AGROCRED No. 21-81
SEPTEMBER 1, 1981

ON ORGANIZING AGRICULTURAL INSURANCE IN JAMAICA

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September 1981

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INTRODUCTION

At the request of the Ministry of Agriculture, this writer visited Jamaica on March 25-28, 1981. During this brief stay, I met with various officials of the Ministry of Agriculture as well as with officers of the Jamaica Development Bank and the insurance regulatory comission. The following report is based upon the conversations and observations of the brief visit.

This report is necessarily preliminary and is designed primarily to provide a general outline of feasible administrative and financial structures for an agricultural insurer. It also briefly sketches the procedures for establishing the insurer and outlines the general procedures that need to be followed for establishing and operating a financially viable insurer so that the insurer will not become an additional burden upon limited state resources.

PHYSICAL SETTING

The island of Jamaica lies at the southwest end of the Windward Passage, south of the tip of Cuba, and almost due east of Hispanola. The east-west extension of the island is from approximately 78° 30' W.at South Negril Point to 76° 15' W. latitude at Holland Bay. This north-south extension of 2° 15' is about 150 miles. From Falmouth located at 18° 30' N. to Portland Point at approximately 17° 30' N. the north south extent is only about 1° or slightly over 50 miles.

This geography is of vital importance when planning agricultural insurance. The enlongated shape of the island unfortunately lies astride hurricane tracks. Between 1886 and 1967, 19 tropical and hurricane storm tracks directly hit Jamaica while 98 (of which 48 hurricanes) tracks had centers which passed within 150 miles of the island. It is estimated that about 1/3 of these produced flooding

and damage. At this writing, post-1967 tracks are not available. However, based upon available data, we may tentatively estimate that the island receives a direct hurricane hit on the average of once every 4.3 years and has a near miss by a tropical storm or hurricane more than once a year. Damage from a near misses occur on the average of every 2.5 years.

It may be said that Jamaica is highly exposed to catastrophic loss because both of its relatively small area and the fact that the island lies directly astride hurricane tracks. This fact in and of itself does not rule out an agricultural insurance program. It does, however, counsel considerable caution in developing the program so as to obtain maximum risk spread within a small area. It also argues strongly for the maintenance of a very substantial reserve and very heavy reinsurance. Each of these three factors must be carefully incorporate in the design of the insurer at the outset: It must have maximum risk spread; it must be heavily reserved; and it must be a program which is reinsurable in commercial markets (as at present no other markets exist). These condition make necessary very careful planning of an agricultural insurance program. They do not, however, argue against developing agricultural insurance. It should be borne in mind that Puerto Rico has operated a very successful agricultural insurance program under similar conditions for over 30 years. The Puerto Rican program is self-financing and commercially reinsured.

CLIMATE

The other major source risk in Jamaica arises from the climate. On the whole, the island has an excellent tropical climate with warm temperatures throughout of the year and relatively high rain fall. However, the mountanous topography creates a wide variety of micro-climates. Temperatures at the lower elevations range from highs around 90° in July to 87° in January with corresponding lows from about 75° to 70°. Highland temperatures are 10°- 20° cooler. Only on the summits

of the Blue Mountains does frost occassionally occur. Temperature variation does not create more than very occassional problems for agriculture.

Rainfall is highest in the summer and autumn seasons when rains brought by the trade-winds are augmented by convectional storms. The major dry period occurs between January and March. The average 77 inch annual rainfall is strongly influenced by the island's terrain with the windward side receiving over 100 inches and high exposed slopes of the Blue Mountains up to 200 inches. The difference can be striking: Kingston averages 35 inches while Port Antonio averages over 130 inches. The leeward plains of Pedro and Liguanea have been known to receive no rain between December and July.

Both excess of rainfall and drought would seem to be problems of agricultural production, although of much less magnitude that hurricanes and tropical storms. These phenomena from available data appear to be both relatively infrequent and geographical scattered. This then is a classical situation handled quite easily by the risk spreading function of an insurance program.

SOILS AND AGRICULTURAL LAND CAPABILITY

These factors are frequently of importance in planning agricultural insurance program designed to offer a stimulus to certain types of agriculture and disincentivate other production options. Likewise certain soil types will frequently produce more severe losses. For example, soils incapable of retaining moisture will aggregate drought losses.

In very general terms, the highland soils tend to be above 3.000 feet and are derived from igneous and metamorphic rock. The lithosoils are highly porous

and easily leached, thus tending to acidity and paucity of nutrients. The other highland solid type, clay, produced by weathering of shales, tend to have poor drainage. Both types are subject to rapid surface erosion.

The upland plateau's soils are either terra rossa or rendzinas soils. The former has a high organic matter content on which agriculture depends. The latter rendzinas or black marls are fine particled, heavy and have poor drainage.

The alluvial soils located on the extensive plains of Southern Jamaica, some narrow north coast plains and several interior valleys are the most productive.

In designing the insurer both the soil characteristic and the land capability are important factors. Certain soils will aggravate naturally occurring phenomena. Just as very porous soils worsen drought conditions, so very heavy soils with poor drainage will produce heavier innundation losses than will well drained soils. Perhaps, more important is that insurance should not promote inappropriate types of agriculture. Relatively small areas of Jamaica are suitable for unlimited agriculture use. Much more extensive areas requires irrigation or drainage. Still others are highly susceptible to erosion and require terraces. Many soils should be utilized for three crops but not general agriculture. Still others are should not be given over to agriculture at all but instead kept in natural vegetation. In designing an insurer under these conditions, very careful consideration must be given to the relationships between soil types and the crops that are produced on them so as not to provide either an incentive to unappropriate forms of production or to select crops subject to heavy losses due to soils which aggrevate naturally occurring phenomena.

AGRICULTURAL PRODUCTION

According to ECLA's 1978 data[1/] about one fourth of the total Jamaican population as well as the economically active population resided in and were employed in the rural areas. Agriculture, contributed, however, only about 8% to the GNP (at factor costs). That contribution to the GNP has declined very substantially from 12.3% of GNP in the 1961-65 period. Likewise, the annual average rate of growth of agriculture declined from 1.5% between 1960-1970 to a mere 1.2% between 1970-77[2/], considerably below the average annual population growth of 1.7% for the same period. In per capita terms the agricultural production index (1965=100) declined from 78 in 1971 to 66 in 1979 while per capita food production declined from 78 to 66 in the same period[3/]. It is clear, therefore, that agriculture requires substantial investment and stimulus to regain its importance in the GNP and to produce the food required for a population growing faster than agricultural production.

THE BENEFITS OF INTRODUCING AGRICULTURAL INSURANCE TO JAMAICA

In almost all human activities, risk, and uncertainty are inherent and inevitable. It is rare indeed, that today a person has not developed his or her own plan for managing risk. Almost 100% of the readers of this publication have some system of risk management, be it savings against unexpected expenses or an insurance policy against an unanticipated occurrance; for example, a house fire or an auto accident. Most have an insurance program to cover two certain occurrences -old age and death. The former protection offered by the state in the form of social security and pension schemes, the latter usually by private companies in the form of life insurance. Likewise, the majority of businesses have developed a risk management program to protect their economic assets and personnel against unexpected

1/ U.N.E.C.L.A., Agricultural Statistics, 1978.
2/ World Bank, Report on World Development, 1979
3/ USDA, Indexed of Agricultural Production 1970-1979.

losses. Many of the larger enterprises now have a professional "risk manager" whose responsibility is to establish and operate an insurance program.

The instrument we call "insurance" is historically relatively new. In its current form, it may be said to have orginated in 18th. Century Britain. The majority of the insurance companies of the world have been created in the last 75 years and perhaps well over 90% of the present coverage offered by these companies has been written in the last 30 years. With the growing complexity of society, more and more kinds of risks have been insured against risk and uncertainty. Since the 1930's, industry and commerce have accepted and utilized insurance as an essential management tool in almost all aspects of their operations.

The partial exception to the general acceptance of insurance has been in agriculture and especially among the smaller, less well capitalized farmer. Most of the "developed" countries have now created systems of insurance which offers the farmer protection against uncontrollable events. The origin of these systems is frequently a major disaster which is of such magnitude that the traditional risk spreading devices fail and many agricultural producers are ruined.

The risks of agriculture are borne by the society with or without insurance. It may be borne by farmers who are decapitalized and eventually may be forced to leave farming; it may be borne by lending institutions in the form of uncollected loans; it may be borne by the larger society in the form of higher prices or in the form of imports or reduced exports. The risk of a society engaging in food production is inherent. It may be ignored allowing the burdens to fall where they may or it may be managed so as to distribute the risk of agricultural production. Each society must make the political decision as to whether it will engage in a risk management program and, if so, how it will distribute the risks. It should

be remembered that the society is already absorbing almost all the costs of the insurer as direct monetary costs or social costs.

The question then arises as to what benefits arise from establishing an insurance system for:

1 - the farmer

2 - the agricultural credit system, and

3 - the society as a whole

In the following sections we have briefly explored the advantages of insurance for each of these.

INSURANCE AND THE FARMER

From the farmer's point of view, insurance is in the first instance a financial instrument. The basic purpose of any insurance policy of the property-casualty type is to prevent a loss of sufficient gravity to endanger the economic life of the enterprise. Insurance, by means of indemnities, functions to level the income stream across years. The importance of income leveling is that the farmer in the first instance can maintain himself and his farm in production and in the second instance can develop his activities and investments as planned without being obligated to sell resources or halt programmed investments because he has suffered a natural disaster. The reduction of the impact of natural cycles on the agricultural enterprise permits more rational planning and a rapid recovery following a natural disaster.

The second reason that agricultural insurance is beneficial to and desirable for farmers is that in general farmers confront serious problems in obtaining credit and in bad years are incapable of repaying loans. Banks must demand adequate

guarantees to extend credit. A mortgage or lien on the crop are the most common. However, in certain years farmers will, due to adverse experience, lose the mortgage good in order to repay their credit. This process is counter-productive for both the farmer as well as for the lender, as the lender loses a client, and must bear the costs of legal process and disposition of the farmer's goods. In many countries, it is politically impossible to take away the productive resources of small and medium size farmers whose livelihood depends upon them. Agricultural insurance offers an escape from this vicious circle of inadequate credit due to a lack of guarantee. An insurance policy taken in the names of both borrower and lender offers a concrete guarantee to the bank that it will recover its loan if the farmer suffers from a natural losses. Thus, the farmer can maintain himself in the credit system in good and in bad years and the bank will have a reliable client who can always repay his loan.

In addition, an insured farmer can dramatically alter his debt-to-equity ratio. Frequently, a small farmer lacks adequate resources to guarantee the credits that his enterprise requires. Given that his fixed assets are small, the farmer can obtain credit equal only to a portion of these assets. Many lenders will lend only 50-75% of the value of these assets. With the introduction of an insurance policy in the name of the farmer and the lender, credit in larger amounts becomes possible, given that the guarantee presented, the insurance policy, protects the lenders against default produced by natural hazards. Thus, agricultural credit insurance permits the utilization of credit based upon need, and not exclusively upon the assets the farmer can offer as collateral on his loan.

The traditional system of risk management through the diversification of production options on the farm is rapidly disappering. In its place, agriculture, especially highly productive commercial agriculture, is developing specialized

systems of production. The specializtion produces a much more efficient system of production, but is inherently more risky given that a natural phenomena which affects a single productive option will have a substantial impact on the financial viability of the enterprise. For example, a diversified small farm is much less risky than a specialized farm producing only one or two crops. The latter is likely to be more efficient but more exposed to a natural phenomena than the former. Agricultural insurance permits specialization without increasing the implicit production risk.

Up to this point, the advantages of agricultural insurance; i.e. leveling income fluctuations, guarantee for production credit, modification of the debt-to-equity ratio, and the ability to specialize in fewer, more productive options without increasing the implicit production risks are advantages enjoyed by any enterprise which utilizes insurance as a management tool. At the outset of this document, we mentioned the terms risk and uncertainty. Risk is the possibility and the probability of an economic loss. An equally important factor in a farmer's decision-making in uncertainty. Uncertainty is a more amorphous concept. In most enterprises,a given technology can be expected to produce a given quantity of a product in any location, other factors being equal. Within certain parameters, the production function can be determined. In agriculture, however, exogeneous factors beyond the producer's control assume disproportionate importance. A technology transfered from a experimental station to a farm will probably not produce the same yield due to a series of factors such a microclimates, soils, and control of technology by the producer. The importance of agricultural insurance in the technology transfer process is that insurance is capable of managing not only risk (the probability of loss) but also uncertainty, the preoccupation of the producer over whether the technology is adequate or not to his particular productive base.

Traditionally a farmer could sow a small area and measure the results. However, increasingly complex technology entails a very large fixed investment. For example the fixed investment for mechanized grain production or drip irrigation requires that the area under production be of sufficient size to cover the cost of the technology and yield a profit. An insurance policy which at a minimum guarantees that a farmer can repay his loan if he suffers a natural loss is a strong incentive to technique adoption. A policy which goes one step further and guarantees a certain yield (valued at a preestablished price) is an even stronger incentive. A well designed insurance scheme facilitates technological change and permits a rapid reply to market signals by removing a large part of both economic risk as well as the farmer's uncertainty.

While agriculture in general is exposed to natural risk, the problem is much more severe for the small and poorly capitalized producer. A farmer with few resources is always closer to financial distress. He has few resources that can function as a "shock absorber" in times of adversity. Natural fluctuations that would be of little importance for a large agricultural enterprise could ruin a small one -or at least force a return to subsistence production. Under these circumstance, many small farmers select the most secure technological option, not the most productive. In many cases, the option chosen by a farmer unable to sustain a loss is the traditional technology which requires few inputs and produces at least enough for the subsistence of the farm familiy even under adverse conditions. Generally speaking, the closer a farm is to being economically marginal, the more conservative the technological options that are selected.

A well designed agricultural insurance program functioning as an integral part of a rural development program can offer a strong incentive for technological change. It can guarantee the production credit and at the same time protect the farmer against a catastrophic loss due to natural hazard.

We in IICA see more clearly with each new project that we mount that agricultural insurance has a major impact upon small farmer with natural resources adequate to permit the utilization of modern technology but who lack sufficient guarantees to obtain credit and the reserves to sustain a major loss. For a small farmer, agricultural insurance has a large multiplier effect. It multiplies the effect of both credit and technology programs and strengthens the financial position of the farmer.

AGRICULTURAL INSURANCE AND THE AGRICULTURAL CREDIT SYSTEM

In Latin American and the Caribbean, it has been estimated that only about 15% of the farmers receive bank credit. Within this 15%, most of the credit is concentrated among large, commercial, and export-oriented farmers. One of the greatest obstacles to serving small and medium size farmers has always been the very high cost of operation and the low rates of recovery, especially when farmers are affected by adverse weather. A well designed and efficiently managed insurance scheme can alleviate the problem of recovery and substantially lower the lender's cost of operation.

The most direct advantage for the bank is that an insurer can guarantee that a farmer affected by adverse weather or uncontrollable plagues can repay his loan. The insurance also functions as a surrogate for lien on the crop or a mortgage. For farmers who do not have sufficient fixed investment to guarantee a loan,

an insurance policy can serve as a guarantee. With an agricultural insurance scheme in operation the bank can dramatically reduce its portfolio of delinquent loans. With insurance, lending to agricultural become a more attractive, lower-cost alternative.

As an agricultural insurer is in the first instance in the business of detecting and remedying risk before it produces a loss, its agents can take over almost all of the tasks of supervision of credit. An agricultural insurance inspector must periodically verify that the credit is being used to purchase the required inputs, that the inputs are used in a timely and correct manner, and that they are producing the expected results. Thus, an agricultural insurance inspector must function as an extension agent and a credit supervisor. The difference is, of course that if an agricultural insurance inspector detects diversion or misuse of credit or inputs, he can take the appropriate action. He may give the farmer a 2 or 3 day period to apply the input or perform the labor; if it is too late, he may reduce the farmer's coverage and advise the bank of the reason so that the bank may adjust its line of credit accordingly. An agricultural insurance inspector assists the honest, dilligent farmer to utilize credit and technology while trying to detect any deliberate or inadvertant misuse of one of the scarcest development resources, loan capital.

It is most important to note that a bank does not know in many cases whether its clients can repay their loans until the end of the agricultural cycle. After the harvest, it is difficult to verify the conditions that allegedly caused a loss and makes payment impossible. Many times if the conditions were detected, they could be remedied. In other cases, some clients may have simply misused the

credit and claimed a natural loss. Agricultural insurance can detect cases of moral hazard, where credit is diverted or good agricultural practices are not used. While insurance will cover natural losses, it does not insure against acts of omission or commission that produces or aggrevates a loss. Thus, from the bank's point of view, an insurer can "purify" its portfolio by paying for honest natural losses and rejecting claims arising form diversion of credit and incompetence. A bank in turn can move these farmers to special program or eliminate them from it portfolio, thus channeling scarce production credit to honest consciencious farmers.

AGRICULTURAL INSURANCE AND THE POLITICAL ECONOMY OF DEVELOPMENT

A developed agricultural insurance system has very substantial advantages for agricultural sector policy planning. Offering insurance for a crop provides a strong incentive to produce that crop, as the farmers' risk are dramatically reduced. Numerous countries have utilized it to assist in achieving self-sufficiency in a given crop (rice in Japan) or for stimulating exports (winter fruits and vegetables in Mexico). By offering protection against natural risks, insurance serves as a production incentive. By not offering or it by substantially raising the premium, it is possible to disincentivate other options.

If a subsidy is provided to agriculture, insurance can serve as a highly efficient channel. Insurance is not fungible as is credit. Likewise, it is far more specific than a subsidized interest rate. Premium rates can be adjusted to very small unit, event to an individual farm. Interest rates seldom can be so selective. Thus, insurance can channel a non-fungible subsidy to the crops and to farmers that agricultural policy seeks to stimulate.

Finally, there is some evidence, albeit tentative, that it is less expensive to offer agricultural credit with insurance that to do so without it. Agricultural insurance appears to reduce the net cost of offering credit, particularly to small farmers, through its inspection and risk management services. For example, the administrative cost of agricultural insurance in Mexico, which has nationwide agricultural insurance system, is about $7U.S. per hectare ($2.83 per acre). That cost, however, appears to be more than offset by the improved recovery rate, and the risk detection and risk prevention services. The average loan size was about $300 per hectare ($120 acre approximately). For only $7 per hectare more in administrative cost,the bank is quaranteeing a very high recovery rate. The administrative cost of insurance in the Mexican case in only about 2.3% of the loan size.

When the cost of operating an agricultural insurance scheme is viewed in a systemic context, it is clear that most of the costs of insurance are transfer payments, not new costs. What the lending agency recovers, the insurer pays out in indemnities. Thus, the money flows through the system in a different and more efficient way. Banks and farmers do not have to carry unpaid debts and do not suffer the consequences of the servicing them.

Finally, a well developed insurer reduces or eliminates the need for state run ad hoc relief programs. At a time when revenue fall due to losses in agricultural sector,the state is called upon to mount a disaster relief program. Insurance obviates this need to the extent that the state has helped build a well capitalized, far reaching program. That insurance eliminates the need for disaster relief programs when revenue flows are impaired is, perhaps, the strongest argument for state participation in creating a reserve. Then, if a long term, systemic approach to rural production credit is taken, it is clear that insurance implies no new administrative costs (indeed they may be lessened) and appears to imply no new capital costs.

Recently, the U.S. has cancelled its disaster relief program and channeled the funds into the agricultural insurer. Farmer are advised that the insurer is the proper instrument to manage their risks and that the government will no longer mount disaster relief programs or respond to political pressures for loan extensions and cancellations. The response to agricultural disasters has moved from the political sphere into the technical one. Farmers who do not take proper precautions, and purchase a subsidized insurance may not later try to utilize the political system to obtain relief.

THE STRUCTURE OF A JAMAICAN INSURER

There are in general terms three possible legal structures for an insurer. It could be located in the private sector and operates as a for-profit insurer. It is most unlikely that private capital will be willing to bear the catastrophic loss risk. One may question whether as a matter of policy, it is wise to further decapitalize agriculture through the insurer's profits.

Another alternative is a state-owned insurer which enjoy the full faith and credit of the government. An autonomous entity with its own administration and reserve could conduct the agricultural insurance program. Through the budgetary process of annual contributions to the reserve, a fund could be created to manage almost any disaster. The insurer could serve as a coordination point for agricultural and credit policies by joining the Minister of Agriculture, the Minister of Finance, and the President of the Agricultural Lending Bank on the board of directors of the insurer. Its capital and reserves would be supplied by the government.

A final alternative is a modification of the state-owned insurer to include

the private sector in a joint capital venture. Almost inevitably the state would be required to supply most of the capital and reserve, however, private sector organizations such as producer associations, private banks, marketing boards, cooperatives, farmer associations and other groups could participate in the capital structure and in the risk bearing. This more democratic structure offers the insured groups the opportunity to participate in the decision-making process about what is insured and how. In addition, it offers the possibility of gradual reduction of the government's participation and the formation of an insurance mutual in which the policyholders themselves are the owners of the insurer.

Perhaps, the most significant advantage of a mixed capital enterprise would be that it would be far easier to reinsure than would a government-owned company. Large reinsurers have on several occassions taken large losses because government owned insurer have made political decisions to pay claims that were not technically justified. Reinsurers have paid the claims and left the companies without reinsurance. The inclusion of the private sector tends to militate against politically motivated decisions and makes reinsurance far easier to obtain. We believe this model to be the most recommendable and incidently, the easiest to establish legally. The partners simply comply with the requirements of the Superintendent of Insurance for the establishment of an insurer; each participant supplies the agreed-upon amount of capital. The government for its part supplies a reserve, guarantees the program, and perhaps offers an administrative subsidy; the insurer then operates as a private non-profit insurance company which accepts only agricultural sector risks.

THE FINANCIAL STRUCTURES OF A JAMAICAN INSURER

Precisely because of the catastrophic risk of agricultural insurance, the

financial structure of an insurer presents the greatest challange and requires most careful thought. There are several problems to be confronted simultaneously in planning an insurer.

The first problem is to determine the size of a reserve. This reserve must be of adequeate size to permit the insurer to meet any financial obligation to its policyholders. The writtings-to-reserve ratio for an agricultural insurer is a matter of some discussion. No fixed ratio can be given as the experience of each country is different. At the outset, it is strongly recommended that the reserve be very large, as the insurer will begin with only one or two crops located in a few areas. With experience, the amount of coverage written as a percentage of the reserve may be increased. For a fully developed nationwide program with an adequate reinsurance program, the writtings to reserve ratio can be narrowed. However, the task of setting reserve levels for each insured options and for the portfolio as a whole has to be left until actuaries and agricultural economists have completed an extensive study of the historical performance of each element of the portfolio and the portfolio in its totality.

It is next to the issue of structuring the portfolio that we turn. At the outset, this issue would not seem of primordial importance. It is, however, vital to the financial integrety of the insurer and an integral part of the financial planning of the insurer. Insurance is a mechanism for spreading through the formation of a "pool" of a very large number of individual risks. In insurance theory, it is generally accepted that there is a statistical independence of losses to any one member of the pool. This relationship is usually described as a normal distribution curve (a Poisson curve, for example) in which there are a large number of very small losses and very small number of very large losses. In agriculture no such assumption can be made. Hurricanes and droughts as insured events are very different than

car crashes and house fires. If one house burns, there is no reason to believe that a house on the next block will burn. The events are statistically independent. Likewise with a car crash. If a hurricane or drought strikes, there is every reason to believe that very large numbers of insured units will be affected, simultaneously.

Therefore, in selecting the options to be insured the maximum geographical, temporal, and climatological dispersion is required. In structuring a portfolio, three elements are of key importance. The first is the performance of the insured crop. What is the frequency, severity, and cause of losses to that crop? The second is the correlation of the frequency, severity, and cause of losses between the insured options in the portfolio. Strong negative correlations between the insured options produce an offsetting effect on the finances of the insurers. Third, the portfolio decisions must carefully balance the relative weights of each crop in the portfolio to obtain a financially viable portfolio that will not be unduely hurt by losses to any single component. To illustrate the process of portfolio selection, we have developed a hypothetical portfolio for Jamaica to indicate the process by which an insurer can develop a financially viable portfolio. It should be remembered that at the national level of aggregation, this exercise is illustrative. The actual portfolio selection requires greater disaggregation as well as information on the causes of the reductions in yields.

Table 1 displays yield data at a national level of aggregation for the nine crops for which reliable statistics are available for a 14 year period. Data for other crops such as citruses, coconut, and specialty crops were not available.

All of Jamaica's important crops show a large viability in the minimum and maximum yields. It should be noted that the variability of yield is

equallly large in commercial crops such as sugar cane and bananas as it is for crops typically produced on small family holdings, such as cassava, corn, and beans. Offering insurance on these crops would (to the extent that the variability is due to natural causes) stabilize farm incomes.

The key consideration for mounting an agricultural insurance program will be how to select the crops to be insured. Obviously, the insured options should be of importance as food crops or as exchange earners. However, to build a financially viable insurer, it is necessary also to select a portfolio in which the components are negatively correlated so that losses in one crop is offset by premiums earned from other crops.

In Tables 2 and 3, we have done covariance and correlation analysis to determine if a viable portfolio can be developed. The initial test proved to be very positive. We see that there are some very negative correlations at very high levels of significance. Thus, maize and legumes show the following correlations:

Maize with:

	CORRELATION	LEVEL
Sugar cane	-0.85373	.0008
Bananas	-0.76302	.0168
Cocoa	-0.77270	.0146
Rice	-0.85239	.0665

Legumes with:

Sweet potato	-0.80072	.0031

One possible portfolio would utilize these strong negative correlations to develop offsetting cash flows. However, the weights of each component would have to be

TABLE No.1

YIELD DATA - JAMAICA
1963-1977

YIELD (KG/HECT.)	MEAN	STD.DEV	SUM	MINI-MUM	MAXI-MUM
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	870.98284	44000.0000	3000	5800
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

COVARIANCE MATRIX

	Sugarcane	Rice	Maize	Bananas	Sweet Potato	Dried Legumes	Cassava	Green Coffee	Cocoa Seeds
Sugarcane	22730727								
Rice	342500	253000							
Maize	-1569727	-125000	148727						
Bananas	2895417	105000	-220694	758611					
Sweet Potato	-243971	62530	-37579.1	107754	456323				
Dried Legumes	53636.4	-26500	5363.64	-42222.2	-64414.5	14181.8			
Cassava	-5522545	110000	367545	-691667	-777302	93272.7	4450909		
Green Coffee	78525	-13100	2105.56	22538,1	3889.56	-1966,67	-96091.7	5631.44	
Cocoa Seeds	216013	90950	-26177,8	51445,2	19766.2	-4979,17	-57004,2	1027.78	7553.61

TABLE No.3

YIELD DATA. JAMAICA

CORRELATION MATRIX

	Sugarcane	Rice	Maize	Bananas	Sweet Potato	Dried Legumes	Cassava	Green Coffee	Cocoa Seeds
Sugarcane	1.00000 0.0000								
Rice	0.16252 0.7940	1.00000 0.0000							
Maize	-0.85373 0.0008	-0.85239 0.0665	1.00000 0.0000						
Bananas	0.78420 0.0124	0.44506 0.4526	-0.76302 0.0168	1.00000 0.0000					
Sweet Potato	-0.07575 0.8248	0.15544 0.8029	-0.14425 0.6722	0.19983 0.6062	1.00000 0.0000				
Dried Legumes	0.09447 0.7823	-0.35520 0.5574	0.11679 0.7324	-0.37241 0.3236	-0.80072 0.0031	1.00000 0.0000			
Cassava	-0.54905 0.0802	0.14342 0.8180	0.45174 0.1631	-0.45378 0.2199	-0.54542 0.0827	0.37125 0.2610	1.00000 0.0000		
Green Coffee	0.28829 0.4519	-0.15725 0.8995	0.07198 0.8540	0.32217 0.4810	0.09368 0.8105	-0.30261 0.4286	-0.60718 0.0829	1.00000 0.0000	
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 0.0000

most carefully considered as the correlation coefficients of the crops negatively correlated with maize and legumes are internally strongly positive (for example sugar cane with bananas is +0.78420 @ 0.124).

In addition, the correlation matrix offers several modest negative correlations at acceptable levels of significance such as: sugar cane with cassava (-0.5495 @ .0802),cassava with sweet potato (-0.54542 @ .0827), coffee with cassava (-0.60718 @ .0829), cocoa with legumes (-0.66153 @ .0523).

The higly positively correlated crops, on the other hand, should be kept to a minimum in the protfolio as they produce simultaneous losses. For example, sugar cane and bananas appear to lose simultaneously as does cane and cocoa.

THE OPERATION OF A JAMAICAN INSURER

Establishing an insurer, especially an agricultural insurer where there is little reliable data, is a complex process. The risks are quite high and caution is required. At the outset, it is doubtful that available production and climatological data will be available in sufficiently disaggregated form to determine the incidence and severity of loss causing phenomena. Likewise, a staff will have to be trained to carry out the highly specialized functions of insurance fieldwork. The administrative, financial and personnel systems will have to be developed. In short, a new financial institution with strong agricultural field work capabilities will have to be created

It is important that the growth of the institution be carefully planned. As the insurer must bear the risk of potentially catastrophic losses, it must grow relatively slowly, developing a very competent staff and learning about the performance of the various elements in its portfolio. As a new insurer, it must exercise

caution in exposing its reserve to losses and should adopt a conservative policy on writting-to-reserve-ratios. The worst imaginable loss can occur at any time, including the first year. This especially true on an island subject to periodic hurricane strikes.

For all these reasons, it is important to begin with a small scale pilot project. During the four to five year pilot project, the insurer can develop a knowledge of the risks it confronts, prepare all the necessary administrative and financial system, and most importantly, intensively train its field staff. If this staff is inadequately trained or motivated, the insurer's financial position will suffer as the result of poorly adjusted claims and preventable losses.

The pilot project also provides the opportunity to establish the required institutional relationships. At the outset, the insurer will probably want to offer protection for the credit used to produce a crop or for the purchase of an animal. This coverage is the first offered because there are no reliable yield figures and yields in adjacent field typically vary widely. Credit, however, is easily quantified. An insurer covers the direct and necessary cost of the production with a given technology. This linkage of credit, technology and insurance is of critical importance if agricultural insurance is to have a developmental impact. However, its development and operationalization requires interinstitutional negotiation between the insurer, the financial institutions, and the Ministry of Agriculture so that the insurer may cover the credit extended as well as supervise the use of the technology to satisfy itself that losses are not produced by inadequate management or diversion of resources.

At the outset of any agricultural insurer, one of the most fundamental problems is to determine a premium. In almost no country, developed as well as

developing, is data available. The type of information required is sui generus and can only be derived in the final instance from the operation of an insurer. While climatological and meterological data can provide some general parameters, the precise premium rate can only be determined by constantly adjusting the rate to the experience of the insurer. Since at the outset, little is known about the incidence and severity of loss, the total coverage must be restricted to keep the potential loss within the financial capability of the insurer. If, for example, an insurer charges a 5% premium, it has the possiblity (of unknown frequency) of a loss 20 times premium income. Experience gained in the pilot project permits a more accurate estimate of the performance of each component of the portfolio. At the end of the small scale trial, the insurer can begin to slowly expand its coverage, adding additional elements and further dispersing its portfolio. Although the program is highly exposed to catastrophic loss during the pilot period, this exposure is necessary to develop a data base and is moderated by the restriction of coverage to an amount compatable with the reserve. Other elements of agricultural risk, such as livestock insurance,farmers credit life insurance, and insurance on agricultural machinery and structures help stabilize the portfolio as well as meeting a genuine risk management need.

CONCLUDING REMARKS

Insurance is in its essence a mechanism to transfer risk and to level the dramatic fluxations caused by unforseen circumstances. While the techniques developed by the insurance industry permit a relatively secure, albeit gradual, development of an agricultural insurer, there is always risk. Catastrophic events may drain the reserve of any insurer before it has had time to create a fund capable of responding to such total disasters. In initiating an agricultural insurance program, it is of particular importance to begin with an adequate capitalization and with the

realization that the creation of nationwide systems of agricultural insurance is a long term project.

This is especially true in the circumstances of catastrophic risk. Early losses, if they should occur, should not be discouraging; neither should unexpectedly good experience lead to reductions of premiums or reserve levels. Agriculture is not distinct from other risky enterprises; risk tranfer mechanism can be designed to stabilize farmer outcomes, to reduce bank losses, and to minimize the impact of adverse weather on the society as a whole. However, it must be borne in mind that the process of designing these mechanism requires time, resources and above all carefully planned growth.

In Jamaica, agricultural insurance could be initiated as a mixed capital enterprise on a pilot basis. The pilot program will provide time to create a strong institutional before expanding the program. The Government of Jamaica will likely be required to participate in the capital and reserve structure for catastrophic risk, especially hurricanes which are an ever present risk to the agricultural sector. Subsidized administrative costs are to be expected at least until the insurer can achieve economics of scale. In addition, the government may wish to offer premium subsidies as production incentives to certain crops and/or classes of farmers.

As insurance is a highly complex field, and agricultural insurance even more so, a detailed feasibility study should be prepared. The study should develop the legal, administrative, and financial structures for the insurer as well as carefully measure the risks in each of the major crops on the island.

For both the creation of the insurer and its operation during at least the pilot phase will require a relatively large technical assistance program. This technical assistance effort should be mounted at the outset in order to assist in all aspects of the feasibility study.

Finally, in the last analysis, only by actually operating an insurer is it possible to gather the data and to develop the systems to build a nationwide program of agricultural insurance. This experimenting inevitably produces some negative results. This should not be taken as a failure but instead as an opportunity to learn and to improve performance. Agricultural insurance has proved possible around the world but it has never been other than complex. Agricultural insurers must learn as they grow, and must grow slowly until they know the risks of the agricultural sector well enough to insure them with reasonable certainty.

FECHA DE DEVOLUCION			

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Título On Organizing Agricultural Insurance in Jamaica

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