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AGRICULTURAL INSURANCE IN PANAMA: INSTITUTIONAL DESIGN AND PORTFOLIO MANAGEMENT

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OFICINA DEL IICA EN PANAMA – PROYECTO DE SEGURO AGROCREDITICIO

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I. Introduction

The objective of this study is to provide the Instituto de Seguro Agropecuario de Panamá (ISA) with a strategy for the technical and political optimization of its portfolio, a necessary step for the evaluation of the impact of crop credit insurance on the financial component of the farm sector. By comparing the actual and normative performances of the agency's portfolio it is expected that some insight will be gained with respect to the problems affecting agricultural insurance. As an added benefit, such insight will yield information of value to the other insurance programs now in the process of implementation.

The problems facing the rural credit delivery system in Latin America are fairly obvious. [Von Pischke, Adams, and Donald]. Faced with low interest rates and obligatory lending

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laws for farmers, private bankers are continually attempting to minimize the losses implied. As a rule, farm credit is allocated in terms of a few large, low-risk loans to a small number of farmers, with a consequent reduction in the cost of administering the bank's portfolio. Farm development banks, on the other hand, face a different problem. By having most of their portfolio in the agricultural sector, these banks have a large share of their funds allocated among many small producers with highly fluctuating farm incomes. As a consequence, the rural credit system in many Latin American countries is in a state of disarray. Private lenders are reluctant to expand their activities in the farm sector, and development banks - plagued by high default rates and negative returns to capital- are being decapitalized.

Concomitant with the imperfections in the rural capital markets, risk and uncertainty in agriculture is being increasingly recognized as a deterrent to farm growth. The fluctuations in farm income brought about by unforeseen variations in prices and yields have produced a highly cautious farmer whose collective behavior may not be socially optimal [Hazell,1980; Just and Pope].

Crop credit insurance, a variant of crop insurance, is a risk management tool long advocated as a solution to farm risk. It enables the farmer to repay his loan in case of a

crop failure covered by a policy purchased at a relatively low cost. The implementation of an insurance scheme in the developing countries, however, has had little support. Questions abound about the adequacy of the administrative mechanisms, the lack of actuarial information, the poor institutional infrastructure, and the moral hazard. This latter aspect has consistently been the most worrisome [Halcrow; Roumasset]. Crop insurance agencies, it is argued, are prone to political manipulation. By declaring an artificial disaster in order to gain support, a government may easily destroy the agency. The other constraints are not as limiting.

In 1975 the government of Panamá created the Instituto de Seguro Agropecuario (ISA), an insurance agency aimed to protect farmers against loan default. With no technical base or actuarial information the program insured loans given to maize, sorghum and rice growers on an *ad-hoc* actuarial basis. In 1979, ISA signed and agreement with the Interamerican Institute for Cooperation on Agriculture (IICA) to undertake a more ambitious project. The four-year agreement gives ISA technical and financial assistance as well as administrative support. Furthermore, the agreement provides IICA with the opportunity to evaluate the impact of crop credit insurance on the development of the farm system.

This study is part of the evaluation process. Its main objective is to analyze ISA's current portfolio and to provide

guidelines for its improvement. In addition, the study deals with the trade-offs involved in the optimization of the portfolio; that is, the shadow prices of the technical and political alternatives. Finally, the study discusses the necessary conditions for future growth, as well as its implications for planning.

II. Crop Credit Insurance in a Development Context

The constraints facing crop insurance agency in a developing country are both technical and institutional. Both inhibit the agency's diversification strategy. On the institutional side, the agency competes with other government agencies for funds and qualified personnel. On the technical side there are limits to insurance experience, low initial acceptance from farmers, and lack of actuarial information. Both types of constraints preclude a rapid diversification strategy. Moreover, the presence of private insurers in the urban and industrial sector further restrict a more diversified portfolio. As a consequence, crop insurance agencies must take full advantage of short-cycle agriculture and base their diversification strategy on spatial and intertemporal options.

The Experience in Panamá

The crop credit insurance program in Panamá was initiated

with a social role in mind. ISA was created in response to petitions from a few medium-sized farmers who wanted protection against climatic risk. The benefits to the development bank and to technical assistance were not foreseen at the time.

Participation is now compulsory for farmers borrowing funds from the Banco de Desarrollo Agropecuario (BDA) for activities covered by the insurance program. At present, five crops and three livestock activities are covered; independent farmers and farmers with private loans participate on a voluntary basis. A five percent average premium for crops and a three percent average premium for livestock enable farmers to recover at least seventy percent of their cost of production in the case of disaster. Each farmer gets his crop or animal inspected at the initiation of the policy. A policy may, at that point, be cancelled on technical grounds. Inspections occur at the initial period, at the request of farmers for technical advice, and at harvest time if a claim is filed [Pomareda; Velásquez]. Technical assistance is automatic in the case of livestock since the animals are vaccinated at the time of the first inspection.

Unlike other crop insurance programs, the ISA program does not guarantee price; it only guarantees repayment of the loan. If a claim occurs at harvest time, the salvage value of

the crop is assessed at the floor price specified by government programs. Adverse selection is avoided by the compulsory nature of the program and effective inspections.

ISA is currently operating at a net loss due to its high operating costs relative to its total coverage. The net deficit is compensated by a government budget subsidy and by a grant from IICA. The insurance portfolio, however, is actuarially sound, leaving a positive balance between premiums and indemnities.

Although it is clear, from the above description, that ISA has little room for diversification, program performance may be improved by modifying premium rates and the spatial allocation of insurance.

III. The Portfolio Model

The present model is based on a portfolio selection model developed by Hogan at the request of IICA. In its most simple form it assumes that a set N of insurance policies with mean returns E and variance V is preferred to a set with mean E and variance $V^* > V$. Realistically, however, ISA's portfolio must consider the inclusion of a riskless asset such as cash reserves, as well as the probability of large stochastic cash demands [Cummins and Nye; Chen, Jen, and Zionts]. The inclusion of a riskless asset implies borrowing costs, while large stochastic cash demands imply emergency loans and

reinsurance. Both are considered important for ISA's purpose.

It is assumed that the number and total amount of claims is stochastic with a probability distribution whose variance is finite. In addition, the cost of income variance is represented by the interest rate on borrowing, and by the premium rate for reinsurance.

The objective of the insurance agency is a mixture of profit maximization and social efectiveness. ISA needs to build up its cash reserves and extend its coverage, while keeping in mind the objective for which it was created, that of protecting farmers at a minimum social cost. Hence, the objective function of the agency is to select an insurance portfolio that maximizes profits while guaranteeing insurance coverage to a basic combination of crop and provinces, as mandated by farm policy.

Finding the optimum portfolio is a quadratic programming problem of selecting a vector of insurance options $\underline{X}$ which maximizes

$$F(\underline{X}) = \underline{EX} - \phi(\underline{X}'Q\underline{X})^{1/2} \tag{1a}$$

, the model's objective function, subject to

$$A\underline{X} \leq b \tag{1b}$$

$$\underline{X} \geq 0 \tag{1c}$$

, where $\underline{E}$ is a (1xn) vector of net earnings per option ,$\underline{X}$ is and (nx1) vector of insurance options, Q is a symmetric positive semidefinite covariance matrix, ϕ is a risk aversion parameter, A is an (mxn) technical coefficients matrix, and $\underline{b}$ an (mx1) vector of resource constraints [Baumol]. This nonlinear model can be solved linearly by using the mean of the absolute deviations (MOTAD) method, [Hazell, 1971], which states that the effect of the quadratic portion $(\underline{X}'Q\underline{X})^{1/2}$ of the objective function (1) can be approximated by the objective function $f(\underline{X})=\underline{EX}-\phi\sigma_x$, where $\sigma_x=(\underline{X}'Q\underline{X})^{1/2}$ is the standard deviation of earnings. This standard deviation can, in turn, be approximated by

$$\hat{\sigma}_x=H\{\frac{1}{T}\sum_t|\sum_j(E_{jt}-\bar{E}_j)X_j|\} \tag{2}$$

, where $\bar{E}$ is the expected value of earnings for option j, $j=1,\ldots n; E_{jt}$ represent the earnings for option j in the year t, $t=1,\ldots,T$; and $H=[T\pi/2(T-1)]^{1/2}$. It can be shown that $\hat{\sigma}_x$ is a less efficient but unbiased estimator of σ_x [Herrey].

Without loss of generality, let the objective function be expressed as

$$\max_C \quad U=R\sum_i\sum_j r_{ij}C_{ij}-RI-G-\phi S+dF \tag{3}$$

where

R is the quota share for reinsurance coverage.

r_{ij} is the premium rate charged to crop i in province j;

C_{ij} is the coverage, or amount covered by insurance, for crop i in province j;

I is the sum total of indemnities paid;

G is the sum total of administrative costs;

ϕ is the risk aversion parameter.

S is the estimated mean absolute deviation of earnings from the portfolio.

d is the interest rate paid on cash reserves.

F is the share of net earnings set aside for reserves.

The R scalar attached to both net premiums and total indemnities reflects the quota share ruling established by the reinsurance company. The quota share means ISA yields a fixed percent of its portfolio to a reinsurance agency in exchange for limited protection against catastrophic risk, thus allowing for a significant reduction in the cash reserve allotment F. The administrative cost G, however, is entirely borne by ISA. The objective function (3) is subject to the following constraints:

$$\sum_i \sum_j C_{ij} \leq 1 \qquad (4)$$

This constraint indicates that options in the optimal portfolio are expressed as fractions or percentages of the total portfolio, thus allowing for changes in ISA's total coverage without having to update the model's coefficients. Also,

$$\sum_{ij}\sum b_{ij}C_{ij}-G \leq 0 \tag{5}$$

$$\sum_{ij}\sum P_{ij}C_{ij}-I \leq 0 \tag{6}$$

, where

b_{ij} is the administrative cost for crop i in province j:

P_{ij} is the fair premium rate, or indemnities to coverage ratio, also called the loss cost.

Equations (5) and (6) generate the sum totals for administrative costs and indemnities included in the objective function. Similarly, the sum total for the minimum loss ratio imposed on the portfolio may be written as

$$\sum_{ij}\sum L_{ij}C_{ij} \geq \bar{L} \tag{7}$$

, where $\bar{L}$ is the average loss rate, or indemnities to net premiums ratio, for the entire portfolio during the five years of operation. This restrictions forces ISA to return as indem-

nities at least a proportion $\bar{L}$ of the net premiums. $\bar{L}$ is therefore defined as the ratio of total indemnities over total net premiums for all the years of operation:

$$\bar{L} = \left[\sum_{ijt}\sum\sum L_{ijt} r_{ijt} C_{ijt}\right] / \left[\sum_{ijt}\sum\sum r_{ijt} C_{ijt}\right] \tag{8}$$

Previous to the adquisition of reinsurance ISA set aside 20 percent of their actuarial earnings to a cash reserve, in spite of operating at a net budgetary loss. With reinsurance coverage now available, this share is assumed to decrease to 10 percent of net premiums.

This cash reserve restriction may be written as:

$$0.10\left[R\sum_{ij}\sum r_{ij} C_{ij}\right] - F \leq 0 \tag{9}$$

The MOTAD estimator of the standard deviation of the portfolio may be derived from equation (2). Following Hazell [1971], the net revenue deviation equations may be written as:

$$\sum_{ij}\sum (P_{ijt} - \bar{P}_{ij}) C_{ij} - Z_t \leq 0 \tag{10}$$

$$2\sum_{t} Z_t - (T/H)(-\phi) = 0 \tag{11}$$

$$t = 1, \ldots, T$$

Where $\overline{P}_{ij}$ is the historical average loss cost for option i in the j province and $Z_t \leq 0$ is a deviation counter measuring positive deviations around the mean for the $t^{\underline{th}}$ set of revenue outcomes.

The social goals and logistical limitations of the agency may be expressed as:

$$\sum_{ij}\sum g_{ijk}C_{ij} \gtrless D_k \qquad (12)$$

, where g_{ijk} is the share of option i in province j on the social or logistical restrictions D_k, k=1,...,K. The logistical restrictions include limitation on the agency's personnel for covering the farming area, accesibility to all areas, the crop types and technologies in the areas, and the total coverage implied by the total amount of funds lent to farmers.

Finally, to guarantee the solidity of the portfolio, a chance constraint is incorporated into the model. ISA will select items in the portfolio until the probability of catastrophic losses -and therefore the use of reinsurance- is at most α. This constraint may be expressed in probabilistic terms as:

$$Pr\{\sum_{ij}\sum \overline{P}_{ij}C_{ij} \leq \Psi \sum_{ij}\sum r_{ij}C_{ij}\} \geq (1-\alpha) \qquad (13)$$

$$, \; 0 \leq \alpha \leq 1 \; ; \; 0 \leq \Psi \leq 1$$

As show by Hazell [1980], such a constraint may be expressed in terms of a standard normal distribution as:

$$\sum_{ij}\sum \overline{P}_{ij}C_{ij} - \Psi \sum_{ij}\sum r_{ij}C_{ij} - 1.65\hat{\sigma}_{x} \leq 0 \qquad (14)$$

Equation (14) indicates that net premiums will exceed indemnities by a certain amount 95 percent of the time. The schematic representation of the linear programming tableau is shown in table 1.

IV. Data

Data for the analysis come from ISA's insurance operations. Although scant, the figures still present some patterns which are of help in the design of premium rates by crop and zone. Table 2 shows the compositions of ISA's portfolio for 1980-81, the last available data set. During that year ISA insured crops and animals for a total of 13 million dollars. Aproximately 6.5 million dollars corresponded to crop insurance and similar figure to livestock insurance. Breeding cows had the biggest share of the portfolio with more than 26 percent of total coverage, followed by upland rice with approximately 25 percent.

The value of crop and animal losses, in proportion to their coverage, is shown on Table 3. The maximum number of years available for any one activity is five, with some new

activities having only two years of data. In term of actuarial history such lengths of time are practically meaningless but, in a normal year, they should yield a rough approximation to long term loss costs. As the table shows, the loss cost figures for some crops in some provinces are extremely high. They obviously indicate a bad year for that item and, therefore, should be viewed with caution.

In similar fashion, the administrative costs are shown in table 4. It can be seen that there is a close correlation between the loss and administrative cost figures. Items which had high losses also present high administrative costs, thus reflecting the additional time spent in claims assesment. It is then obvious that several of the items are being run at a loss, requiring a readjustment in their premium rates. For some cases, such as corn in the provinces of Panamá and Colón, and sorghum in Coclé and Veraguas, the premium rate adjustment cannot be as high as the loss cost due to their short actuarial history.

V. Model Results

Model results are based on several logistical premises. It is assumed that allocations to cropping and livestock activities are divided equally. At present, the proportion of the portfolio asigned to crops is 51.9% and the proportion asigned to livestock is 48.9%. In addition, a minimum loss

rate of 70% is assumed for the entire portfolio. That is, for every dollar received in terms of net premiums ISA must return at least 70 cents as indemnities. Finally, the proportions of the portfolio currently held by each province have been roughly kept equal to reflect the working capacity of each regional office.

The optimal model solution is shown in table 5. Comparing it with the composition of the 1980-81 portfolio it is evident that many of the current items have been left out. Such items are the ones contributing the most to ISA's actuarial losses. Furthermore, such activities also account for high administrative costs brought about by the cost of assesing the insurance claims. Thus, the portfolio is reduced from 39 to 17 items, or by roughly one half. It should be noted, however, that some of the activities in the optimal port folio, i.e. beans, have a relatively high loss cost and high administrative costs. Their presence in the optimal solution obviously obey model restrictions. Rice and breeding cows are the main activities in the solution, followed by the coverage of bulls and feeder cattle.

Net income is still negative. Due to the logistical restriction imposed by the model the net balance between net premiums and indemnities is not enough to offset the administration and inspections costs (table 6). As indicated in the second column of the table, optimization under current condi-

tions leads to a reduction of 43% in ISA's net deficit. Such savings are mainly due to the significantly lower losses and administrative expenditures brought about by the elimination of most of the losing activities. By trimming the portfolio the cost of actuarial losses diminish by 24% and the administrative expenses are reduced by 26 percent. The earnings on accumulated reserves remain constant since they are independent of the model solutions. Reserve allocations, however, have decreased due to the presence of reinsurance.

Since actual premium rates are actuarially unfair for some items in the portfolio a new premium rate structure was simulated. However, for lack of a better alternative, the costs of administration and the net deviations were kept at the previous levels. Rice premiums, which are now too high, were lowered substantially, while other items such as sorghum and maize were generally assessed a higher premium. The new premium rates are assumed to be only actuarially fair and do not account for some of the cases where administrative costs are overly high. Hence, the new rate structure attempts to reflect what would happen to the portfolio under present logistical conditions.

The results for the case of higher net premiums are similar to the original model solution, except for the fact that livestock activities have become more diversified than the cropping activities. (Table 7). Portfolio performance, as

previously shown in table 6, is slightly improved under the new rates. The net deficit is now 56% lower than the deficit for 1981. The significant increase in premium income is offset by the model restrictions. As a consequence, administrative costs are even higher than in the original solution and the loss rate increases to 83% of net premiums.

The standard deviation of income was so small in the cases described above, that it was considered non-significant . The chance constraint, however, was binding at a level close to one percent and, therefore, not considered a problem for portfolio strategy.

Given that the optimal portfolio also yields a loss, it is obvious that the conditions for a positive net benefit must be examined. From the previous results it can be ascertained that a positive income will not be obtained from premium rate manipulation alone. It is clear that lowering the administrative costs is also necessary. In order to break even, the administrative costs should decrease to 1.41 percent of coverage if current premium rates are maintained. If a new premium rate structure is implemented the cost of administration and inspection needs to be 1.62 percent of coverage in order to reach the break even point.

Achieving low administrative costs is feasible only when a certain degree of automation and a long agency-client rela-

tionship is established. The administrative cost per dollar of coverage has been steadily declining since ISA started its operations, from an initial 16.9 percent of coverage in 1977 to an average of 3.5 percent in 1981. Hence, the possibility of ISA lowering its operational costs and reaching some economies of scales is fairly certain.

Premium rate manipulation is an entirely different matter. Although the historical loss cost for certain crops in certain areas may indicate a rate of 10 to 20 percent of coverage, it is difficult to recommend that a similar premium rate be implemented. The low returns to agriculture among ISA's clients and the politically sensitive nature of a compulsory program make a farmer-supported insurance scheme unfeasible. Hence, the evidence from the model suggests that a net compensation to farmers, from the non-farm sector of the economy, must be sought.

The need for a subsidized premium may be argued on equity grounds. Consumers, as beneficiaries of farm production, should also help spread the risk now faced entirely by farmers. If, in addition, retail food prices are regulated as in the case of Panamá, the need for a subsidy becomes clearer. The above argument may be better understood in the case of a bad year. Model results indicate that when the value of losses relative to premiums received is high, the actuarial component of the insu-

rance program bears most of the burden. As shown in Table 8, the increment in loss rates (the ratio of indemnities to net premiums) affects the loss cost more than the value of the claims. If the insurance scheme is borne entirely by the farmers then the premium rates would have to increase substantially.

VI. Conclusions

For a compulsory scheme, such as the agricultural credit insurance program in Panamá, the results are useful for overall strategies and should not be interpreted as recipes for portfolio selection. In turn, such solutions are only appropriate in the context of a voluntary insurance program. Nevertheless, several conclusions regarding program structure may be drawn.

The combined actuarial and administrative cost of the program seems to be high relative to other productions factors such as the price of credit. Moreover, unless future actuarial performance indicates otherwise, the value of total losses and the cost of administrating the program have to decrease substantially just to reach a break even point. This suggest several strategies which may be pursued in the future. First, it is necessary to incorporate into ISA's portfolio a set of insurance activities which would yield a lower loss rate. The incorporation of life and farm machinery insurance is a good example.

Second, if a non-profit policy is to be maintained, then it is necessary to endow ISA with sufficient reserves in order to obtain more earnings with which to balance the portfolio. A deficitary program, maintained with grants and governmental budgetary allocations, will need a long time for reserve build up and will have little room for short run manouvering. Third, given that food prices are regulated downward (as in most Latin American countries), the cost of insurance may yield a net disincentive to farmers. This in turn suggests that consumers should also share farm risk. The consumer's share may be in the form of subsidized premium rates, as in the case of Mexico, with the subsidy being drawn from non-farm sources such as non-farm insurance or income taxes. The present budgetary subsidy received by ISA is drawn from agricultural sector budgets and it is only for ISA's take-off stage.

Finally, the optimization of the model seems to indicate that minimizing the costs of credit insurance in Panamá may yield little gain in terms of political impact. By insuring 17 of the 39 options now available ISA would save a maximum of 170,400 dollars but reduce geographic coverage a great deal. Such reduction may be damaging in terms of institutional image, albeit only in those cases where insurance is considered a positive assett by its clients.

In terms of program structure the model is very useful

for simulation. As shown in the previous section, new premium rates, cost subsidies, returns on reserve allotments, loss rates, reinsurance rates, and loss costs may be simulated in order to measure their impact. In addition, new activities may be incorporated into the model with little effort. However, there is still a great deal of room for model improvement. Specifically, it is necessary to develop linkages with reserve management and the bank's portfolio. Such linkages would permit the tracking of new credit policies and measure their effect on the insurance program. Finally, the model should be developed to allow for a more dynamic framework in reserve management, incorporating elements for stochastic cash demands at harvest time and planning the cash flow needs accordingly.

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Table 1. Linear Programming Tableau for Portfolio Model.

Equations \ Activities		Insurance Options: Crops $X_1, \ldots X_k$	Insurance Options: Livestock $\ldots X_n$	Total Indemnity	Total Administrative Expense	Deviation Counters	Standard Deviation	Cash Reserve	RHS
Net income	(3)	$R\,r_{ij} \ldots$	$\ldots R\,r_{nn}$	$-R$	-1		$-\phi$	d	max
Total coverage for crops	(4)	$1 \ldots$							$= e \leq 1$
Total coverage for livestock	(4)	$\ldots$	$\ldots 1$						$= (1-e)$
Administrative Cost	(5)	$b_{ij} \ldots$	$\ldots b_{nn}$		-1				≤ 0
Indemnities	(6)	$P_{ij} r_{ij} \ldots$	$\ldots P_{nn} r_{nn}$	-1					≤ 0
Loss Rates	(7)	$\bar{L}_{ij} \ldots$	$\ldots \bar{L}_{nn}$						$\geq \bar{L}$
Cash Reserves	(9)	$0.1 r_{ij} \ldots$	$\ldots 0.1 r_{nn}$					-1	≤ 0
MOTAD Equations	(10)	$(P_{ijt} - \bar{P}_{ij}) \ldots$	$\ldots (P_{ijt} - \bar{P}_{nn})$			-1			≤ 0
$\vdots$		$\vdots$	$\vdots$			$\vdots$			$\vdots$
		$(P_{ijt} - \bar{P}_{ij}) \ldots$	$\ldots (P_{nnt} - \bar{P}_{nn})$			-1			≤ 0
Deviation Identity	(11)					$2 \ldots 2$	$-T/H$		$= 0$
Social goals	(12)	$1 \ldots$	$\ldots 1$						$\lesseqgtr D_k$
$\vdots$		$\vdots$	$\vdots$						$\vdots$
		$1 \ldots$	$\ldots 1$						$\gtreqless D_k$
Chance constraint	(14)	$(\bar{P}_{ij} - \Psi r_{ij}) \ldots$	$\ldots (\bar{P}_{nn} - \Psi r_{nn})$				-1.65		≤ 0

Table 2. Insurance Portfolio for the 1980-81 Fiscal Year.

Activity and Province	Insurance Coverage (in Dollars)	Percent of total Coverage
Total Coverage	13,114,208.0	100.0
Rice		
Chiriquí	2,212,380.0	16.870
Los Santos	315,620.0	2.407
Coclé	165,500.0	1.262
Veraguas	494,350.0	3.754
Panamá	151,790.0	1.157
Corn		
Chiriquí	45,508.0	0.347
Los Santos	817,078.0	6.230
Herrera	123,916.0	0.945
Coclé	22,714.0	0.173
Panamá	3,562.0	0.027
Sorghum		
Chiriquí	60,010.0	0.458
Los Santos	391,796.0	2.987
Herrera	469,030.0	3.576
Coclé	140,634.0	1.072
Panamá	73,256.0	0.558
Beans		
Chiriquí	31,237.0	0.238
Tomatoes		
Los Santos	934,500.0	7.126
Herrera	111,375.0	0.849
Coclé	241,380.0	1.840
Veraguas	3,000.0	0.023

Table 2. Cont...

Activity and Province	Insurance Coverage (in Dollars)	Percent of total Coverage
Feeder Cattle		
Chiriquí	425,349.0	3.243
Los Santos	825,492.0	6.295
Herrera	192,428.0	1.467
Coclé	8,680.0	0.066
Veraguas	178,487.0	2.886
Panamá-Colón	137,620.0	1.050
Breeding Cows		
Chiriquí	997,516.0	7.606
Los Santos	1,150.870.0	8.783
Herrera	200,665.0	1.530
Coclé	214,050.0	1.632
Veraguas	603,983.0	4.605
Panamá-Colón	325,776.0	2.484
Semen Bulls		
Chiriquí	247,690.0	1.888
Los Santos	342,925.0	2.615
Herrera	28,175.0	0.215
Coclé	42,500.0	0.324
Veraguas	124,135.0	0.954
Panamá-Colón	45,080.0	0.343
Others		
(Transport Insurance and Hog Insurance)	15,150.0	0.115

Cource: ISA. Financial Report 1980-81

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Table 3. Loss Cost by Activity and Province. 1977-81

(In percent of coverage)

	Chiriquí	Los Santos	Herrera	Coclé	Veraguas	Panamá-Colón
Rice	1.31	0.74	-	4.54	2.73	0.03*
Corn	4.31	2.94	6.16	1.99	6.97	61.84
Sorghum	5.16	7.81	6.39	11.27	15.76	0.32
Beans	9.90	-	-	-	-	-
Tomatoes	-	3.99	9.41	7.69	47.18	-
Feeder Cattle	1.28	1.51	2.98	4.60	2.08	-
Bulls	2.51	1.35	0.0	2.33	3.74	3.13
Breeding Cows	2.08	1.18	1.49	2.02	1.79	1.03

* 1980-81 only

$$\text{Loss Cost} = \frac{\sum_{t}^{T} \text{Indemnities}_{ijt}}{\sum_{t}^{T} \text{Coverage}_{ijt}} \times 100.0$$

i = activity

j = province

t = years

Table 4. Administrative Expenses by Activity and Province. 1980-81
(In percent of Coverage)

	Chiriquí	Los Santos	Herrera	Coclé	Veraguas	Panamá
Rice	3.15	0.87	-	0.33	3.35	4.99
Corn	8.02	4.94	5.37	5.43	-	42.53
Sorghum	9.73	2.68	2.95	1.75	-	6.20
Beans	11.68	-	-	-	-	-
Tomatoes	-	3.54	3.91	6.57	32.36	-
Feeder Cattle	5.11	5.26	4.80	6.75	4.88	3.33
Bulls	0.89	0.85	1.54	1.75	12.2	0.96
Breeding cows	3.50	3.117	2.60	3.75	3.16	2.25

Table 5. Optimal Portfolio for 1980-81

Agricultural Insurance	Percent of total Coverage.	Livestock Insurance	Percent of total Coverage
Rice		Feeder Cattle	
Chiriquí	20.0	Panamá-Colón	12.0
Los Santos	8.4		
Corn		Bulls	
Coclé	4.38	Chiriquí	9.4
Veraguas	2.62	Los Santos	6.44
		Coclé	2.16
Sorghum		Cows	
Los Santos	2.01	Los Santos	4.15
Coclé	0.463	Herrera	13.46
Veraguas	1.99	Veraguas	2.39
Panamá	0.54		
Beans			
Chiriquí	0.6		
Tomatoes			
Los Santos	9.0		

Table 6 . Portfolio Performance Under Actual and Optimal Conditions. 1980-81

	1980-81 Portfolio	Optimal Portfolio	Optimal Portfolio Under New Premium Rates
Net Income	- 2.3173	- 1.32	- 1.018
Net Premiums	3.9619	3.309	4.241
Allocations to reserves	0.402	0.365	0.365
Earnings to accumulated reserves	0.076	0.076	0.076
Loss Cost	3.0664	2.34	2.77
Administrative Expenditures	3.6908	2.73	2.93
Loss Rate	0.77	0.70	0.83
Chance Constraint		1.188	0.753

Table 7. Optimal Portfolio Under New Premium Rates.

Agricultural Insurance	Percent of total Coverage	Livestock Insurance	Percent of total Coverage
Rice		Feeder Cattle	
Chiriquí	20.0	Herrera	12.0
Los Santos	8.4		
Corn		Bulls	
Coclé	4.5	Chiriquí	6.35
Veraguas	2.5	Los Santos	5.64
		Coclé	2.5
		Panamá	3.52
Sorghum		Cows	
Veraguas	4.5	Chiriquí	3.05
Panamá	0.5	Los Santos	6.96
		Herrera	9.0
		Panamá	0.98
Beans			
Chiriquí	0.6		
Tomatoes			
Los Santos	9.0		

Table 8. Portfolio Performance Under Increasing Loss Rates. (In % of total Coverage).

Loss Rate	Net Income	Loss Cost	Administrative Cost
0.55	- 0.736	1.778	2.678
0.6	- 0.799	1.817	2.714
0.7	- 0.963	2.237	2.584
0.8	- 1.146	2.696	2.446
0.9	- 1.481	3.173	2.447
1.0	- 1.869	3.522	2.591
1.1*	- 3.396	3.451	4.105

* Treshold loss rate for reinsurance.