultural Disasters (1997) attributed the reasons for the failure of the South Africa scheme to the low participation rate, which in turn seems to have been a function of an insufficiently developed pricing structure, an insufficient subsidy and the disincentive posed by the existence of other avenues for receiving ad hoc drought assistance from the Department of Agriculture in the form of free disaster relief.

Jarvie & Nieuwoudt (1989) used discriminate analysis to study the factors why

South African maize farmers insure or not insure their crops. Results from a sample of 82 maize farmers indicated that those producers who insured their crops comprehensively had a low percentage of gross farm income from livestock, a relatively unfavourable liquidity position, substantial long-term debt, and a low gross farm income to assets ratio. These farmers also had a high-risk index, tend to be older and more experienced. A risk index that takes cognisance of individual farmer yield, crop specialisation or diversification was used.

As very little research has been undertaken on crop insurance in South Africa, the discriminant function estimated by Jarvie and Nieuwoudt (1989) is shown below:

$$DISC = -0.593\ LS^{XX} - 0.532\ LIQ^{XX} + 0.495\ DEBT^{XX} - 0.491\ GA^{XX} + 0.299\ RISK^{XX} + 0.294\ EXP^{XX}$$

where

XX = variables significant at 1% level
DISC = 1.0 if insured, zero otherwise,
LS = % income from livestock,
LIQ = A principal component was extracted from three variables namely gross farm income, credit reserve, and the ratio of assets to liabilities,
DEBT = Long term debt,
GA = Ratio between gross farm income and assets,
RISK = Coefficient of variation of crop yields weighted by relative area under a crop
EXP = A principal component of years farming and age.

All the variables were significant at the 1% level. As the function is in standardised form the importance of a variable is indicated by the magnitude of its discriminant function coefficient. For instance the livestock index was the most important variable (it had the highest standardised coefficient) in explaining the separation between the two groups (insured versus non-insured). It was concluded that crop insurers should direct their efforts at cropping areas known to be specialised in their enterprise portfolio and that have relatively small herds of livestock, variable yields and fair amount of debt.

In the South African maize belt, farmers have little scope to diversify as all crops are affected by similar weather conditions. It is thus not surprising that the livestock variable was important as this is probably the only enterprise that could provide some stability to crop farming under the conditions where most of the income is derived from a single crop. Research conducted in the USA (Nieuwoudt *et al*, 1985 and Nieuwoudt, 1984) indicated that farmers insure more

in areas where one crop is predominant, for instance wheat in Kansas and Montana. The implication is that the demand for insurance is high in South Africa where most income is from a single crop as in the maize, wheat and sugar cane areas.

2.1.3 Lessons from the SA experience

The programme became not viable after the SA Government started to withdraw premium subsidies from crop insurance. Further, massive drought assistance given to farmers reduced the incentive to insure. Inclusion of a livestock enterprise may be a good risk management strategy.

2.2 Experience with the USA Federal Crop Insurance Programme.

2.2.1 Historical perspective

The Federal Crop Insurance Act was signed into law in the United States in 1980. Policy makers envisioned a crop insurance programme that would ultimately operate on a near actuarially sound base with limited government financial assistance. The major insurance product made available to farmers under this Act was named Multiple Peril Crop Insurance (MPCI) and was marketed to individual farmers by private insurance companies. The Act authorised the Federal Crop Insurance Corporation (FCIC) to subsidise producer premium payments and to reimburse participating private insurance companies for their administrative expenditures and part of their underwriting losses. MCPI covers all natural risks, including unavoidable losses from drought, excessive rain and storm damage. Producers can purchase individualised coverage for either 50%, 65% or 75% of normal yield and one of three different price election levels. Normal yields are based on Actual Production Histories (APH).

Price election levels are determined form FCIC forecasts of expected prices. Should the producer's yield fall below the elected coverage level, he or she receives an indemnity equal to the yield shortfall times the elected price level. Insurance product choices have expanded from individual- farm yield insurance to include area-yield insurance and a variety of crop revenue insurance products. The programme has expanded in recent years and about two-thirds of planted acreage of corn, soybeans, and wheat was covered by crop insurance in 1998 (Dismukes, 1999).

MPCI has been plagued by low participation rates, huge federal outlays and high loss ratios incurred by insurers (Smith & Baquet, 1996). Acreage insurance during 1981 was significantly higher in areas where a single crop dominates than in

more diversified farming areas. For instance in North Dakota and Montana 40% to 50% of wheat acreage (predominant crop) was insured but in the diversified corn belt only 4% of the wheat acreage was insured in Illinois (Nieuwoudt *et al*, 1985).

Between 1980 and 1988, the loss ratio experience by private insurers (indemnities paid divided by premiums collected) averaged 2.05, well in excess of the approximate 0.95 level generally regarded as necessary for break-even insurance operations. During 1998 US growers paid $900 million in crop insurance premiums while during 1995-98 the US government spent $1.2 billion per year on premium subsidies, administration and operating subsidies, and net underwriting losses (Dismukes, 1999). The US Treasury's contribution to the Programme is thus significant and greater than the farmers' contribution while farmers receive twice as much in indemnities as they pay in premiums. Mandatory crop insurance was required after 1994 in order to qualify for other programme benefits but this was terminated in 1996 (Dismukes, 2000).

Miranda (1991) attributes the failure of the Federal crop insurance programme to operate on an actuarially sound basis to the problems inherent in trying to tailor coverage to individual yield-loss experience, these include adverse selection, moral hazard and high administrative costs. Halcrow (1949), cited by Miranda (1991), concluded that individual-yield crop insurance "will work in a satisfactory manner only under a system of conditions so exacting in their specification that they will be found to a rather limited extent in American Agriculture".

2.2.2 Delivery of federal crop insurance in the USA

USDA's Risk Management agency (RMA) is charged with the administration of crop insurance programs for the Federal Crop Insurance Corporation (FCIC). The FCIC regulates and promotes insurance programme coverage (Dismukes, 1999). This includes the setting of premium rates, ensuring contract compliance and providing premium and operating subsidies. Crop insurance policies are sold, serviced and underwritten by private insurance companies. Insurance companies also develop new insurance products that are approved for subsidies and reinsurance by FCIC and offer private coverages (without subsidisation) that supplement federal crop insurance. Companies compete for crop insurance business through insurance agents who sell and service the policies. Agents may be independent or contracted to a single company. Private companies share their underwriting risk with the FCIC by designating their crop insurance policies to risk-sharing categories, called reinsurance funds. Each fund allows for different levels of risk sharing, thus the proportion of losses paid of gains earned varies by

government fund. Companies that qualify to deliver crop insurance annually submit plans of operation for approval by the FCIC. This provides information on the ability of the company to pay potential underwriting losses and on the allocation of the company's crop insurance business to the various risk sharing categories or reinsurance funds. In addition to underwriting terms, companies are paid a subsidy by FCIC for administrative, operating and loss adjustment costs. The reinsurance terms are specified in the Standard Reinsurance Agreement (SRA) which applies to all companies delivering FCIC-reinsured policies (Dismukes, 1999).

Insurance product choices have expanded from simple individual yield crop insurance called Actual Production History Multiple Peril Crop Insurance to include area yield insurance and various crop revenue insurance products (Adjusted Gross Revenue and Group Risk Income Protection were added in 1999). Revenue insurance is covering a substantial portion of crops in some areas (Dismukes, 1999).

CAT (short for catastrophic) is a minimum level of insurance provided to producers at low cost. During 1999 CAT coverage at 50% of the producer's expected yield and 55% of expected price cost $60 per crop (the processing fee). While the cost is low only about 28% of expected revenue is insured and CAT coverage levels have declined in recent years (Dismukes, 2000).

The primary area-yield insurance product, The Group Risk Plan, is gaining popularity after its implementation in 1994 (Harwood *et al*, 1999).

2.2.3 Lessons from the USA experience

There are several lessons from the US programme:

(a) Governments should not get involved in the management of the programme, as the programme will then not be driven by business principles. When the FCIC programme was administrated by the US government during the period up to the early eighties, farmers in the high risk areas (cotton in Texas) received indemnities in excess of premiums for 10 out of 11 consecutive years implying that risk taking is subsidised while the opposite happened in the corn belt. The very nature of the information problem is that premiums of the more risky producers are subsidised at the cost of the least risky, creating a price distortion.

(b) Adverse selection arising from the information problem can be tackled through either higher subsidies, better information on risk faced by

individual farmers or compulsory insurance. Compulsory insurance will make those who would not willingly buy insurance worse off. The USA has promoted insurance through high subsidies, providing farmers better insurance products and obtaining better information on risk faced by farmers. A subsidy makes insurance attractive to risk adverse farmers who would have dropped out because of adverse selection. There is no welfare benefit if a risk neutral person insures as risk does not distort the prices he perceives. A problem is that subsidies create distortions of their own if subsidised premiums are lower than expected indemnities.

(c) A major problem with the MPCI was lack of acceptable participation and the relatively large loss ratios since 1980. Low participation may impact on risk spreading. A bigger problem of low participation is, however, that if few farms are insured that in the event of drought the government will bend to political pressure and offer disaster assistance. This in turn will remove all the incentives that farmers have to insure. Crop insurance has expanded in recent years, almost tripling in size since the early 1990's while providing farmers with greater choices. Whereas disaster payments discouraged participation in crop insurance in the early eighties, farmers who insure their crops now receive more disaster payments, reversing incentives to insure. Increased participation in crop insurance comes at a high cost to the US tax payer as the USA Government is paying more than 50% of the total cost of the programme. Given the magnitude of the US Government's contribution it is questionable whether the programme is cost effective.

3. PROBLEMS INHERENT IN CROP INSURANCE

Studies in recent years have concluded that market failure in crop insurance primarily results from asymmetric information problems, particularly adverse selection and moral hazard. The asymmetric information problem stems from the fact that the cost of obtaining accurate loss-risk information and the cost of monitoring farmer behaviour are prohibitively high (Miranda & Glauber, 1997). Recent scholars claim that systemic risk and not asymmetric information poses the more serious obstacle to the emergence of an independent private crop insurance industry. These problems are briefly evaluated.

3.1 Asymmetric information

(a) Adverse selection

Adverse selection arises because producers are better informed about the

distribution of their own yields and are thus better able to assess the actuarial fairness of their premiums than the insurer, who lacks access to reliable individual yield data and other relevant information. Producers who recognise that their expected indemnities exceed their premiums are more likely to purchase coverage than those whose premiums are actuarially high. As a result, the insurers expected indemnity outlays exceed total premium income, and, in the long run, the insurance operation loses money. Efforts by the insurer to avoid these losses by raising premiums only result in a smaller and more adversely selected pool of participants (Miranda, 1991).

(b) Moral hazard

Moral hazard results from asymmetric information. It occurs when, without the knowledge of the insurer, the insured changes behaviour after purchasing insurance in a manner that increases the probability of receiving an indemnity payment (Miranda & Glauber, 1997). Coble *et al* (1997) note that moral hazard has a significant effect on expected MPCI indemnities in most poor production years but not in years when growing conditions are favourable. Coble *et al* (1997) conclude that current monitoring practices do not effectively control moral hazard.

(c) High administration costs

Record keeping and other manpower requirements needed to verify individual production histories and to adjust individual yield-loss claims raise insurer expenditures and impose high transactions costs (Miranda, 1991).

(d) Elasticity of demand for crop insurance

Nieuwoudt & Bullock (1986:659) estimated the elasticity of demand for crop insurance in the USA at -0.43 implying that the area insured is not responsive to the premium rate or the level of subsidies. The implication is that a 1% subsidy on premiums is estimated to increase acreage insured by 0.43%. This low price elasticity of demand implies that significant subsidies are required to stimulate the demand for crop insurance. Goodwin (1993) estimated the demand for crop insurance in the USA at -0.32 for relative insured acres and -0.73 for liability per planted acre. Both studies indicate that the demand for crop insurance is inelastic. The Nieuwoudt & Bullock (1986) study indicated that disaster payments in the USA did discourage participation in crop insurance by about 20%. SA farmers' expectations that they would receive State assistance in event of disasters may have contributed to the low participation rate in the SA crop insurance programme.

Whereas disaster payments discouraged crop insurance participation in the USA in the early eighties, subsidy incentives were changed under the 1999 Agricultural Appropriations Act. Farmers with crop insurance may receive greater benefits from disaster payments which will encourage them to insure. In addition to crop insurance indemnities, USA farmers can apply for disaster payment assistance (Dismukes, 1999).

Increases in premium rates just prior to 1993 have been followed by substantial policy cancellation but the above estimates of a low price elasticity of demand indicate that other factors such as increased yields may have contributed to the lower participation rate. Goodwin (1993) indicated further that the price elasticity is relatively lower (higher) in counties where indemnity payments are high (low) relative to premiums.

3.2 Systemic risk

Systemic risk in agriculture stems primarily from the impact of geographically extensive unfavourable weather events, such as drought or extreme temperatures, which induce significant correlation among individual farm-level yields. Insurers of random events such as automobile insurance need not keep high reserves as claims can be paid by premiums received even over relatively short periods. Insurers of non-random events such as drought need to keep large reserves which are costly. This lack of stochastic independence among individual yields defeats insurer efforts to pool crop loss risk across farms, causing crop insurers to bear substantially higher risk per unit of premium than other property liability and business insurers. Without adequate reinsurance or government subsidies, crop insurers pass the cost of bearing the additional risk onto farmers, rendering individual crop insurance extremely, if not prohibitively, expensive (Miranda & Glauber, 1997).

Miranda and Glauber (1997) propose that systemic risk, and not asymmetric information, represents the primary cause of crop insurance market failure. They argue that if the asymmetric information problem is fundamentally intractable then private crop insurance markets are inherently not viable and government crop insurance programs cannot avoid suffering either high actuarial losses or low participation rates. If systemic risk is the primary cause of market failure they propose cost efficient remedies in the form of either area yield reinsurance or exchange traded area yield options. Their analysis indicates that, through the optimal use of these contracts, crop insurers could reduce their portfolio risk levels to those comparable with conventional insurers, thus substantially reducing the cost of providing crop insurance to farmers.

According to Miranda and Glauber (1997), an insurer's portfolio of insurance liabilities embodies systemic risk to the extent that the riskiness of the portfolio is greater than if the liabilities were mutually independent. Systemic risk ratios indicate that United States crop insurers face portfolio risks 22 to 49 times larger than if indemnities were independent. The coefficient of variation (variance divided by mean) of total indemnities paid by the ten crop insurers ranged between 67% and 130% while the variations ranged between 5.3% and 5.6% for automobile and fire insurers to 14.9% for crop-hail insurers (Miranda & Glauber, 1997). Crop insurers face portfolio risk approximately ten times larger than those faced by private insurers offering more conventional insurance.

3.3 Impact of size on yield variability

Schurle (1996) showed that smaller-acreage farms have greater yield variability than larger-acreage farms due to the aggregation effect. Smaller farmers may, however, have outside income sources which may reduce the total risk.

4. AREA YIELD CROP INSURANCE

Area yield crop insurance has a short history in the USA. The US President's proposed 1994 budget strongly endorsed GRP as a replacement for farm-based crop insurance. In response the US Congress did not eliminate farm-based crop insurance, but instead mandated that GRP be expanded to the extent practicable. Sweden implemented a similar programme at an earlier date (1961) while the Canadian province of Quebec introduced a programme in 1977 (Skees *et al*, 1997).

4.1 An answer to asymmetric and systemic risk and high administration cost

In his paper of 1949, Halcrow, cited by Miranda (1991), proposed an alternative to individual-yield crop insurance whereby indemnities and premiums would be based on the aggregate yield of a surrounding geographical area as opposed to an individual producer's yield. Under an area-yield plan, the producer receives an indemnity equal to the difference, if positive, between the area yield and some predetermined critical yield level. Each participating producer receives the same indemnity, per insured acre, regardless of his or her own crop yield, and would therefore pay the same premium rate.

Area yield crop insurance offers advantages over individual yield crop insurance by increasing the actuarial fairness of premiums. Adverse selection would be mitigated as information on area yields is readily available and reliable. Moral hazard would essentially be eliminated as a producer could not significantly

increase his or her indemnity by altering production practices. Administrative costs would also be substantially reduced as claims would not have to be adjusted individually and verification of individual production histories would not be required (Miranda, 1991 and Mahul, 1999). No fieldwork is required to adjust losses (Dismukes, 1999). These features are important for small-scale farmers where the cost of farm visits will be high per hectare of land and information on yields be lacking.

Miranda (1991) decomposes individual yield variation into a systemic component, perfectly correlated with area yield, and a non-systemic component, uncorrelated with area yield. He defines a variable, ßi, that measures the sensitivity of the producer's individual yield to the systemic factors that affect the area yield. The more highly correlated a producer's yield is to area-yield, the greater the risk reduction from area-yield insurance. Producers with the highest ßi's enjoy the greatest risk reduction under an area-yield plan (AYP), while producers with the highest yield variances obtain the best risk reduction under and individual yield plan (IYP). Area-yield crop insurance covers only systemic individual yield risk. There are areas where yield risks are not systemic for instance the problem of freeze in a fruit growing area. Non systemic risks such as hail are generally well provided by private insurance companies.

4.2 Area yield crop insurance as a hedging instrument

An AYP is not a true insurance programme since payments to producers are not based on their own specific yield losses. An AYP is more accurately described as a hedging instrument (Miranda, 1991 and Skees *et al*, 1997). More specifically, it is like a put option in which the critical yield (forecasted yield times elected coverage level) plays the role of the strike price.

As with a put option on an index, an area yield policy has an associated basis risk (Skees *et al*, 1997). The basis risk is when a farmer experiences farm level yield losses when area shortfalls are insufficient to trigger an indemnity payment. The less than perfect correlation between the individual farm yield and the area-yield index reduces the effectiveness of the area-yield insurance instrument in managing individual farm income risk (Wang *et al*, 1998).

4.3 The Group Risk Plan (GRP)

Skees *et al* (1997) discuss the Group Risk Plan (GRP) in which the indemnity payments are based on the percentage shortfalls in actual area yields relative to a forecasted yield as opposed to Miranda's AYP where indemnity payments are based on the unit difference between actual and forecasted yields. Historical area

yield dates are used to develop forecasted yields and premiums.
Most farm yields vary more than county yields due to the aggregation effect on individual data while farm yields may be greater than county yields. Farmers are thus allowed to scale the amount of protection they purchase by up to 150% of the forecasted yield times the expected price. This will help in setting a target indemnity payment that meets cash flow requirements. Scaling is important for providing more risk protection as farm yields are not perfectly correlated with county yields (Skees *et al*, 1997).

Skees *et al* (1997) provides the following example to illustrate the workings of a GRP. For a given year a county (the Area) has a forecasted soybean yield of 40 bushels per acre. The forecast is made about six months before farmers make their insurance purchase decision and plant their crops. A scaling of 150% with a forecasted yield of 40 bushels per acre and an established FCIC price of $6.00 allows a farmer to purchase up to $360 of protection per acre. The farmer selects a 90% coverage level. Thus the critical yield is 36 bushels per acre (90% x 40). The farmer will receive an indemnity if the actual county yield is below 36 bushels per acre. If the actual county yield were 27 bushels per acre or 25% below the trigger yield of 36 bushels per acre, the producer would receive an indemnity payment of $90 per acre ($360 x 25%).

Prices used in indemnity payments are set at planting. In the case of MPCI an expected price is used. Group Risk Income Protection uses the harvest-time future's market price (Dismukes, 1999). Both procedures keep the value of the insurance consistent with the expected value of the crop.

4.4 The basis risk

Basis risk is when farm level yield losses are experienced while area shortfalls are insufficient to trigger indemnity payments. It is important, in designing area yield contracts, to minimise this risk. Four elements of contract design are able to affect the basis risk: the area to be used for the yield index, the procedure for forecasting the central tendency in yields for the area, the indemnity payout rules and the insurance deductible and protection choices.

4.5 Optimal coverage levels

Should producers be free to select their coverage level under an AYP and how high should the critical yield be set? Under an IYP, the yield guarantee is normally set well below the producer's normal yield and coverage levels in excess of 100% are not permitted. This is necessary to guard against moral hazard. Under an AYP moral hazard is essentially eliminated therefore optional

coverage levels and high critical yields are feasible. Risks are reduced under optimal AYP's (where coverage levels are optional) for all individuals as the critical yield increases.

4.6 Considerations in designing GRP

GRP coverage requires a significant county yield history to determine actuarial premium and coverage levels. Area-yield insurance is effective in reducing administrative costs and asymmetric information problems (the only paper work required from the insured is an acreage report shortly after the normal planting period).

However, the assumption in GRP is that when county (provincial) yields are low, most farmers in that county will also have low yields. This is the situation in dryland cropping areas in South Africa where drought conditions are widespread. If this is not the case as in fruit growing regions an individual insurance is preferred. Wang *et al* (1998) conclude that at high levels of yield basis risk, an area yield index does not allow a farmer to manage yield risk efficiently and an individual farm yield index is a preferred design.

According to Miranda (1991) producers tend to shun the options and futures market as measure of hedging price risk. AYP's therefore may not get widespread acceptance. In order to get high rates of participation, AYP's may have to be subsidised (Miranda, 1991).

While systemic yield risk is reduced by the same proportion under an AYP, the total risk reduction varies among producers. In areas defined as homogenous regarding soil or climate, non-systemic yield risk can be attributed almost exclusively to producer specific factors such as choice of production practices. Reduction of the latter may promote a misallocation of resources by encouraging risky production.

5. REINSURANCE

Common risks fall in a continuum between perfectly independent at one extreme and perfectly correlated at the other. Auto and life is near the perfectly independent side and prices and exchange rates are near the perfectly correlated side with crop yield in between but more towards the perfectly correlated side. Insurance markets provide protection to independent risk while option and future markets are developed to handle correlated risks.

Reinsurers, like all insurers, are designed to address diversifiable not systemic

risk. The cost of holding reserves sufficient to cover huge losses like widespread drought renders private crop reinsurance prohibitively expensive. As an alternative to the current reinsurance programme, Miranda and Glauber (1997) propose the development of markets for area-yield reinsurance contracts. These contracts could be marketed on established options and future exchanges or, alternatively, sold by the government.

5.1 Area-yield reinsurance

Area-yield reinsurance contracts would indemnify the owner based on shortfalls in regional yields, offering crop insurers protection against huge losses resulting from widespread natural disasters. The contract would be written by the government, for a specific region, crop and yield guarantee and settled on final regional crop yield estimates. Premiums would be set based on actuarial considerations. Miranda's farm level model showed that the most dramatic risk reduction would be obtained if the contracts were offered at state level in the United States.

Area-yield reinsurance could be provided by government at low cost given that historical yield levels for various crops and regions have been compiled for years. No additional information beyond what is currently being collected would be required to settle reinsurance claims. Area yields could not be manipulated by the insurer. Government area-yield reinsurance contracts could therefore significantly reduce potential moral hazard and adverse selection problems between the government and the insurer. Rate setting responsibilities for individual policies could be shifted to the insurance company, which would assume some underwriting gains and losses from individual crop insurance contracts at the margin. This would restore incentives for crop insurance companies to improve their actuarial performance by closely monitoring the adverse selection and moral hazard problems between the insurance company and the individual farmer.

5.2 Area-yield options

Options and future markets offer a free-mark alternative to government provision of area-yield reinsurance. Like area-yield reinsurance contracts, the writer of the option (like the writer of the reinsurance contract) would pay the bearer of the contract the value of the shortfall in regional yield. The contracts would be written by profit driven futures markets participants and the premium rates would be set by an open market process.

Options and futures markets offer a viable alternative to government reinsurance precisely because such markets are designed for the allocation of highly correlated risk (Miranda & Glauber, 1997).

Area-yield options contracts would be efficiently priced on a competitive market and would reflect the full spectrum of private information available on how various factors, like prevailing weather patterns, are affecting yield expectations. They would be available to anyone whose income varies with aggregate agricultural production while participation in government crop insurance programs has been limited to farmers. According to Miranda and Glauber (1997) the Chicago Board of Trade has launched trade in Iowa area-yield futures in 1995. They contend that if the private insurers succeed in reducing the cost of adverse selection and moral hazard that it may be possible for the federal government to withdraw entirely from the crop insurance market.

6. SMALL-SCALE FARMERS IN SOUTH AFRICA

6.1 Crop statistics on small-scale farmers (ESKOM, 1999).

There are approximately 2.1 million households (of a total of 8.6 million in the country) engaged in some form of small-scale farming. These farms are concentrated in three main areas:

Eastern and Western Cape	(31%)
KwaZulu-Natal	(27%)
Northern Province	(24%).

These small-scale farmers can be divided into three types:

(a) Emerging farmers who earn money by farming as well as other means and who are trying to become established full time farmers (7% or 140 000).

(b) Farmers who farm as a hobby or sideline, but make a living by other means (18% or 380 000)

(c) People who grow food and livestock to make ends meet - subsistence farmers (75% or 1540 000).

Over 90% of these farmer grow some form of crop or vegetable or fruit. Maize is grown by 73% of farmers while substantial proportions grow various vegetables: beans (48% of farmers), pumpkin/hubbard squash/butternut (47 %), spinach (36%), potatoes (36%), cabbage (31%), onions (20%), tomatoes (16%), carrots

(15%), beetroot (13%), sweet potatoes (10 %). The only fruit of significance was peaches (17%). All other crop types have an incidence below 10%. Due to climatic differences between provinces these crops are grown in different proportions in the provinces.

Maize contributed 56% to crop income followed by spinach 10%, potatoes 6% and others 28%. Although two thirds of these small farmers own livestock, crops contribute more to income than livestock.

6.2 Sentraoes crop insurance

Sentraoes has a group insurance contract for hail with the Lesedi Corporation for 60 small wheat farmers (Van Rooyen, 2000). Farms are, however, individually insured with the Corporation as the names of individual policy holders appear on the addendum of the contract. The small farmers are all insured for the same yield and all pay the same premium. Farms are visited only once to determine claims. No subsidy is received for this insurance.

Area insurance for drought will be more cost effective than **individua**l insurance, as at least two visits are required for drought insurance. A subsidy will still be needed to make this policy viable (Van Rooyen, 2000). He suggests that the cost of monitoring could be reduced by (a) using satellites, (b) taking samples from say 10 farmers in an area of say 100 farmers and (c) utilising a network of people on the ground for instance people familiar with the area and using bicycles. He further contends that insurance for vegetables will not be viable as risks vary dramatically between crops while the latter is grown in small patches. Van Rooyen (2000) is of the opinion that **individual** drought insurance will not be viable.

6.3 Fire insurance for small-scale cane farmers

Grocane provides fire insurance to 230 small-scale cane farmers from the 2000 season. No subsidy is received for this insurance and payments are based on the final cane price. The premium is only paid at the end of the season and based on tons crushed (Oliver, 2000). Although small-scale farms are individually insured they are treated as a group as they can not comply with certain requirements for insurance and because of their size. Grocane is reinsured through Lloyds of London.

No drought insurance is available to small and large-scale commercial cane farmers. According to Oliver (2000) it is uncertain whether Grocane will be

interested in drought insurance of small growers, as these schemes need to be studied.

6.4 Comments

A crop insurance programme for small-scale farmers will probably be targeted at the 140 000 emergent farmers. Dryland maize will be an important crop in such a programme. Area insurance as discussed in this document is proposed where risks are systemic as in the case of dryland crop farming. Vegetable crops are also important in small-scale farming but the risks that affect the latter are not of a systemic nature as these crops are under irrigation. Consideration should be given to individual yield insurance in the latter case. According to van Rooyen (2000) individual yield insurance for vegetables may also not be viable as risks differ between vegetable crops while individual crops are grown in small patches. Maize and wheat are grown on a larger scale but even in this instance farms may be small, as most small-scale farms in KwaZulu-Natal are less than two ha.

Innovative solutions should be considered to reduce high administration cost as these costs may make the programme not economically viable. Administration cost can be reduced through group schemes as for example the group scheme of Sentraoes. Livestock is important on most farms which provides liquidity and a stabilising influence on small-scale farming in the dryland crop areas.

7. ESTIMATED ANNUAL COST OF SMALL HOLDER CROP INSURANCE TO SOUTH AFRICAN GOVERNMENT

In this section the annual cost of small holder crop insurance to the South African Government will be estimated based on estimated value of small holder production in South Africa and relative cost data for the USA.

In 1998, USA growers paid about $900 million in crop insurance premiums for about $28 billion in guarantees on about 180 million acres of crops. During 1995-98 the USDA's Risk Management Agency has spent about $1.2 billion per year on premium subsidies, administration and operating subsidies, and net-underwriting losses. The cost of a GRP will be lower than of individual yield insurance but on the other hand targeting the programme at small farmers in South Africa will substantially increase the cost.

The contribution of small holder production to gross farm income is estimated by experts who have worked in this field at 5% to 6% (Vink, 2000 and Meyer, 2000) and 11% (Kruger, 2000). A figure of 5.5 % was used in the further calculations as

most researchers working in this field support this figure.
Gross income of field crops and horticulture for the SA agricultural sector (1998/99) = R26020.4 million (NDA, 2000: 84).

Estimated % contribution of small farmers to total production	5.5%
Gross income (crops and horticulture) of small holders	R1431.1 million
Estimated total insurance liability of small holder production	R1431.1 million
Estimated percentage of crops insured	66%
Annual cost to the South African Government (assume 66% insured)	R40.5 million
Estimated premiums paid by small growers (assume 66% insured)	R30.4 million

The subsidy cost to the South African treasury is estimated at R40.5 million given that 66% of crops and horticultural products of small holders are insured. The information requirements of an in insurance programme for vegetable crops will be high if individual farms are insured.

8. CONCLUDING COMMENTS

Droughts are a common phenomenon in Southern Africa. It is important to be pro-active rather than reactive and the SA government's concern regarding risk management strategies is a wise decision. This risk protection can facilitate access to operating loans by offering some financial security to a lender. In the USA, farmers have been encouraged to insure their crops in order to mitigate the impacts of drought. The US crop insurance programme has, however, been expensive to the government as the contribution of the US government to the programme exceeds premiums paid by growers.

The high cost of the USA programme has been attributed to asymmetric information (adverse selection and moral hazard) and systemic risk. The administration cost for small growers of a crop insurance programme will be significantly more than for large growers as farms need to be visited to verify claims. In recent years several journal papers have shown the advantages of area insurance as a method to overcome these problems. The USA Department of Agriculture has adopted an area insurance plan (called Group Risk Plan) in 1994. Indemnity payments are made when the area yield falls below a critical level and there is no need to visit farms to access claims. In the SA situation the cost of such a programme will be substantially less for small growers than an individual insurance programme.

Insurance schemes are most effective in reducing producer risk when contracts are written by the private sector while government subsidises part of the underwriting losses and administration costs. The private sector would also perform the initial farm level examinations, conduct claim assessments and bear a share of the risk. Private sector reinsurers would help form the pricing strategy and also bear a share of the risk. It is essential that schemes be structured in a way which provides incentive to farmers to reduce risk exposure by adopting risk-reducing practices or investing in risk-reducing improvements.

Along with insurance, risk management strategies should be considered such as low risk technologies (McGregor & Hudson, 1999). Incorporation of a livestock factor in high-risk crop areas may provide the farmer with better liquidity (Jarvie and Nieuwoudt, 1989). McGregor & Hudson (1999) favoured that only input cost should be insured and not unrealised profit. Input cost insurance has often been proposed but under an insurance programme a farmer can determine what percentage of total income is cost and insure his crop at that level.

9. LESSONS FOR SOUTH AFRICA

The following lessons are drawn from this study.

1. Subsidised crop insurance for **individual** small-scale vegetable growers under irrigation will be more appropriate than area insurance. The reason is that risk faced by these growers is not of a systemic nature (correlation between yields for different farmers is low if drought is eliminated) and different farmers may experience different risks. It may, however, not be economically viable to insure vegetable crops of small holders under irrigation as risks for individual vegetable crops differ while individual crops are grown in small patches. If individual areas under a crop are larger then private insurers may be interested to insure against this type of risk as the risk associated with vegetables is not expected to affect whole regions and the cost of holding large reserves is thus not a problem. Individual crop insurance may then be viable as in the case of fire insurance (sugar cane) and hail insurance. Small farmers are **individually** insured for hail through a group insurance contract between Sentraoes and the Lesedi Corporation. Innovative group insurance contracts could reduce the administration costs.

   A variety of vegetables are grown by small-scale farmers and due to climatic differences in the provinces, different crops dominate in the different provinces. Main contributors to crop income are spinach and potatoes. Peaches are the only important fruit produced. Cost of crop

insurance is, however, high because of the high administration cost (cost of farm visits, verification of damages, not availability of information etc.) in addition to problems such as adverse selection and moral hazard.

2. An area insurance plan (farmers are insured **as a group**) is proposed for dryland field crops such as maize because risk is systemic (drought related). In this Report the Group Risk Plan (GRP) whereby a farmer takes out insurance on a crop loss of the area is shown to be more cost effective especially for small-scale farmers. The GRP has lower administration cost as individual farm yields are not required, and verification of individual farm losses is not needed. Further adverse selection and moral hazard are not issues. GRP is appropriate where unfavourable weather induces high correlations among individual farm yields (systemic risk is high).

3. The value of field crops and horticultural products of small holders is estimated at R1431 million. Assuming 66% is insured, then the government contribution is estimated at R 40 million and the premium cost to growers at R30 million. The cost to the Government is estimated as 33% more than the premium cost to growers. These cost estimates are seen as conservative due to the small farm sizes and the non-availability of sufficient data series to capture risks.

4. A problem with crop insurance is that a large part of the cost to government goes to administration of the scheme and thus does not reach the target group (farmers). Due to the high cost of crop insurance to the government other strategies of risk management for small growers should be considered such an Income Equalisation Deposit (IED) scheme.

5. It is recommended that an IED for small growers should receive serious consideration with the government making a contribution as for example in Canada. Instead of the government paying R133 for every R100 that a grower pays for crop insurance the government could make a matching contribution to small growers, with the contribution being gradually phased out when the grower's turnover say reach R50 000. If an IED for large-scale commercial farms is accepted then this will provide a logical link between the drought assistance provided to small and large-scale farming. An IED for small growers can include all enterprises namely crops, horticultural crops and livestock. It will thus be of a more inclusive strategy than crop insurance. In addition an IED does not have the problems that are inherent in crop insurance (asymmetric information etc). A main issue in South Africa is the high cost of delivery of crop insurance to very small growers while information is not readily available.

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