CROP AND LIVESTOCK INSURANCES*

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F O R E W O R D

Before beginning my talk on the subject of livestock and agricultural coverages, I would like to express my gratitude to the Insurance Association of the Caribbean for the opportunity to attend this Conference and my special thanks to Mr. Alister O'B. Campbell, Secretary General.

I N D E X

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by

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I. MARKET SIZE

As agricultural and livestock coverages are an emerging insurance product, I should like to begin with a few basic facts which indicate the potential size of this market. Looking just at the English-speaking Caribbean, the aggregate value of agricultural production in millions of 1980 U.S. dollars rose from $476.3 million in 1960 to $559.3 million per year in 1981[1/]. For all of Latin America, the annual aggregate value of the agricultural sector's production was over $28 billion dollars. In Latin America and the Caribbean, as elsewhere, agriculture is one of the largest business. In terms of GNP, agriculture ranked fourth after manufacturing, commerce, and financial services. In the Caribbean nations, it has been government policy to neglect agriculture and focus upon other industries and services, especially tourism. There are clear indications that those policies are changing. For example: in 1979 only Barbados had a positive growth rate in its agricultural sector; in 1980, three of the five countries turned in positive rates of growth. Although far from conclusive, one does get both from data and from conversations the clear impression that agricultural production has gained importance as a source of employment as well as a source of hard currency.

Be that as it may, it is clear that in just five relatively small Caribbean nations with a total population of 4.5 millions there is almost $600 million of agricultural goods produced per year. Furthermore, and more germane to us gathered here, agricultural production is perhaps the single most risky productive activity

1/ Interamerican Development Bank, 1982 Report, p.385. The countries included are the Bahamas, Barbados, Guyana, Jamaica, and Trinidad and Tobago.

and probably the one where insurance as a risk management device is least known.

II. LACK OF MARKET PENETRATION

Why then is it that a huge market remains untapped when competition and saturation are closing off other avenues of growth for the insurance industry? There are, I believe, four reasons why the insurance has made almost no headway in entering this potential market:

First: There is little knowledge of the risks of agricultural production and even less about the incidence and severity of losses produced by these risks. While we are generally aware that hurricanes, floods, droughts, and pests destroy crops and livestock, except at the most aggregate national level our knowledge of the frequency and severity of these losses is minimal. Furthermore, it would be fair to say that our knowledge of how these events affect various nations simultaneously or sequentially approaches zero. This latter factor is, as we shall see, of importance in considering reinsurance.

Second, in the absence of knowledge, there is the presumption that there is no statistical independence of events. That is, agricultural insurance, and to a lesser degree livestock covers, are catastrophic covers under which everyone loses at the same time. It is thus difficult to reserve against this contingence and, in the absence of data, almost impossible to develop adequate rates.

Third, and in my opinion, the most serious problem in penetrating the market in a substantial way is quite simply that there is an absence of reinsurance capacity. Looking again at the data I cited at the outset, to insure only 10 % of the value of agricultural production in five Caribbean nations, $60 million in capacity is required. To insure only 10 % of the agricultural production of Latin America and the Caribbean, $2.8 billion of capacity is needed. If we begin to calculate the required capacity for the large, more developed nations, we are simply engaging in a futile exercise, especially when we bear in mind that these is perhaps $2-3 billion of reinsurance capacity in the world today. This aggregate capacity problem is long-term. More germane is the fact that in recent years some poorly planned schemes have come to market and the experience on them has been adverse, as is to be expected. This has temporarily exhausted the capacity for well-run, adequately rated schemes that simply have had bad luck.

Fourth, and finally, past and present experiences with agricultural and livestock covers have not been very successful. Both the U.S. and various European nations have a small crop hail industry and there are several small livestock insurers in the U.S. while Lloyds accepts some bloodstock risks from British and continental insurers. Private run schemes have seldom achieved a large, well-diversified spread. In a recent World Bank Policy Paper[2/], 15 programs in developing countries and seven programs in developed countries were surveyed. With several exceptions, most were government insurers and had an administrative and/or a premium subsidy. Of the 22 programs, 6 had reinsurance. That number is now reduced to five and possibly to four. Thus, it appears that the very limited experience available would indicate that government is the chief risk bearer and that there has been only modest involvement by private sector insurers and reinsurers. While this understates somewhat the size of the agricultural insurance industry, due primarily to risks placed directly at Lloyds, it is fair to say that from the point of view of the private sector it has been a marginal and likely not very profitable line of business.

III. A REEVALUATION OF THE FEASIBILITY OF AGRICULTURAL INSURANCE

If in the foregoing sections, I have painted a rather bleak picture of the feasibility of this class of business, I have done so to

2/ J. D. Von Pischke, Agricultural Insurance, Policy Note No.5, World Bank, 1983.

accurately reflect the traditional pessimism about its feasibility and profitability. Recently, however, a reevaluation of the usefulness and viability of agricultural insurance has been undertaken by numerous public sector organizations including FAO and UNCTAD of the United Nations, World Bank, USAID, U. S. Federal Crop Insurance Corporation, and my own organization. In the private sector, I am aware of at least one large, aggressive international insurance group, and at least two major international reinsurers who have set up study and planning groups to carry out a reevaluation of agricultural risks. Although this process is still in its initial stages, I would like to summarize what seem to be the major findings of these groups working independently and sometimes in isolation:

> Agricultural insurance presents a paradox: On one hand, the evidence is clear that public sector insurers quickly depart from established insurance principals and make crucial decisions on coverages, underwriting, premiums and indemnities on political grounds, thus converting the schemes into social insurance or welfare schemes3/. On the other hand, the private sector has the ability to run technically viable insurance programs but clearly can not manage the implicit catastrophic risk of the business where, for example, a 5 % premium not only can, but certainly will on some occassions, produce a 2,000 % loss ratio. Only one loss of that magnitude can destroy a program.
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> One useful model that has developed to combine the comparative advantages of the two sectors is the "Partnership of the Sectors" under which the U.S.'s enormous program is being privatized with FCIC in effect becoming a reinsurer,and leaving the management of the program to the private sector.
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> The technical problems of the lack of data and the interdependence of incidence of loss can be overcome in the medium term, although the technology required is only partially developed and very sophisticated. Its continued development will have to be partially financed out of public funds as will some of the costs of field testing--a policy frequently followed in other high technology industries.

3/ One example: The Mexican crop insurance scheme costs $800 million U.S. in subsidies last year--or $12.30 per capita.

International risk spreading devices are essential for the medium and long term, and should be managed according to traditional reinsurance principals. International guarantee funds should be avoided as there is no way to stop one or more countries from decapitalizing them through politically induced losses. International reinsurers can retain some of the risk, and exercise a salubrious pressure on the insurance management to follow accepted insurance practices. The ultimate reinsurer must be the national governments.

In this process of the reevaluation of the feasibility of agricultural insurance, considerable attention has been given to breaking the bottlenecks that I mentioned at the outset. I would like to look again at each one of the four reasons that I set forth at the outset and deal with some of the efforts underway to overcome these problems.

The problem of the lack of knowledge is just that. No one, until we began our work, had systematically explored the ways to use the available data and to create new data which would in the future serve as the basis for premium calculation and reserve setting. The problem here is two fold. Existing data is not very good except in the developed countries and very little can be inferred from the data as to the cause of the increase or decrease in production. The time series are short and we still do not know for how long a period we need data to estimate the frequency and severity of loss. It appears to vary widely according to the phenomena. One hundred years is adequate in the Caribbean for hurricanes but the present "El Niño" high pressure disturbance is unparalleled in written history, affecting as it does agriculture from Indonesia and Australia across the Pacific to the Americas and on the Southern Africa, incidentally keeping hurricanes east of the Antilles.

Our approach to this problem has been a practical application of portfolio management theory using a linear programming model to deal with both the knowledge problem and the lack of statistical independence of losses among insured crops. Although the mathematics are somewhat too complex to discuss here. It is useful to highlight some of the steps in developing premium rates for specific risks.

Several sets of data on production variability and climatological factors are useful for a first approximation of the incidence and severity of natural losses in agriculture. The data on several potentially insurable crops are combined in a correlation matrix to test covariance. We attempt to avoid the all or nothing option by spreading over crops, over time, and over distance in a systematic way. In the portfolio approach, somewhat differently from standard actuarial techniques, we are interested in three factors which determine the overall result of the portfolio: the variation around the mean of each individual crop; that is, the frequency of loss or degree of variability in each individual crop; the correlations among elements of the portfolio, i.e. do several crops lose simultaneously or not; and the relative weight of each element in the portfolio.

By way of example, the following tables display Jamaican data for the 1963-1977 period. Table No.1 displays the standard statistical yield data. Perhaps, the most important are the minimum and maximum values. Jamaican agriculture is obviously characterized by a high degree of variability. The second step is somewhat more complex. In Table No.2, I have displayed a correlation matrix. It is intuitively appealing to believe that when one crop suffer losses, another may benefit from the same condition. Reality is more complex. Looking at Table No.2 one can note a whole range of both positive and negative correlation. It would appear, for example, that yields of sugar cane are highly positively correlated with cocoa and bananas, mildly positively correlated with rice and coffee; mildly negatively correlated with sweet potatoes, and strongly negatively correlated with maize[4/]. One would, of course, wish to minimize the

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4/ Bear in mind that these are correlations of incidences of loss, not correlations of severity of loss. That is, the data could contain a large number of insignificant losses, although standard deviations in Table No.1 seems to indicate this is not the case. A caution: Mark Twain, our great American sage and humorist, once noted that there are three types of lies: little white lies, damned lies, and statistics. These are very aggregate national data and do not tell us the cause of variability. In at least one case it has nothing to do with weather, but instead the financial policies of the Jamaica Development Bank. So my Jamaican collegues, do not rush off and insure lots of cane and maize saying I told you that it would be good business; what I told you was that it is an interesting hypothesis worth looking at more closely.

TABLE No.1

YIELD DATA - JAMAICA

1963 - 1977

YIELD (KG/HECT)	MEAN	STD. DEV.	SUM	MINIMUM	MAXIMUM
SUGAR CANE	62545.454545	4767.67524	688000.0000	55900	72900
RICE	440.00000	502.99105	2200.0000	0	1300
MAIZE	1454.545454	385.65175	16000.0000	800	2000
BANANAS	4888.8888	870.98294	44000.0000	3000	3800
SWEET POTATO	7806.818181	675.51666	85875.0000	6654	8815
DRIED BEANS	827.272727	119.08743	9100.0000	600	1000
CASSAVA	9290.909090	2109.71777	102200.0000	6000	12700
COFFEE	289.77777	75.04295	2608.0000	208	450
COCOA	152.11111	86.91151	1369.0000	99	376

TABLE No.2

YIELD DATA. JAMAICA

CORRELATION MATRIX

	SUGAR CANE	RICE	MAIZE	BANANAS	SWEET POTATO	DRIED LEGUMES	CASSAVA	GREEN COFFEE	COCOA SEEDS
SUGAR CANE	1.00000 0.00000								
RICE	0.16252 0.7940	1.00000 0.00000							
MAIZE	-0.85373 0.0008	-0.85233 0.0665	1.00000 0.00000						
BANANAS	0.78420 0.0124	0.44506 0.4526	-0.76302 0.0168	1.00000 0.00000					
SWEET POTATO	-0.07575 0.8248	0.15544 0.8029	-0.14425 0.6722	0.19983 0.6062	1.00000 0.00000				
DRIED LEGUMES	0.09447 0.7823	-0.35520 0.5574	0.11679 0.7324	-0.37241 0.3236	-0.80072 0.0031	1.00000 0.00000			
CASSAVA	-0.54905 0.0802	0.14342 0.8180	0.45174 0.1631	-045378 0.2199	-0.54542 0.0827	0.37125 0.2610	1.00000 0.00000		
GREEN COFFEE	0.28829 0.4519	-015725 0.8995	0.07198 0.8540	0.32217 0.4810	0.09368 0.8105	-0.30261 0.4286	-0.60718 0.0829	1.00000 0.00000	
COCOA SEEDS	0.68474 0.0419	0.99972 0.0152	-0.77270 0.0146	0.65568 0.1098	0.41108 0.2717	-0.66153 0.0523	-0.31101 0.4153	0.15758 0.6855	1.00000 0.00000

positively correlated elements in the portfolio and maximize the negatively correlated elements and thus reduce the average variation around the mean of the entire portfolio while generating premium income sufficient to offset indemnities. In reality, the third element, the relative weight of each element, is often determinative. Likewise, if seasonality analysis indicates that several elements of the portfolio are hit simultaneously, a larger reserve is required. Thus correlations, relative weights, and the seasonality of loss are useful to structure an adequate portfolio on an _a priori_, instead of simply taking a position on one or more crops.

This data is processed within a linear programming model to help us determine the optimum portfolio, and the overall results of each suboptimum portfolio that we select. As data is generated by insurance operations, it is fed in. With this methodology we are able in the first intance "guestimate" a premium, and second over time build a file on each farm. I should point out that the approach here is essentially a yield based methodology. We are currently experimenting with a meteorological and climatological data to enrich our analytic base. This data is very revealing as to the causes and timing of losses. Yield data is "end result" data from which it is difficult to infer cause. Climatological data reveals causes but not effect. Thus the two sets together, produce an excellent cause and effect analysis for most risks--certain disease and pest damages except. Let me explain briefly how we use climatological data together with yield data. The process of developing an agroclimatological profile uses techniques developed by agroclimatologist, which uses daily observations on temperature, rainfall, and wind or other relevant factors. We then use this profile to explain the deviations in Table No.1, and the correlations in Table No.2.

Yield data is very aggregated, climatological data somewhat less so. However, agricultural risks are highly location specific. Thus rate making may require even more location specific data. This problem is approachable on both an _a priori_ and an _a posterior_ basis. The latter is the familiar retrorating. _A priori_ subjective risk distributions may prove useful. "What if" questions put to farmers and experts alike can produce very useful results. These hypothetical questions about the kind and amount of damage produced by specific phenomena can produce excellent disaggregate data that can be incorporated into the climatological and yield data sets to produce a much clearer understanding of the causes of loss and the effects of a given phenomena at a given time on a specific crop within a quite small area.

While I have simplified, perhaps to the point of distortion this process,I should like to make one more comment upon imaginative uses for existing data. Here in the Caribbean, hurricanes and tropical storms are the principal risks. It could be most useful to manipulate storm tracks which are accurate for at least 300 years, wind velocities, and the damages to agriculture on each of the islands based upon whatever records are available coupled with subjective risk distributions derived from panels of experts,and farmers to determine if the islands as a whole could usefully be insured against this scourge.

The next step in creating the required data base has yet to be taken. While obvious that a severe hurricane may ravage a single island, it is not clear what the incidence and severity of loss to agriculture would be in the whole Antillean chain. In the case of the islands, it is a manageable task; on a worldwide basis, it is far more formidable. For example, we know that the same high pressure disturbance in the Pacific which caused drought in Australia and flood in Peru helped keep hurricanes in the 1982 season to the east of the Antilles. It is a time consuming, though not theoretically intractable task, and a necessary step to develop reinsurance portfolios that well produce satisfactory results.

Thus, a beginning has been made in dealing with the knowledge problem and in the management of a class of business whose individual elements are statistically dependent, thus not subject to normal distribution theory for rate-making. While almost every line of insurance has its reserarch institute or rates organization, as yet very little time and money has been dedicated to the study of agricultural risks. It is to be hoped that the beginning we have made will be carried on by others.

Let us then turn to the problem of capacity. While decidedly a serious problem, it is not an intractable one. Reinsurance markets for this class of business are gradually opening up. In fact, one very large brokerage house at Lloyds has recently set up an agricultural services division, which has placed reinsurances from Latin America, Africa, and Asia as well as assisted several countries to intiate programs. However, it is simply unrealistic, in my opinion to believe this market or any reinsurance market will be able to absorb more than a fraction of total agricultural risks if the presently existing programs grow to nationwide scale. Likewise, I view with considerable skepticism the often-voiced expectation that reinsurance markets will write truely catastrophic loss covers. Furthermore, I do not think they should, as bankrupting the international reinsurance system is in no one's best interest.

How then can we develop adequate risk-spreading mechanisms? This is the proper role of government. Instead of administering the basic coverage, this should be left to the industry. Governments jointly or severely have to absorb the catastrophic risk. The role of the reinsurance markets is to provide the intermediate levels of coverage, and through their ties with the insurers help to keep the game honest, and the underlying rates fair.

It would on the face of it seem unappealing to government to accept this catastrophic risk. Government does so anyway in a totally disorderly ad hoc manner through relief and rehabilitation programs developed after the disaster. Government simply bears the risk of agricultural disasters by ignoring the possibility of its occurrence and reacting in a hasty manner under extreme political pressures by diverting funds, requesting relief and emergency loans, and creating pools of cash to be doled out according to the supposed severity of loss. This chaotic process reached a point in the U.S. that the Congress cancelled the disaster relief program,and told farmers to either buy subsidized insurance or be prepared to suffer the consequences, and we shall in this terrible agricultural year how serious government is about this.

What I propose is then not shifting an additional burden to government but simply ordering and quantifying the burden it already bears, while at the same time allowing an orderly creation of a fund to meet these infrequent but certain agricultural disasters.

More specifically, governments could, as several countries already have, establish concessional reinsurance facilities which are capitalized through annual budget appropriations. Thus, government avoids a run on the Treasury when it can least afford it. Private companies who sell agricultural covers,could be required to reinsure part of the portfolio commercially. The part that can not be placed would be ceded to the concessional reinsurance facility. This does several things at once. First, the insurer has to retain some risk; second, the reinsurer provides a spread of risk for medium size disasters and third, the government knows what its contingent liability is,and can prepare to meet it in an orderly manner rather than having to divert funds when its own revenues are lowest.

A further step would be for governments to pool their risks. I think that a common pool as proposed by UNCTAD is not viable as one or several governments are likely to decapitalize it. Each government would probably have to run its own reinsurance account. However, the governments could negotiate contingent loans from international or regional development banks to help offset the impact of a large loss.

To clarify how such a system would work, let us imagine a hurricane insurance pool within CARICOM. Each country sets up a program managed by a pool of local insurers. Commercial reinsurers accept part of the total cession of risks while a special reinsurance account in the Treasury or the Central Bank accepts the catastrophic loss reinsurance. The Central Bank or the Treasury would in turn negotiate a contingent loan with World Bank, the Inter-American Development Bank, the Caribbean Development Bank, or EEC. When the fund proved inadequate, the bank would disburse in hard currency so that the fund could disburse in local currency.

While I must admit that this type of scheme will be difficult to establish, I would also argue that it is in fact what is already occurring on an <u>ad hoc</u> basis throughout the Caribbean. The only major distinction is that it would decide before hand, who pays what under what conditions in an orderly contractual manner rather than the frantic pursuit of disaster relief grants and loans after a disaster. It should be equally appealing to both local governments and international lenders as it orders a presently rather chaotic process, and infuses cash when it is most needed under prenegotiated conditions.

Finally, I should like to deal with the problem of the historic adverse experience of insurers that have underwritten agricultural and livestock risks. The reason that many fail or have remained quite small is simple: it is a catastrophic loss business in which the frequency of loss is essentially unknown. A 5 % premium rate implies a 2 000 % maximum possible loss. Statistically a loss of that magnitude will occur with still unknown frequency. Almost no company is capable of capitalizing and reserving to sustain a loss of this magnitude. It is very long term business. Decades are required to build up an adequate reserve. Once in place and protected against a sudden decapitalization, there is no reason that agricultural business can not operate much like any other properly and casuality cover. These problem can only be dealt with within a framework such as the one outlined above that permits insurers, the international reinsurance system, and ultimately national governments and international financial institutions to absorb and spread risks.

Let me close by thanking you one and all for the opportunity to present my ideas on agricultural insurance. While I personally continue to believe, based upon our work, that agricultural insurance is possible and will come about, I would like to close in a slightly more realistic vein. Most of the catastrophic loss covers of today were not even dreamed of 10 years ago and thought impossible five years ago. For example, a $1.5 billion oil well risk was recently placed and the day of the $2 billion risk is just around the corner. Likewise, space related megarisks would only a short time ago have seemed impossible. To a very large extent, our ability to bring insurance and other financial services to agricultural enterprises will depend upon our inventiveness and our capacity to work hand-in-glove with the international reinsurance industry, the respective national governments,and the international financial organizations. It is an ardous, exciting, and challenging opportunity for those relatively few of us who work in this field. I would like to invite you to join us and to bring us your ideas and skills. Jointly we can develop coverages that will provide the agricultural industry the security taken for granted in almost every other field of industry and commerce.