FINAL REPORT

"CROP CREDIT INSURANCE SYSTEMS"

Performed by:

THE INTERAMERICAN INSTITUTE FOR COOPERATION ON AGRICULTURE

(IICA)

Under:

USAID GRANT AID/LAC/IGR-1297

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IICA INTER-AMERICAN INSTITUTE FOR COOPERATION ON AGRICULTURE

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TABLE OF CONTENTS

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PREFACE

Agricultural risks have a negative impact in the development of the rural sector, and although farmers have traditional mechanisms to adjust to risks, many such mechanisms proof useless because of the magnitude of the disasters. In those cases insurance should be available to provide farmers a basic income and to allow then to return to production.

Although insurance is recognized as an important component of an agricultural risk management strategy, it has not been appropriately manage to become self financed. In fact, because of its design, coverage of all risks and allowance to pay indemnities for partial losses, insurance has been too costly and hence it has required strong subsidies. On the other hand, it must be recognized that because of the complexity and the nature of the agricultural sector, insurance is difficult to manage.

The awareness of these issues motivated IICA to undertake AID's proposal of a joint project to evaluate the feasibility of agricultural insurance. IICA agreed to support, with the financial contribution of AID, the insurance program in Panama and to create new programs in Ecuador and Bolivia, with the expectation that such programs provide a case to analyze the managerial aspects and the economic feasibility of crop insurance as well as its effect on farmer's welfare, public finance and production. These country experiences allowed IICA to test in situ, several hypothesis about agricultural insurance in particular.

This report offers a background to the agricultural Crop Credit Insurance Project, a description of the administrative and financial aspects of the Project operation and a comprehensive analysis of the issues related with the viability and effects of crop insurance. It presents the hypothesis, methodology of the research and provides it results and conclusions.

Many of the studies and analysis have been published as internal reports, journal articles and research notes, but their main conclusions are stressed here in a comprehensive report. This is the result of a combined effort of IICA with several national institutions, and it was possible by the participation of many professionals. Their contribution allowed to define the problems and to address the proper questions, to generated and to manage the data and to apply methods for the analysis that provided the answers.

The research mandate of the Project, in accordance with the contract with AID, required the design of a program that would investigate the demand for crop insurance by farmers and agricultural banks. This was thought so, because crop insurance is conceived as a risk management device and hence as a way to stabilize farm income. Furthermore, if implemented as credit insurance, it would increase loan recovery of banks. On the other hand, the research had to address the factors that determine cost and finance of crop insurance, and hence the nature of insurance supply and the requirements of governments funds for such purpose. As earlier studies indicated that most insurance programs were strongly subsidized, the issue of government costs and distributional effects of insurance had to be addressed, hence the need for a sector level analysis.

This report offers a comprehensive analysis of many important issues about crop insurance and its linkage with credit and production, but by no means it exhausts the debate. The interaction in the demand and supply of insurance should be carefully studied by countries, which already have insurance programs and by those which are considering insurance. In the case of this latter group, they are well advised to analyse the nature of risks and the options to manage them before they create insurers and give them a particular design.

The results of this work have an important implication for the action of IICA in the hemisphere as well as for many institutions around the world. For IICA it represents the achievement of an understanding of the benefits of limitations of insurance, and hence it strengthens IICA's capacity to serve the countries. For the institutions around the world it provides important information, which ought to be kept in mind for the design and implementation of crop credit insurance programs.

I. BACKGROUND TO THE AGRICULTURAL CROP CREDIT INSURANCE PROJECT

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A. Introduction

Production risks in agriculture have long been recognized as one of the most intractable problems of agricultural development. Flood, droughts, frosts and uncontrollable pests have been, and continue to be, the single most difficult problem, both for affected producers and for the entire agricultural sector as a whole. At the individual level, uncontrollable natural phenomena can wipe out years of a producers' investment, at the sectoral level, it can and frequently does wreak havoc with public finances by forcing food imports when tax revenues are reduced, by compelling government to institute disaster relief programs and by reducing, and in some cases destroying, the capacity of the agricultural credit system to recover its loans from producers.

Production disasters in developing countries poise particularly severe problems for several reasons. First, many are quite small in geographical area, or production is concentrated in a small area, thus a single phenomena (e.g. hurricane or drought) will affect the entire agricultural sector. Second, many developing countries are major agricultural exporters and the whole economy is affected by natural disasters. Third, as a general rule, capital markets, especially for the agricultural sector, are less developed and are less able to bear a major losses in agriculture without a subsequent reduction in lending volumes. Finally, most agricultural enterprises tend to be very thinly capitalized and thus, less able to bear the nasty shock of a natural disaster without decapitalization.

In almost every other field of economic activity, insurance is routinely used to affect intertemporal capital transfers. In the modern sector, almost no productive investment is made without insurance. In fact, many productive investments are contingent upon the availability of various forms of insurance. In its essence, insurance is surprisingly uncomplicated. it substitutes a regular

premium for losses of essentially unknown frequency and severity. This risk transfer is a very straightforward management device from the point of view of the insured. For a given sum he is relieved from losses of a stated amount. The calculation of the insurer is somewhat more complex; in exchange for a given sum he is liable to pay a large indemnity for which he has created a reserve and has accepted a spread of risks that will not suffer losses at the same time. Thus, the insured is freed of the risk that an unforseen event may interrupt the planned development of this activities by transfering some of his risks to his insurers.

The uncontrollable vagaries of nature and the pervasiveness of insurance in modern life quite naturally suggested that insurance could be useful in managing agricultural risks. The idea of using insurance to level the producers' income fluctuations is hardly new. In the first half of the ninteenth century, "limited risk" insurance covers were offered in at least three German states to protect farmers from hail damage. Livestock insurance emerged, again in Germany, in the last half of the ninteenth century. In the twentieth century, most European countries, United States, Canada, Israel, and Japan among others have developed agricultural insurance schemes, usually public "all-risk" insurers. Several developing countries including Mexico, Costa Rica, and Brazil, have experimented with and to some extent institutionalized agricultural insurance. A special case, Puerto Rico, began a coffee insurance program and grew gradually to insure numerous crops on an "all-risk" basis.

These insurers have been state-owned and generally subsidized for at least part of the administrative and/or indemnity costs. Private sector involment, excepting hail insurance in United States, Canada, and some European countries, has been confined to specific

(or limited) risk and has not developed a large market. Several small livestock insurers also operate in United States and some livestock insurance is sold in Europe.1/

B. The Temper of the Times

The available information at the outset of the feasibility study for the current project in 1976/77, seemed to indicate that agricultural insurance had emerged as agriculture made the transition from a basically subsistence oriented peasant economy to a commercial market oriented production system. Most of the developed countries, as well as several developing countries with sophisticated agricultural sectors (e.g. Mexico), had established agricultural insurance programs. In one case, Japan, insurance appeared to have been a major factor in developing self-sufficiency in a critical staple grain, rice. The then available information cited several important reasons for establishing agricultural insurance programs. Among the most frequently advanced reasons were:

- Stabilization of farm incomes through indemnity payments in bad years.

- Stabilization and improvement of agricultural lenders'portfolio by enabling producers to repay loans despite losses, thus preventing decapitalization.

- Encouraging new lending to agriculture by reducing the riskiness of lending and producing higher recovery rates through insurance indemnities.

- Encouraging technology adoption and innovation in production. Farmers, it was argued, frequently are reluctant to adopt new technology because of uncertainty and the risk that they will expose substantial (usually borrowed) resources to losses arising from natural hazards. They thus opt for a known sub-optimal technology in the absence of insurance.

- Reducing the need to mount ad hoc disaster relief programs by substituting a known liability which can be reserved against for a politically sensitive, sometimes chaotic process of trying to decide who gets paid and how much without any orderly means of measuring the magnitude of losses actually suffered.[2/]

While there had been numerous call from the developing countries, especially in Latin America, for agricultural insurance and some Mexican sponsored conferences and technical missions in the 1960, it was not until the mid-1970's that a consensus began to emerge that agricultural insurance was not only a nice idea, but could also be made to work in developing countries. At FAO, P. K. Ray continued his work. In Geneva, UNCTAD', Louis Boul[3/] and his associates explored the development potential of agricultural insurance. Several people within World Bank also studied the feasibility of agricultural insurance[4/], USAID published several documents produced by its staff and contract employees.[5/] Academics also took a limited interest in the potential of agricultural insurance as a development tool. The tenor of this work was quite optimistic and in general presumed that the problems of agricultural insurance were largely technical in nature.

In addition to these works, several field studies on the effect of risk upon farmers decision-making were carried out. The most important of these was the Cáqueza Project (or Proyecto de Desarrollo del Oriente de Cundinamarca, to use the full Spanish title). This project, conducted by the Colombian government with assistance from Canada's IDRC, contained a quasi-insurance scheme for output sharing between the scheme and participating maize producers who would use an improved technology package in return for the project assuming the production risk. Farm incomes rose markedly among participating farmers. There were strong indications that the removal of production risks accelerated technology adoption.[6]

While this brief section is by no means a complete bibliographical review of the work carried out in the 1960's and 1970's on agricultural insurance[7/], it would be fair to say that by the middle of the decade of the 1970's a consensus was developing in international organizations and the scholarly community that some form of agricultural, or crop, insurance would be beneficial. Seldom was heard a dissenting[8/] or a cautious[9/] voice. This consensus, it should be noted was based primarily upon logical, economic, and sometimes emotional arguments. There was relatively little empirical study of the few operating insurers and none on the insurers which then existed in Latin America (Mexico, Puerto Rico, and Costa Rica).

Almost everyone who touched the issue of agricultural insurance admitted that it was both complex and highly risky. There was considerable scepticism about transfering the insurance technology developed in the U.S. and Europe, and some confusion as to how to proceed to develop a situation-specific insurance technology in the light of the conditions that prevail in most of the developing world.

Especially troublesome was the lack of usable data to determine disaggregate yield variations, inadequate climatological data, and extreme variability of yields due to microclimates, technology, cultural practices and soils. Finally, there was concern about developing an adequate premium calculation methodology.

If the technical aspects were troublesome, they were thought to be tractable and apparently subject to solution over time. The catastrophic nature of agricultural risk made agricultural insurance unlike any other class of insurance. Everyone lost at once. Frequently over a wide area and occasionally within a given country, all agricultural producers were affected by the same phenomena (i.e. hurricanes and drought). Most writers held that some form of a multinational pool or a public sector reinsurance facility was needed to provide for an adequate dispersion of risk (Maurice and Boul for example)*. It was assumed that this pooling of national risks would provide an adequate "spread" to permit the pool to survive over time. Little thought was given to phenomena that affected very large areas.

While there was some disagreement over the specific way that the insurers would operate and the type of coverage (crop or crop credit) they would offer, there was, in retrospect, a surprising unanimity of the underlying assumptions about the broad outlines of how the programs should be structured and financed. From the perspective of 1984, after five years of field experience, it is remarkable how certain factors were given importance and other totally neglected. And, more importantly for present purposes, it

*The former reversed his opinion on this matter, has we shall see below.

should be noted that an intellectual theory of the late 1970's to a substantial degree structured the operational program of the 1980's. A true unity of theory and practice, for better or worse, as we shall see.

Perhaps it is not going too far afield to suggest that the near unanimity arose from a structuralist view of the economic world, while the neglect of factors to prove critically important was due to an absence of neo-orthodox economic analysis. As projects reflect the beliefs and the "operational code" of the people and organizations that develop and implement them, it seems essential to explicate the reasoning that underlay the idea and the practice of attempting to use agricultural insurance for development purposes if we are to understand how the subsequent project fared in the vicissitudinous world of developing countries.

Different kinds of economics define problems differently, prescribe different policies, and sometimes, pursue different policy goals.

A structuralist view of the development process, despite very substantial differences among member of the school, tend to follow the reasoning of writers such as, Ragnar Nurske, Raul Prebisch, Gunnar Myrdal, W. Arthur Lewis and A. O. Hirschman. The world of the structuralists tend to be inhabited by obstacles, bottlenecks, and constraints. A major problem of development for the Less Developed Countries (LDC's) is a lack of flexibility. Change is difficult, resources get stuck and entrepreneurship is generally lacking, especially in non-traditional fields. As a general rule, the state is required to take an activist, interventionist and

frequently an entrepreneurial role. There is also the unspoken assumption that with development, the LDC's will acquire institutional and financial structures similar to those of the more advanced countries (MAC's). Administrative elites in government have the prime responsibility of creating of creating Hirschmanian "linkages" through project and sectoral planning and "reform mongering". When this process required bringing in outside talent and development aid, it is usually in the form of specific project assistance coupled with surveillance. The structuralists are generally suspicious of the price mechanism, arguing that is relatively inflexible and requires a quite large price change to achieve small adjustment. A corollary of this argument was the state needed to intervene to set the prices of certain key inputs (including finances) and some commodities (frequently foodstuffs).

Specifically in the agricultural sector, producers, especially small and medium sized ones, tend to lack the attitudes, the entrepreneurial skills, and the know-how to move from a traditional to a more modern farming practice. The problem is particularly acute in the area of agricultural finance, where a vicious self-reinforcing circle of archaic production practices coupled with low levels of capitalization in a disaster prone industry, disqualify the producer from borrowing to modernize his operation. State or state-guaranteed lending usually at subsidized interest rates is the policy solution most frequently advanced to overcome this problem. In the 1960's and 1970's some form of insurance was increasingly advocated to protect farmers (and consequently lenders) against decapitalization. Again, the argument was not only the state should offer insurance but also needed subsidize it to facilitate its adoption as well as manage the insurer, as the private sector would not initiate agricultural insurance.

The structuralist took a rather benign and to some extent naive view of the state's capacity for efficacious intervention. The overlooked (or at least generally did not remark upon) the fact that state institutions are frequently inefficient, inept, corrupt, and more responsive to political pressures than to economic rationality.

Thus, it may be said that the shared assumption upon which the crop credit insurance project was based, were an activist government pursuing interventionist economics. The goals of this policy were institution building, technology transfer (or technology modification) to help modernize the small farm agricultural sector. The method of reaching the small farmer "stuck in the mud" was through project planning and financial and technical assistance coupled with project management and surveillance. These shared assumptions were never clearly enunciated as such, however, in retrospect is clear that they structured the approach to the problem of natural risk management in agricultural production. Some were in fact part of the USAID mandate--to work with small farmers and to assist in institutional building, others were part of USAID's modus operandi--to work with governments by offering project aid and technical assistance. Finally, the literature of the period shows a consensus developing on the nature of the problems that the sector confronted and the method to attack those problems--governments intervening actively in broad sectors of the economy to achieve not only economic growth but also distributive justice.[10/]

C. The Project Paper, Analysis, Implementation Plan, and Recommendations

In the preceding section we summarized the then current debate about agricultural insurance and the approach to problem solving

which was viewed as the most likely to succeed. In this section we shall focus upon the Project Paper itself, in order to elucidate the arguments set forth and the reasoning used to justify the crop credit insurance project. This discussion will also shed very considerable light upon the subsequent organization and operation of the project as it developed within the Interamerican Institute of Agricultural Sciences (IICA)*.

The key section of the Project Paper (PP) is the analytical chapter which cover the technical, financial, social, economic and institutional viability of the project. This section alone covers 60 of the 86 pages of the PP and reflects several man-years of preliminary work both in Washington and in the field.

The technical and financial analysis sections, subtitled "reaching small farmers" argued that crop credit insurance (that is, insurance which protects the direct investment in crop production) would protect both lenders and farmer borrowers. The latter's behavior would change under insurance. The small and poor farmer would be willing to sow new crops or use new technology if he were protected against loss. The insurance was conceived of as a surrogate collateral which would help the farmer become "credit-worthy" without having to take production risks that could leave him both indebted and without sustenance for his family in case of a crop failure. The insurance institution, it was argued, was capable of helping to reduce loan delinquency due to dishonesty through the

*The name was later changed to the Interamerican Institute for Cooperation on Agriculture, the acronym remained unchanged.

inspection function to verify that the crop did indeed fail to a degree that prevents repayment. The "non-serious farmers" are eliminated gradually and lenders are left with a cleansed portfolio of honest progressive farmers utilizing scarce loan capital in a near optimal manner.

The cost of financing the agricultural insurance system was based upon the assumption that governments could transfer the subsidy on credit inputs and extension services to the insurance program. Additional revenues would be available from enhanced loan collections, and consequentially less frequent recapitalizations of lending institutions. Finally, general revenues would have to bear any undistributed costs.

A strong argument was presented that the additional investment -if any-could be justified by the fact that insurance could be used to "lever" private sector lending for production. Insurance would provide the protection that private sector lenders required to extend increasing loan volumes to agriculture.

Reinsurance from the commercial market was discounted from the outset as it was recognized that the reinsurer would be exposed to a "social hazard". In its place a pool of national governmental insurers would offer reinsurance. This pool, denominated ALARA (Asociación Latinoamericana de Reaseguros Agrícolas), would gradually build a loss adjusting systems sufficiently strong to attract commercial reinsurers.*

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*This "social hazard" was never discussed but from the context it is clear that the committee realized that one or more governments might decapitalize the fund that backed ALARA. This argument was never applied to the proposed public sector insurers, and, this turned out to be a critical factor.

The strategy put forward for creating this new development linkage was a carefully weighed, incremental 15 year plan that offered several "go--no-go" points at which results to date were measured. The first of three stages was to establish three pilot projects and develop them to the "take-off point", as well as to plan ALARA. These goals were embodied in the present grant. Subsequent stages of five years each were to expand the number of programs, "graduate" existing programs and to fund and "graduate" ALARA.

As envisioned, the insurance cover would be "all risk" (except moral hazard), marketed through lending institutions with the lending institutions receiving the indemnity payment. The insurance would be obligatory for all borrowers who meet the basic conditions of eligibility set by the insurer.

Insurance involves two costs. The administrative costs to be paid by AID were estimated (as it turned out with reasonable accuracy) at slightly over $2 million for four years. The contingent or loss cost to be borne by the host governments were assumed to be costs already borne as the "government has to replace losses from public banks anyway". Additional technical assistance costs of about $2 million were also funded by AID. Both of these costs would be absorbed by the host government at the end of the pilot stage.

The social analysis section cited three groups as project beneficiaries of the program: 1,500 highland Bolivian farmers, 1,000 Ecuadorian farmers on both the coast and in the mountains, and 1,000 farmers on Panama's agricultural frontier. These groups were viewed as encompassing the range of living conditions and characteristics of the target group. The target group, although poor, was far from the "poorest of the poor", but instead those farmers who

possessed certain prerequisites, in this case between two and ten hectares of land of sufficient quality to permit a move into the cash economy through technical innovation and a switch to higher value but riskier crop options. Again, the basic argument was that insurance which protected farmers against losses by guaranteeing a minimum income (which was in fact zero but with no bank debt) would serve as a lubricant for both credit and technology to small poor farmers with adequate land for market production.

The PP's economic analysis section argued that these benefits would be "substantial" although very difficult to quantify, as they were associated with credit which made possible the adoption of modern technology, which in turn produced the higher yields. As there was no empirical data from which to work, it was impossible to analyse an existing program (e.g. Mexico). Instead a linear programming model developed by Robert M. House for small farmers in Guatemala's highlands, was reworked by Robert R. Nathan Associates to estimate the farmers' income stream over time under various assumptions as to the loosening of the risk constraint by insurance.[11] The guarded conclusion was that crop credit insurance's potential benefits were economically quite high, if they could be realized within the existing and known institutional constraints. A further caveat was that it was possible that the benefits could only be realized at unacceptably high social costs. Likewise tight credit policies could obviate part or all of the benefits. With the substantial benefits shown by the model and with these reservations in mind, a small scale experiment to develop further data and analysis and to test operational and institutional arrangements appeared "eminently justified". It was clearly a calculated risk whose potential return outweighed the difficulties in realizing it.

These analyses led the project committee to recommend to AID the funding of a four year pilot project. The recommendation however was tempered with a considerable amount of realism, arising from the long experience of the committee with AID project work. While crop credit insurance appeared a promising mechanism,, the committee was keenly aware that the existing agricultural services upon which the insurance depended, the lack of data for rate making, difficulty of comprehension on the farmers' part and land tenure patterns, among other problems, could sharply reduce benefits and raise costs to unsustainable levels. Learning, training and communications were viewed as essential if these problems were to be overcome. The processes were structured within a cautious, experimental, carefully monitored project of limited duration which was designed to generate data and analysis which would in turn serve as the basis for future decision making.

The choice of IICA to execute the project was according to the PP based upon IICA's supervision by its member states, its entree to Latin American governments, its large, well qualified staff and the potential to institutionalize and manage complex and far-flung projects.

To summarize, the newly created insurers were to be public sector institutions serving as a linkage between the public agricultural lending banks on the one hand and small farmers on the other. The mandatory insurance would serve as collateral while the surveillance function of the insurer would vouchsafe the correct use of recommended technology. This system of guaranteeing the farmer that he could pay his loan (but not necessarily feed himself) was thought to help modify his behavior and make him more disposed to adopt more productive technology and/or to modify his cropping pattern. Initial administrative and technical assistance costs of

about $4 million were borne by USAID. The loss costs, it was argued, were paid already in the form of bank recapitalizations. At the end of the pilot project all costs were to be absorbed by the host governments and could be paid in large measure through a redistribution of existing subsidies, especially those on inputs and credit. The international risk spread would be managed by ALARA, an intergovernmental pool to be funded by USAID at a later stage of the 15 year project. IICA was chosen as the implementing agency because of its strength in agricultural disciplines and its structure which facilitated access to host governments.

From the perspective of almost $5 million (plus substantial local counterpart funds) invested in 40 man-years of work, of trial and error, of research and learning, it is surprising how precient the committment was. As we shall see, they identified the basic issues as well as a great many of the problems that the project would encounter, although they did not give sufficient weight to some and overemphasized others. Their assessment and subsequent recommendation of the project as highly experimental with the potential for producing substantial benefits proved to be correct. Their evaluation of the riskiness of the project was also on target.

Development work is always characterized by the "too little" phenomena, too little time, too little trained personnel, too little knowledge and too little money. Given the knowledge available in 1977 on crop insurance, the project logically appeared to be a reasonable and calculated risk whose potential developmental benefits were as large as they were long-term and difficult to realize. It was the classic type of project that AID has been willing to undertake.

On August 31, 1978, the grant between IICA and USAID was signed and the experiment was underway.

End Notes

[1]A brief history is found in P. K. Ray, Agricultural Insurance: Theory and Practice and Application to Developing Countries. Pergamon Press, 2ed., 1981. A very good though somewhat dated survey of the types of crop covers offered around the world is found in Crop Insurance: Types and Problems, Munich Reinsurance (Münchener Rückversichesungs Gesellschaft) 1973.

[2]Typical of the line of reasoning used to justify agricultural insurance is the following passage taken from a description of the program published by the Insurance Fund for Natural Risks in Agriculture Ltd. (INFRA) of Israel. Similar arguments are found in almost all of the insurers' descriptions of their purpose. This one is cited for its succinctness.

> "Farmers' crops are subject to many natural hazards over which they have no control. As result of weather, these crops are totally or partially destroyed even in good years. In many cases, the loss of a crop results in financial difficulties. When crop failures or heavy losses come in a series of years, financial distress is general for those involved.
>
> Insurance is a device designed to meet the problem of risks and to give the farmer a solid method of managing his risks. The insurance spreads the losses among many farmers exposed to those risks and over many regions and years. It enables the farmer to substitute payment of a regular annual premium cost for irregular and damaging losses.
>
> The farmer has a major investment in his crops. With modern commercial methods of farming, costs are high. Most of the farmers are borrowing money to invest into each year's crops. Loss of that investment often means inability to repay the loans. The insurance improves the credit position of the farmer as it stands as additional security and he uses it to pay off his loans in case of crop failure.
>
> Insurance may also be looked upon as stabilizing farmers' income, as it assures their purchasing power every year.
>
> It is wrong to assume that insurance is needed only where losses are frequent, but of little need where losses are infrequent. It is not the frequency of

the loss that counts, but the amount and the importance of the amount risked. Where losses are infrequent, the insurance coverage is desirable because it makes the premium cost low. Even in areas of low risk, spot losses and widespread catastrophes do occur.

The benefits of insurance extend beyond the farmer, as also others are dependent upon farm income. If the farmer can repay his loan, his financial position is better and he can spend more money. Agricultural income is a major factor in the national income and any stabilizing instrument as insurance has its effect on the prosperity of the country as a whole.

Crop catastrophes often necessitate Government grants, loans or other forms of assistance to affected farmers. The insurance eliminates the need for such relief measures, which put an heavy burden on the State's budget."

Insurance Fund for Natural Risks in Agriculture Ltd. (INFRA), Description, September 1977. Mimeo, Tel Aviv, Israel.

[3]P. K. Ray, op. cit.

Louis P. Boul, "UNCTAD's Special Program on Insurance", Best's Review, November 1975, pp. 56-59.

[4]Clive Bell, "Reducing the Risk of Innovation on Small Farms, Experience with a Pilot Crop Credit Insurance Scheme in Northeast Bihas," World Bank, Mimeo, 1974, Vincent R. McDonald, "Crop and Livestock Insurance, An Aid to Small Farm Development," World Bank, Mimeo, 1975, and Bernard Oury, "Crop Insurance, Creditworthiness and Development", September 1970. Reprinted in Development Digest, April 1971.

[5]Nelson Maurice, "Exploiting Crop Credit Insurance for Development Purposes in Developing Nations." Paper presented at the Fertilizer Association of India. December 1977.

Earl Wilson, "A Preliminary Report on the Feasibility of Crop Insurance in the Dominican Republic." Report prepared for the Agency for International Development, June 1976.

Robert R. Nathan Associates, Inc., "An Economic Assessment of Crop Insurance for Small Farmers in Latin America." Report prepared for the Agency for International Development, August 1977.

[6]Development Alternatives, Inc., Strategies for Small Farmer Development: An Empirical Study of Rural Development Projects, Vol.11. Report prepared by the Agency for International Development, May 1975. This report summarizes project results.

[7]Additional bibliography is found in Paul R. Crawford, Crop Insurance in Developing Countries: A Critical Appraisal. MS Thesis, University of Wisconsin, Madison, 1977. And in World Bank, "Agricultural Policy Note No. 5", Mimeo March 25, 1983. Prepared by J. D. Von Pischke. The research section of this report also contains an annotated bibliography.

[8]James Roumasset, "The Case Against Crop Insurance," Agricultural Development Council, May 1979 protested vigorously that insurance was unnecessary and perhaps pernicious. The attack unfortunately was first published in an obscure journal, The Philippine Review of Business and Economics, March 1978. The article may have been a reply to Roumasset's ADC Collegue, V. M. Dandekar, who published a favorable report, Crop Insurance for Developing Countries, ADC, September 1977. Orest Koropecky, "Risk Sharing, Attitudes and Institutions in the Rural Sector: A Critique of a Case Against Crop Insurance in Developing Countries," Robert R. Nathan Associates, Inc., September 1980, undertook to refute Roumasset's arguments. The Philippine government despite Roumasset's specific argument against insuring paddy rice proceeded to institute a scheme based on its Project Feasibility Study: The Philippine Agricultural Insurance System, Land Bank of the Philippines, 1976.

[9]Paul R. Crawford, op. cit. It is enlightening to cite from Crawford's conclusions to illustrate the arguments frequently used to argue against agricultural insurance as a development tool.

> "In reviewing case studies of crop insurance, it becomes apparent that the problems faced by developing countries in operating crop insurance programs seriously limit their possibility of success. The lack of education of the farmer, small and fragmented land holdings, vaguely defined tenure patterns, and the absence of land records greatly increases both the costs and administrative difficulties of a crop insurance program. The heterogeneity of agriculture, in terms of input availability, cultivation practices, farm size, production costs, yields, and levels or risk increases the administrative complexity of a

crop insurance program and makes it difficult to elicit farmer cooperation. The lack of social and economic infrastructure makes operation of crop insurance more difficult and costly, as well as increasing the risk involved in extending insurance to the farmer. A general bias exists in crop insurance programs towards the benefit of the larger, more progressive farmer, and this bias is exacerbated by the reluctance of the peasant to participate in such programs. This reluctance is due, in part, to his suspicion of any government action, as well as to his lack of an understanding of the crop insurance concept. Further, the existence of self-insurance and the ability of peasants to moderate the adverse impact of crop failure by altering their consumption and production patterns, decreases their need for crop insurance.

Many of the problems facing crop insurance programs involve institutional constraints which manifest themselves as an inability to perform needed operational tasks (such as inspecting crops, processing applications and claims, and maintaining coverages at adequate levels over time) within the time constraints set by agricuture and within the resource constraints set by agriculture and within the resource constraints faced by the government and the farmer. These institutional problems, though they are as diverse as the programs themselves, have a common thread of causality in that they are the inevitable result of targeting crop insurance at peasant farmers within the context of traditional agriculture.. Since many of these obstacles are inherent in peasant agriculture,they will not be eliminated until the agriculture in these countries has reached some, as yet undefined,level of development. Moreover these problems are most acute for crop insurance programs attempting to serve large numbers of small farmers within the context of traditional agriculture.

Crop insurance is not a cost-free endeavor. In contrast to what some writers imply, it is not self-financing, nor even remotely so. Rather, for it to be successful, crop insurance requires a massive commitment of resources on the part of the government and the agricultural sector. In some ways crop insurance in developing countries may be little more

> than an income support and redistributive mechanism. The question which must be answered is whether crop insurance is more effective and equitable as a redistributive mechanism than alternative measures.
>
> In the absence of more extensive empirical research, the main conclusion to be drawn from this thesis is that crop insurance, as a means of increasing rural incomes and promoting agricultural development, specifically with regard to the small farmer, has been exaggerated by those who have written on the subject. The practical experiences and severe problems faced by developing countries in operating and financing such programs do not bear out the enthusiasm of these writers. Crop insurance, while seemingly a theoretically justifiable option, suffers in actual practice from severe institutional constraints."

After observing operating programs, another University of Wisconsin-Madison scholar came to different conclusion. See Andrew James Hogan, The Role of Crop Credit Insurance in the Agricultural Credit System in Developing Economies, Ph.D. Dissertation, University of Wisconsin-Madison,, 1981.

[10]This discussion draws upon several of A. O. Hirschman's works, particularly A Basis of Hope, Yale University Press, 1971, and The Strategy of Economic Development, Yale University Press, 1958, as well as an M.D. Little, Economic Development, Theory, Policy and International Relations. Basic Books, 1982.

[11]Robert M. House, "A Linear Programming Analysis of Small Farms in the Central Highlands of Guatemala", USDA, ERS/FDD/SAIDG, November 1975.

Robert R. Nathan Associates, Inc., "An Economic Assessment of Crop Insurance for Small Farmers in Latin America". Report prepared for USAID under Work Order No. 17 AID/afr-c-1134, 1978.

II. PROJECT ADMINISTRATION AND FINANCES

II. PROJECT ADMINISTRATION AND FINANCES

A. Staffing and Organization

The Crop Credit Insurance Systems Grant between IICA AND USAID was issued on August 31, 1978. IICA extended a contract to the project "coordinator" on September 5, 1978 effective as of October 2, 1978 when he reported to work in San José.

The first task was to begin the operational design of the project and initiate interviews for staffing. The basic outline of the project was set forth in the grant document. However, the design of the administrative mechanisms was left largely to the project leader in consultation with the Washington-based AID project officer. Several important decisions which were to affect the future of the project were made during the initial months. Several other factors which proved to be equally critical to the future of the project arose logically and as a matter of course from the institutional structure and operational system of IICA. A brief analysis of these design decisions made within a preexisting institutional context will be useful to the understanding of this project.

When the project coordinator arrived, he was given a free hand to structure the project within the operational norms of IICA. Initial consulting work had made clear that the structure of the project would be a critical variable. Of special importance, given that the project was funded in Washington, supervised and coordinated from Costa Rica and operating in Panama, Ecuador, and Bolivia would be the project management ability to control personnel and finances. The design that emerged had several salient features to strengthen management's hand against the desintegrative tendencies inherent in a project streching from Washington to La Paz.

First, all finances were to be centrally allocated and disbursed. The first structural decision was for the project coordinator and his recently contracted financial specialist to control, monitor and supervise all cash and capital goods expenditures. The central staff prepared its own budget, and in consultation with technicians in each country, a budget for the advisors' work. These funds flowed through the normal IICA channels. More importantly, all subgrant disbursements were to be initiated by the central project staff based upon a request and adequate documentation from the countries. Funds were disbursed to cover the cost of carrying out an agreed upon plan of insurance. By setting up this control and monitoring system, the project developed the ability to link the technical assistance to the funds provided under the grant for administrative support. Furthermore, agreements with the host country's insurer were to be made for only one year at a time and the budget was made part of this agreement. Thus, the insurers would submit to the country advisor and the central staff on a monthly basis the expenses incurred and would be reimbursed. This system had several advantages. It proved a very useful linkage between grant financing and technical assistance. There is a tendency to accept advice and technical assistance (TA) when it is convenient and ignore it when it is not. Advisors are frequently marginalized. To avoid this TA was packaged with the AID provided grant funds. The involvement of the country advisor and the project staff in the important internal operations of the insurers was thus strenghtened.

The subgrants were budgeted for specific purposes and so utilized. It was a check on a tendency to overstaff, concentrate staff at the central office and to purchase more capital goods than required. Although unforseen at the time, this system was useful to protect the insurers from a certain degree of unsound decisions.

It may be argued that this system was so tight as to stifle local managerial autonomy and created substantial paperwork. In operation, the initially tight controls were gradually relaxed and management was given increasing autonomy as the insurers developed adequate accounting systems and as management gained experience. However, the "tight fit" between the monthly disbursements and the realization of the agreed upon plan remained a key element of the project. Chapter 4 contains a detailed financial analysis.

A second structural decision was to centralize the research and technology development component in San José instead of decentralizing it to the field level. A full time San José-based researcher was contracted to develop research programs designed to meet the scope of work contained in the grant. Mexico, then thought to be rich in data which could be utilized at low cost, was the first test site. The research section reports on this work in considerable detail. However, to anticipate that section, it was quickly discovered that the Mexican data had systematically overstated expected yields (and thus insurance coverages). Thus, the first source of data proved to be of limited and questionable value and the research had to be refocused on the only other existing insurer, Panama's Instituto de Seguro Agropecuario (ISA). Inevitably, the research effort "overrepresents" Panama, as it was not until the middle years of the project that research could begin in Bolivia and even later still in Ecuador due to the late creation of the insurers.

At the outset, the research effort focused upon the design of a theoretical framework and a methodology to shed light upon the research agenda set forth in the grant document. As work progressed, that focus had to be modified to include a substantial effort to develop agricultural insurance technology. The answers to many of the issues in the research agenda presupposed and depended upon a functioning agricultural insurer possessing an adequate level of technology. This technology we quickly discovered was nowhere well developed (contrary to expectations about Mexico) and not easily transferred due to different local circumstances. The research as it evolved became a complex mix of theoretical work combined with agricultural insurance product development.

Notwithstanding minor problems, the project organization and staffing was adequate to permit a fair test of the concept and viability of agricultural insurance. By late 1979 the pieces were in place to launch the operational phase of the project. The staff recruited was highly professional and showed dedication to the project that was admirable. IICA provided an institutional structure which permitted the staff to work almost from the moment of their recruitment in the countries where they were assigned, as well as providing a legal framework to permit subgrant agreements to be signed expeditiously. In addition the IICA administrative system enabled money to flow quite rapidly as soon as the conditions precedent to subgrant disbursement had been met.

B. Control of Sub-Grant Agreements with the Insurers

The funds budgeted and allotted to the sub-grants for the development and strengthening of national crop insurance programs

were disbursed in accordance to contractual agreements between IICA and the insurers. The first agreement was signed on March 17, 1979 with the Instituto de Seguro Agropecuario (ISA) of Panama. Table 1 shows the dates of signature and validity of all the contracts and their renewals. In the case of ISA and Compañía Nacional de Seguros Agropecuarios (CONASA) of Ecuador, one year or shorter extensions were signed, and with Aseguradora Boliviana (ASBA) the contract duration is four years with expiration on January 21, 1984, subject to the submission and approval of an annual budget.

Once the contract terms and the budget were discussed and agreed upon by the insurer's management and Project's technical staff, it was submitted for revision to the Project Director and IICA's Legal Advisor before sending the authorization to sign it to the IICA local director. AID's "Standard Provisions for Non-Profit Organizations- Other than Educational Institutions" are included as part of every sub-grant agreement with the alterations specified in Grant Amendment No. 9.

The basic framework to establish a limit for the annual expenditure for each crop insurers was the AID Grant Modification Letter itself, which assigned a sub-grant amounts for each country. Although transfers among budget line items were authorized, the total Grant amount set the upper spending limits.[1]

The annually negotiated budget was conceived of as a tool to oblige management to make an early study of its problems and to instill the habit of careful study of operations. It also provided the project staff a yardstick to measure crop insurer's efficiency and to control expenditure. It must be said that at least in the first year it was not easy to build an accurate budget, so some

TABLE 1. Sub-Grants Contractual Agreements

TYPE	VALIDITY FROM	TO
	ISA - PANAMA	
CONTRACT	MARCH 17, 1979	MARCH 16, 1980
CONTRACT	MARCH 17, 1980	MARCH 16, 1981
CONTRACT	MARCH 17, 1981	MARCH 16, 1982
CONTRACT	MARCH 17, 1982	MARCH 16, 1983
ADDENDUM	MARCH 17, 1983	DEC. 31, 1983
ADDENDUM	JANUARY 1, 1984	MARCH 31, 1984
	ASBA - BOLIVIA	
CONTRACT	JANUARY 21, 1980	JAN. 20, 1984
ADDENDUM	JANUARY 21, 1984	JUNE 30, 1984
	CONASA - ECUADOR	
CONTRACT	OCTOBER 15, 1980	OCT. 14, 1980
ADDENDUM	OCTOBER 15, 1981	DEC. 31, 1981
ADDENDUM	JANUARY 1, 1982	APRIL 30, 1981
CONTRACT	MAY 1, 1982	DEC. 31, 1982
ADDENDUM	JANUARY 1, 1983	DEC. 31, 1983
ADDENDUM	JANUARY 1, 1984	AUG. 31, 1984

Note, The signatory for ISA is the Minister of Agricultural Development and for ASBA and CONASA their General Manager.

transfers were necessary. Nevertheless, gradually experience in operations and financial management permitted the project team to establish budgets that accurately reflect the financial needs of the insurers.

The most disturbing variation affecting expense behavior with respect to the budget was by far the accelerated currency devaluation which occurred in Bolivia and Ecuador. During the life of the Pilot Projects, in Bolivia the dollar rate of exchange went from 24.50 pesos to near 2,000 pesos and in Ecuador rose from 25 sucres to around 90 sucres. These rapid fluctuations distorted the budget, as since some expenditures, like vehicles and office equipment, maintained their dollar value, while others such as salaries tended downward local currency, at least in the short term. As an example, ASBA monthly payroll in mid 1980 totaled around $5,400 for twelve employees, while in mid-1983 it cost dropped to $830. It must be said that although ASBA peoples' welfare deteriorated significantly due to inflation and devaluation, compared with the general situation of office workers in La Paz, they were probable somewhat better off, less drastically the same occurred with CONASA in Ecuador.

Notwithstanding these problems, the annual system was a useful tool for insurer's management and permitted the Project's staff to control costs and operations by inducing better planning and coordination.

Controlling actual costs incurred by the insurers and the cash disbursements to them in compliance with the agreed upon budget is done by following procedure,

1. The insurer prepares a detailed list of all cash transaction eligible for repayment which is send to the Project Coordination in San José, having previously been revised and approved by the Project's resident technician. The list is accompanied by a copy of the corresponding checks and vouchers and by an itemized statement showing each account's budgeted and actual expenses and disposable balance. These documents all together constitute the reimbursement request.

2. Once received, the reimbursement request is analyzed. If it is correct, an internal memorandum is send to IICA's Financial Division soliciting reimbursement to the insurer. This is done through IICA's office in the respective country, except in Panama where the funds are send directly to ISA/IICA Agreement bank account in the Banco Nacional de Panama. A confirmation letter is send to the insurer advising them of the reimbursement.

3. When clarifications are required, a deduction is made for those transactions being questioned as being permisible under the terms of the agreement or due to insufficient supporting documentation. An explanation of each deduction is included in the confirmation letter. When the Insurer sends the request information, and if approved, the deducted amount is included separately in the following reimbursement.

4. The reimbursement documentation is kept in fire proof files in San José and the original vouchers and other information is stored on the Insurer's premises, where according to the agreement terms, they are ready for inspection by the Project's personnel and AID auditors.

At the begining of a Pilot Project a cash advance to establish a revolving fund was given to start operations. At the end of the Project, actual expenses incurred in accordance with the sub-grants' terms will be charged against the revolving funds. Any unutilized funds must be turned back to IICA for return to AID. Briefly, it could be said that in accordance with the above procedures. IICA's accounting system controlled the overall cash disbursements to insurers, while the Project Staff had the supervision and control of how the funds provided through the sub-grants agreements were being used by the insurance institutions.

C. Overall Project Costs

During the Project life nearly by $4.7 million were expended. Table 2 details te use of these funds with the latter showing the amounts disaggregated by year.

Operations were spread over four countries and were of a multi-disciplinary and multifunctional nature. Under these circumstances it was of great importance to achieve an efficient use of financial resources, which in turn requires adequate budgeting and expense control procedures. The information exhibited in this section shows how the financial resources were expended to procure the basic objectives assigned to the Project.

A reduced and well balanced staffing, from the point of view of covering the disciplines required in an insurance program with relatively few permanent personnel supported when required by short-term consultants, was a key element to achieve the most efficient use of Project relatively limited funding.

The total cost of the sub-grants shown in Table 3 displays the actual expenses as of December 31, 1983 and the estimated disbursements for year 1984. Only in the case of ASBA in Bolivia did the Project finance all the operating expenses. In Panama, where the Project contributed to strengthen the existing Crop Insurance Program, the expenses financed by the sub-grants represented approximately one third of ISA's operating costs, the larger part being financed by Government subsidy. In Ecuador, the Banco Central made a contribution of 2.5 millions Sucres annually to cover CONASA's operations costs, which at the beginning of 1981 represents $100,000 dollars, but in 1983 it was reduced by devaluation to less than 30 percent of the original value.

TABLE 2 Project Costs and Annual Disbursements
(thousands of dollars)

	Total Project Costs	ANNUAL DISBURSEMENTS							Total Project Costs %
		1978[1]	1979	1980	1981	1982	1983	1984[2]	
A. IICA PROJECT									
Personnel costs[3]	1,240.0	12.0	198.2	179.5	188.2	239.9	246.2	176.0	26.5
Consultants	309.1	-	43.6	52.4	126.2	77.0	3.9	6.0	6.6
Travel & per diem	327.6	2.7	68.4	50.6	51.9	71.5	54.0	28.5	7.0
Data processing	44.3	-	2.0	10.7	8.0	10.3	11.3	2.0	0.9
Other direct costs	309.1	1.9	46.2	50.2	67.0	62.9	65.0	15.8	6.6
Administration[4]	290.0	3.0	48.9	44.3	46.6	59.2	60.8	27.2	6.2
TOTAL IICA PROJECT COSTS	2,520.0	19.6	407.3	387.7	487.9	520.8	441.2	255.5	53.0
B. SUB-GRANTS									
Panama	951.0	-	128.5	203.4	215.3	204.7	109.1	90.0	20.3
Bolivia	706.0	-	0.6	206.3	152.8	237.2	52.1	57.0	15.1
Ecuador	503.0	-	--	34.9	165.8	145.7	66.4	90.2	10.8
TOTAL SUB-GRANTS	2,160.0	-	129.1	444.6	533.9	587.6	227.6	237.2	46.2
TOTAL PROJECT COSTS	4,680.0	19.6	536.4	832.3	1,021.8	1,108.4	668.8	492.7	100.0

[1]Project operations started on October 1978.
[2]Projected.
[3]Include salaries, bonuses and benefits.
[4]Overhead of 24.7% of personnel costs with a maximum of $290.0.

TABLE 3. Sub-Grants: Cost Analysis

(thousands of dollars)

	Total	Panama (ISA)	Bolivia (ASBA)	Ecuador (CONASA)	%
Personnel costs	1,058.2	428.3	348.6	281.4	49.0
Operation Costs	719.8	354.2	221.8	143.8	33.3
Office space and Equipment	381.9	168.5	135.6	77.8	17.7
Total	2.160.0	951.0	706.0	503.0	100.0

Table 4 shows the total costs by country, including the operational cost of the IICA Project in San José and the three countries as well as the funds channeled through the subgrants to the pilot projects in Panama, Bolivia, and Ecuador. Pilot operations absorb nearly $3.1 millions, or 68.4 percent of the total, of these, the largest share represents the sub-grants which amounts to nearly $2.2 millions, or 70.4 percent of the $3.2 million assigned to the pilot projects.Bear in mind that the $1.5 millions representing the Project cost in Costa Rica include not only the Project administration but also the research activity based in Costa Rica as well the financial supervision and control of sub-grants funds.

The larger amount absorbed by the operations in Panama is due to the early beginning of the sub-grant there (March 1979) since ISA was already operating when the Crop Insurance Project started. On the other hand, an extensive period in Bolivia and Ecuador was devoted to the creation and organization of the institutions before insurance operations commenced. ASBA was legally organized on July 1979, the General Manager appointed in November of the same year, and the insurance operations started only in mid-1980. CONASA was organized in October 1980, after almost eighteen months of preparatory work and negotiations with governmental authorities, field insurance operations began in mid-1981.

During the negotiation and organization period in Bolivia and Ecuador the only cost incurred were those of the IICA Project under the responsibility of the resident technician. The sub-grant disbursement began only after the agreements were signed on January 21, 1980 with ASBA, and on October 15, 1980 with CONASA.

TABLE 4. Project Costs by Countries

(thousands of dollars)

	Total Cost	Coordination Costa Rica	PILOT PROJECTS Panana	Bolivia	Ecuador
A. IICA PROJECT					
Personnel Costs	1,240.0	753.5	111.7	193.9	180.9
Operation Costs	990.0	681.4	98.1	96.9	113.6
Administration	290.0	174.5	26.5	46.0	43.0
TOTAL IICA PROJECT COSTS	2.520.0	1.609.4	236.3	336.8	337.5
B. SUB-GRANTS	2.160.0	-	951.0	706.0	503.0
TOTAL PROJECT COSTS	4.680.0	1.609.4	1.187.3	1.042.8	840.5

D. Functional Cost Analysis of IICA Project Components

The Crop Credit Insurance Project can usefully be divided into three basic functional components related to the accomplishment of Project's purposes. These components are the following

- Technical Assistance
- Economic Research
- Project Administration

Each function was charged with the cost actually incurred according with the accounting records, but in some cases a distribution had to be applied. Personnel costs were assigned based upon the nature of the duties of each person working in the Project. However, considering the reduced staff, some technicians worked on two or more functions. In the case of the Project Director, the cost of his salary and benefits were assigned in equal shares to Project Administration, Technical Assistance, and Economic Research, while the cost of the Financial Specialist was prorated evenly between Technical Assistance and Project Administration. The cost of the Project Leader in Panama was assigned in equal parts to Technical Assistance and Economic Research. The item, Other Direct Costs, was distributed to functions on a pro-rata base in the following manner:

Technical Assistance	50.0%
Economic Research	25.0%
Administration	25.0%

The scope and nature of each of the functions mentioned above are as follows:

Technical Assistance

Participating insurers in Panama, Bolivia, and Ecuador received technical assistance in the form of a resident advisor, who was assisted by Project Coordination specialists and by short term consultants hired to assist in specific matters. The multi-disciplinary nature of the Project makes it very difficult to appoint a professional who master such varied field such as insurance management, agricultural technology, finance, accounting, insurance law, and actuarial statistics so it was necessary to organize a comprehensive technical assistance by coordinating and integrating the work of the resident technician with the specialized expertise of other Project personnel and consultants. This function accounted for the largest part of IICA Project costs.

As can be seen in Table 5, the cost assigned to this function is $1,078,800, or 23.3 percent of the total Project costs and 45.5 percent of cost incurred in IICA. The funds assigned to the insurers are also included in Table 5 for comparative purposes. A large share of the Technical Assistance costs were the technical staff and consultants with a combined total or $700,900 or 65.0 percent of the function total cost. Field work accounted for a large share of the remaining 35.0 percent of the functional cost in the form of transportation costs and per diem allowance incurred by the resident technician. Less important items were support staff salaries, publications, communications, and general office expenses.

Economic Research

This function was designed to achieve the specific objective of research into the economic desirability and feasibility of crop credit insurance in the participating countries and the analysis of the benefits, feasibility and potential for crop credit insurance as

a development tool. Initially the project included a research activity in Mexico to conduct a financial benefit/cost analysis of agricultural credit policy and insurance, and a study of the impact of crop credit insurance on small farmer production, but this activity was soon cancelled due to unreliable information and a reluctance of the national crop insurer, ANAGSA, to discuss certain issues of their programs. Thus, the research effort centered on the three pilot projects, particularly in Panama and Bolivia, since the late start of the Project in Ecuador reduced the possibility of extensive research there.

As shown in Table 6, the total cost for Economic Research is $839,700, or 18.1 percent of total Project Cost. Technical staff and consultants totaled is $422,600 or 50.3 percent of research cost. Consultants' help was valuable to assist in the methodological design, while local manpower, included in "Other Direct Costs", helped in the field surveys. Data processing cost of $44,600 largely represents the amount charged by IICA for the use of its Computer Center.

Administration

This function includes the supervision by the Project Director, the financial management and control of the sub-grants and the reporting to AID/Washington about the Project execution and accomplishement.

The administrative function $456,500, or 9.8 percent of total Project Cost, or 19.2 percent of the IICA component, excluding the sub-grants. As mentioned before personnel costs in this function

TABLE 5. Functional Costs Analysis
(thousands of dollars)

	Total Cost	IICA PROJECT COST ANALYSIS			Operation of crop insurers
		Technical assistance	Economic research	Adminis- tration	
A. IICA PROJECT					
Personnel Costs	1,240.0	536.0	422.6	281.4	-
Consultants	309.1	207.1	96.0	6.0	-
Travel & per diem	327.6	81.9	114.0	131.7	-
Data processing	44.3	-	44.3	-	-
Other direct costs	309.0	154.5	77.3	77.2	-
Administration	290.0	125.4	98.8	65.8	-
TOTAL IICA PROJECT COSTS	2.520.0	1.104.9	853.0	562.1	-
B. SUB-GRANTS					
Panama - ISA	951.0	-	-	-	951.0
Bolivia - ASBA	706.0	-	-	-	706.0
Ecuador - CONASA	503.0	-	-	-	503.0
TOTAL SUB-GRANTS	2,160.0	-	-	-	2,160.0
TOTAL PROJECT COSTS	4,680.0	1,104.9	853.0	562.1	2,160.0
PERCENTAGE	100.0	23.6	18.2	12.0	46.2

include only part of the staff salaries and benefits, as they devoted part of their time to the other functions. Briefly it can be said that every effort was made to keep the administrative tasks at a reasonable level and reinforce the technical functions.

E. Annual Financial Planning and Control

During the Project it was important to have an annual planning system which could be useful to define the specific activities to be carried out and the financial requirements to perform and complete them. IICA has an operational planning system on a yearly base which to a large extent was adequate to provide guidance as to budgetary control and a yardstick to evaluate performance. In addition, IICA's accounting system provided a monthly statement which presents a comparison among budgeted and actual expenditure for each of the Project units in Costa Rica and in the countries. Adjustments to the Project's Operational Plan, when needed, were introduced by redefining activities and/or through the standard procedures for budget transfers.

Sub-grants disbursements to insurers follow a separate procedure as previously explained under the titles "Control of Sub-Grant Agreements with the Insurers".

The sub-grants agreements all had clauses stipulating the preparation of operational plans and periodic reports covering insurance, financial and administrative operations. In addition a frequent on-site supervision was carried out by the Project Director assisted by the Staff. These reports and visits were useful not only for the planning and measurement of performance, but also to

have a direct feeling on how the technical assistance was working and the need of help by other Project Technician or external consultants.

Finally, it could be said that the planning and control set up was important to reinforce the linkage of technical and financial assistance to the crop insurers, a relevant characteristic of the Project, and provide information on the achievements and results of both which could be used in internal and external reporting of the Project.

TABLE 7. Total Proyect Costs
(thousands of dollars)

	Total Project Costs	DISBURSEMENTS Actual as of Sept. 30, 1983	Estimated October 1, 1983 to the end of the Project	Total Project Costs %
A. IICA PROJECT				
Personnel Costs	1,183.4	990.4	193.0	25.5
Consultants	312.5	303.1	9.4	6.7
Travel $-per diem	304.3	278.3	26.4	6.6
Data Processing	44.6	40.6	4.0	1.0
Other direct costs	249.2	235.8	13.4	5.4
Administration	281.0	248.0	32.6	6.0
TOTAL IICA PROJECT COST	2,375.0	2,096.6	278.4	51.2
B. SUB-GRANTS				
Panama	1,009.0	861.0	148.0	21.7
Bolivia	721.4	648.4	73.0	15.5
Ecuador	536.6	412.8	123.8	11.6
TOTAL PROJECT COSTS	4,642.0	4,018.8	623.2	100.0

END NOTES

[1]The following table summarizes the ammendments to the basic grant.

GRANT AID/LAC/IGR-1297

AMENDMENTS

AMENDMENT No.	EFFECTIVE DATE	PURPOSE
1	09.29, 1978	Increase grant obligation $1,080,000.
2	05.30, 1980	Establish a biannually revised time phase implementation plan and travel regulations for project funded personnel.
3	07.14,, 1980	Increase grant obligation to $1,680,000.
4	09.30, 1980	Increase grant obligation to $1,839,000.
5	03.30, 1981	Change project objectives increasing to four the project assisted crop insurers regulate assistance to the Dominican Republic authorize the hiring of consultants from AGRIDEV, Israel, and increase Grant obligation to $2,489,000.
6	04.6, 1981	Administrative change to Amendment No. 5.
7	08.27, 1981	Increase grant obligation to $2,639,000.

8	12.22, 1982	Increase grant obligation to $3,936,000, and establish as conditions for further disbursements a valuation and an audited financial statements.*
9	08.17, 1982	Increase grant obligation to $3,936,000. Delete alterations to Standard Provisions and attach the Standard Provisions dates 2-82 superceding the previous issue.
10	04.22, 1983	Increase grant obligation $4,001,000.
11	09.30, 1983	Increase the estimated cost of Grant through September 30, 1984 to $4,687,000 and the grant obligation to $4,556,000. Establish a schedule for review and presentation of the Final Report and modifies the Financial Plan.
12	04.30, 1984	Increased grant obligation to $4.687,000 modifies Financial Plan.

*By letter of April 28, 1982 AID waive these conditions for one year, subject availability of adequate funds during 1983.

III. ORGANIZATION AND DEVELOPMENT OF THE COUNTRY PROGRAMS

III. ORGANIZATION AND DEVELOPMENT OF THE COUNTRY PROGRAMS

The organization and development of the country program is the heart of this experimental project. At the outset of the project (1978), an insurance program already existed in Panama. Both, Ecuador and Bolivia, had expressed interest in establishing crop-credit insurers as part of the AID-funded project but had taken no action to establish the insurers. Thus the project staff faced two quite different sets of circumstances. In Panama, an accord with an existing institution could be quickly negotiated. In the other countries, the staff had to begin the long, slow task of bringing insurers into being, assisting them to negotiate finances, to plan and initiate operations, and train staff from the manager down to the field inspector. Obviously different time scales applied in the two sets circumstances and, or course, given the history of frequent changes of government in Ecuador and Bolivia, the process could easily be delayed*. Below, we have discussed each country individually in a historical perspective. After reviewing the development of each of the country programs, to this historical narrative, enriched with the material produced by research provide the elements for policy analysis and conclusions.

A. Panama

The Instituto de Seguro Agropecuario (ISA) was established as part of the restructuring of the Panamanian rural sector following

*The possibility that one country or even two countries would not set up insurers was considered and Colombia and the Dominican Republic were prepared as alternatives. The latter was so enthusiastic about agricultural insurance that the government created the Aseguradora Dominicana Agropecuaria, C.A. (ADACA) in 1982 with only limited TA from the IICA team.

the 1968 Revolution. This restructuring produced a number of new parastatal institutions to meet the financial, marketing and technology development needs of the agricultural sector. One of the new institution that arose from this process was ISA. Together with a new agricultural development bank (BDA), a new marketing institute (IMA) and a new research and technology development and transfer institute (IDIAP), ISA was created to help increase rural income and augment production and productivity. These, in turn, were designed to help Panama reach self-sufficiency in food grains. Public Law Number 68 of December 15, 1975 established ISA as an autonomous public sector institution. ISA's board of directors was composed of the Minister of Agriculture, the Minister of Commerce and Industry and the Director General of ISA. In practice, the Minister of Agriculture and the Director made all important decisions, as the Minister of Commerce and Industry seldom played an active role. ISA's financial structure consisted of an initial "capital" of $1,000,000 in the form of a government guarantee together with another "full faith and credit" guarantee. No specific provision was made either for a reserve or a quantified subsidy.

ISA began operations with a small budget and two technicians. After orientation visits to the United States, Puerto Rico and Mexico, ISA began to collect weather data. Based upon this data, an initial premium of 5% was charged for the pilot insurance operations on corn and sorghum. Rice was excluded as the Ministry of Agriculture officials considered it too risky. The first year (1976/1977) nine policies were issued on these two grains. From the outset, ISA showed a steady pattern of growth, both in the number of crops and livestock options insured and the number of hectares covered by insurance. The increasing size of the portfolio managed

by ISA also showed a steady geographical diversification within the rather limited area under cultivation in Panama. By 1983, ISA insured rice,
corn, sorghum, beans (pilot stage) industrial tomatoes, onions, and was initiating coffee and melon insurance. In addition, nearly 14,000 head of livestock, both cattle and swine, were insured in seven provinces. The livestock coverages included feeder stock, semen bulls and breeding stock.

The ISA program was successfully targeted at small farmers and stock raisers because the insurance was obligatory for the clients of the BDA (although compliance was far from universal). These, in turn, were the smallest farmers in the official credit system. A survey conducted prior to the signing of the IICA/ISA subgrant agreement showed that 31 percent of ISA's policies were issued to farmers insuring 1-5 hectares, 31% insuring 5.1-10 hectares and only 10 percent insuring more than 31 hectares. About 50 percent of the insured farmers claimed assets of less than $10,000, while over 70 percent of the stockraisers reported assets of less than $20,000. Although these are far from a perfect measures, it is clear that most of the clients served were "small farmers" and thus eligible under the terms of the AID grant. It should be noted that many were on government "asentamientos". Those insured were in no way either primarily subsistence farmers nor landless renters or sharecroppers, they were instead a middle strata of semi-commercial, usually thinly capitalized, farmers reached by the network of government services to farmers.

On March 16, 1979 IICA and ISA signed a one year agreement to provide $156,000 in administrative support. In addition, technical assistance and training were provided directly by IICA. The basic purpose of this grant was to assist ISA to expand and improve its

insurance programs and to upgrade staff and equipment. Over the life of the project, the total amount granted under the agreements as renewed through 1983 was near $1 million.

The subgrant was very successful in expanding ISA's coverage. Following the signing of the ISA/IICA accord, the number of policies increased from 809 to 2,114 while coverages rose from $2.6 million to $8.1 million. Table 1 provides a summary of operations through the 1982/83 agricultural year.[1]

The research section of this report discusses at length the economic aspects of the Panamanian program and should be read in conjunction with this historical narrative. The Panamanian program as the oldest, largest, and most professional of the country programs offers an opportunity to study some of the policy implications of launching an agricultural insurance program.

1. Is agricultural insurance useful to small farmers and can it be provided at acceptable costs? This is really two questions. Based on the Panamanian experience, there is little doubt that agricultural insurance can serve farmers whose operations are small in size yet principally commercial in orientation. This group consisting of a middle strata of farmers producing primarily for the market and are firmly within the "modern sector". They are clients of the state agricultural lending bank and have usually adopted and adapted at least some modern technology. At the farm level, our quantitative and qualitative studies of "typical" farms indicate that the "impact" of insurance has a wide range of effects depending upon the agroecological niche the farm occupies. In low risk zones, insurance has slight impact. Insurance in zones with high natural risk produces a very substantial and easily measured changes on income variation and crop mix. The following table, Table 2, shows the effects of insurance under two sets of assumptions about the producer's risk parameters for a typical farm in Guararé. This area

TABLE 1. ISA, Operational Summary 1976 - 1982[1]

	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83*	Total
TOTAL PORTFOLIO								
Coverage ($)	25,898	1,129,579	2,636,498	8,121,592	12,114,208	13,449,904	16,556,766	54,034,445
Number of policies	9	351	809	2,114	2,722	2,785	2,854	
Indemnity ($)	1,588	17,784	102,462	194,642	402,143	969,270	2,859,941	4,547,830
Net premium ($)	1,165	58,723	113,815	331,567	519,579	761,812	910,662**	2,697,323
Loss ratio	1.36	.3	.9	.59	.77	1.27	3.14	1.69
CROP Insurance								
Coverage ($)	25,898	1,130,433	1,887,511	4,575,710	6,806,637	8,894,768	12,993,662	
Insured hectares	122	5,410	7,307	13,988	16,183	19,328	24,898	
Number of policies	9	351	525	1,284	1,446	1,796	1,827	
Indemnity ($)	1,588	17,784	93,731	130,451	290,013	753,969	2,727,222	
Net premium ($)	1,165	58,723	103,741	269,630	356,261	469,950	N/A	
Loss Ratio	1.36	.3	.9	.48	.81	1.65	N/A	
LIVESTOCK INSURANCE								
Coverage ($)			748,987	3,555,862	6,307,571	4,605,136	3,563,104	
Number of head			3,392	11,677	18,969	13,885	10,469	
Number of policies			284	830	1,276	989	1,027	
Indemnity ($)			8,731	64,191	112,130	215,301	132,729	
Net premium ($)			100,074	61,937	163,318	304,862	N/A	
Loss Ratio			.87	1.04	.69	.7	N/A	

*First Semester. The total indemnities show the amount paid to date. The total estimated loss exceeds three million dollars for 1982/83.

**Estimated at 5.5 percent of coverage, the same rate as 1981/82. It is quite likely that losses will exceed those shown, thus inflate the loss ratio. As of the date of this report, final data is not available.

TABLE 2. Impact Insurance in a Typical Farmer in Guarare, Los Santos Province

	Risk Neutral (Ø=0)		Risk Averse (Ø=1.0)	
	No insurance	With insurance	No insurance	With insurance
ANNUAL INCOME				
Average income ($)	4,719	5,235	4,234	4,685
Standard deviation	942	1,108	178	373
Variation coefficient (%)	20.0	21.2	4.2	8.0
SALES (Quintals)*				
Maize	186.1	702.0	10	361.7
Sorghum	35.9	136.1	-	3.1
Industrial tomato	587.0	337.1	565.4	584.7
Sweet pepper	-	-	31.3	5.2
Cassava	90.3	158.7	83.6	88.9
Milk (lts)	25,520	25,520	25,520	25,520
Meat (kgs)	8,700	8,700	8,700	8,700
INPUTS				
Labor	525	607	452	548
Non-insured credit ($)	4,569	3,165	3,344	3,178
Insured credit ($)	2,163	7,403	2,083	4,838

*1 quintal = 100 lbs.

is characterized by frequent natural hazards for the mixed small farm and livestock operations of the area. Income is higher with the insurance in both cases as insurance weakens the farmers' adversion to risk and leads him to produce more profitable but much higher risk crops, particularly corn and sorghum which are frequently hit by drought.* It does not follow however that insurance produces these changes. More likely, insurance goes hand-in-glove with the agricultural modernization process and supports it. Change in agriculture arises when a producer has an opportunity to respond profitably to a market opportunity. Credit, technology and insurance provide the means to respond. It is stretching logic to argue that insurance "induces" change. But that is not to say that insurance does not promote it, its presence appears to be an important element in the decision making process of farmers exposed to risk. It would be fair to say that insurance is an important financial mechanism for risk transfer and intertemporal income distribution for producers who are willing changing their cropping patterns to make their operations more profitable but are impeded by the real fear of ruinous loss. To the extent that producers move toward specialized (or monocultural) cropping patterns, insurance becomes increasingly useful. See the report on Panamanian tomato producers in the research section, for a concrete case of the demand for insurance capital-intense, monoculture farms.

The answer to the first part of the question as to whether insurance is useful to small farmers is a qualified affirmative. If risk is a significant factor, if other inputs are available (credit and technology) and if profitable opportunities exist, farmers can

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*Income for insured farmers is understated as insurance indemnities are not included. However, as most, if not all, of these funds go to the bank, they would be reflected in the debt structure which is not included in this table.

usefully adopt insurance to meliorate the risk of investing additional capital in more specialized production. The second part of the question as to whether it can be provided at acceptable costs is far more problematic and depends upon the particular circumstance. Insurance is a service whose cost of production depends upon numerous factors, including the riskiness of the environment; the manner in which the service is produced, and the ability of the farmer (or livestock producer) to pay the premium or, alternatively, of the government to absorb the cost.

In Panama, the agricultural insurance premium at the outset was 5 percent. Gradually as experience was accumulated, it was differentiated by crop and zone and ranged from 3 percent to 7 percent. It presently averages 5.5 percent while livestock premiums ranged from 1 percent to 10 percent. Producers in Panama almost uniformly claimed their premiums when added to their interest (of around 12 percent) pushed the cost of borrowing too high. Yet the true cost of insurance is considerably higher. As Tables 3 and 4 show, very few options in the ISA portfolio were charged a premium that reflected the true costs of indemnities and administration. Only three agricultural insurance premium rates are marginally above the cost of delivering insurance while some subsidies are over 90 percent. Much the same is true with the livestock portfolio. In fact, if we compare the premiums and indemnities in Table 1, we see that between 1976 and 1982, indemnities were 94 percent of premium income. With the catastrophic losses due to "El Niño"* in 1983 are included, premiums have been inadequate to meet even the cost of

*"El Niño" is a high pressure disturbance usually occurring around Christmas that affects weather in a large area from Central America to Chile. In 1983, it was particularly strong and affected agriculture from India costward across Australia to the Americas and finally even to Southern Africa. While it is a recurring phenomena, it reached record intensity in 1982/83.

TABLE 3. Producer Net Subsidy
Crop Insurance 1982

Province and Crop	Premium Rate 1981 - 1982	Loss Ratio Plus Administrative Costs	Percentage of Subsidy
RICE	0.05		
Chiriqui		0.0324	0
Los Santos		0.1333	62.5
Cocle		0.0927	46.1
Veraguas		0.0777	35.6
Panama		0.0395	0
MAIZE	0.05		
Chiriqui		0.1027	51.3
Los Santos		0.0530	5.7
Herrera		0.0874	42.8
Cocle		0.1133	55.9
Veraguas		0.6990	92.8
Panama		0.0451	0
SORGHUM	0.05		
Chiriqui		0.1123	55.5
Los Santos		0.3000	83.3
Herrera		0.3628	86.2
Cocle		0.1514	67.0
Veraguas		0.2750	81.8
Panama		0.6089	91.8
BEAN (Poroto)		0.05	
Chiriqui		0.3742	86.6
TOMATO	0.06		
Los Santos		0.1853	67.6
Herrera		0.1420	57.7
Cocle		0.1275	52.9
Veraguas		0.1385	56.7
ONION	0.06		
Los Santos		0.2773	78.4
Herrera		0.4937	87.8
Cocle		0.1810	66.8

TABLE 4. Producer Net Subsidy
Livestock Insurance
1982

Province and Purpose	Premium Rate Average 81/82*	Loss Ratio Administrative Costs	Percentage of Subsidy
FEEDER STOCK			
Chiriqui	0.0294	0.0489	39.9
Los Santos	0.0278	0.0475	41.5
Herrera	0.0296	0.0574	48.4
Cocle	0.0274	0.1605	82.9
Veraguas	0.0294	0.0607	51.6
Panama	0.0277	0.0830	66.6
SEMEN BULLS			
Chiriqui	0.0416	0.0392	0
Los Santos	0.0476	0.0389	0
Herrera	0.0400	0.0585	31.6
Cocle	0.0408	0.0116	0
Veraguas	0.0204	0.0446	54.3
Panama-Colon	0.0480	0.0591	18.8
BREEDER STOCK			
Chiriqui	0.0393	0.0414	5.1
Los Santos	0.0398	0.0369	0
Herrera	0.0395	0.0404	2.2
Cocle	0.0385	0.0532	27.6
Veraguas	0.0456	0.0406	0
Panama-Colon	0.0395	0.0597	33.8

*Premium rate average 1981/82 = (Earn premiums 81/82)/(Coverage 81/82).

indemnities by a large amount during the life of ISA. Subsidies have had to defray administrative costs and the difference between premiums and indemnities. Furthermore no reserve has been created to cover future losses. The government of Panama is liable for another or a series of large losses that will occur with essentially unknown frequency.

How much then does it cost to produce the insurance and who pays the cost? Again the answer depends upon numerous variables. In Panama, the administrative cost of insurance per unit has declined steadily as the program has grown. In 1982/83, ISA's operational budget subsidy was about $500,000 including the IICA subgrant. ISA issued $16.5 million of coverage. This implies that at present administrative the cost of producing insurance is approximately three cents per dollar of coverage.* Given that most of agricultural insurance administrative costs are the fixed costs of field inspections, the possibility of further reductions due to scales of economy are rather limited. Our work indicates that these costs under some rather optimistic assumptions can be lowered to around 1.5 cents per dollar of coverage without significantly reducing the throughness of inspections. In 1983 ISA had 2,854 policyholders for whom the administrative costs of about $175 per policy was paid.

*This is an average for the ISA portfolio. Administrative cost for the crop covers range from a high 7.5¢ per dollar for sorghum in Veraguas to .2¢ per dollar for rice in Cocle. Livestock insurance administrative costs range from 5.7¢ per dollar for feeder cattle in Cocle to only 0.64¢ per dollar for semen bulls in Veraguas. See Tables 7.a and 7.b Gustavo Arcia, El Seguro Agrícola en Panamá. Draft Nov. 24, 1983. Mimeo.

The average coverage per policy was around $5,000. Under Panamanian conditions, this cost could be reduced to about $85 - $90 per policy. That this 3 percent charge on top of an average (and inadequate) pure risk premium of 5.5 percent and an interest rate of 12 percent would prove to onerous if passed to producer merits careful consideration, especially when prices are kept artificially low. However, the 5.5 percent average premium is, at least in Panama, returned with "interest", thus it is a charge only to the years when no indemnity is received and over time is more than fully returned to the insureds. ISA operations have over the life of the project paid the insureds almost $2 million more than they have paid in. While there are certainly cases where invidividuals have been charges too much, as a whole farmers and stockmen have received considerably more than they have paid.

The administrative cost then is currently around 3 percent and the present premium rate around 5.5 percent. However, we have not yet calculated the cost of the implicit premium subsidy supplied by the government (and temporarily by the reinsurers). Over the life of the program, the data in Table 1 indicates that indemnities exceeded premiums by $1,850,507, or about 3.5 percent of coverage.* Thus, ISA's breakeven costs required an average premium and subsidies of 12 percent of the total amount of coverage, of which at present the insureds pay 5.5 percent and the rest (6.5 percent) is borne by the government. Under optimistic assumptions, about 1.5 percent of the government's contribution may be saved through economies of scale. Thus, if the past seven years are indicative of the future, it appears likely that ISA's costs--whether paid by the insureds or by subsidies--are likely to decline from the present

*This implies a pure premium (without administrative costs or a reserve capitalization fee) of 5.5 percent + 3.5 percent or 9 percent.

12 percent to around 10.5 percent of the average amount of coverage issued. The government of Panama also remains liable for any losses in excess of premiums.

Should future indemnities parallel those of the past seven years, about 9 percent (5.5 percent premium + 3.5 percent subsidy) will be transferred back to the farmers in the form of indemnities. The net result for farmers is then positive by 3.5 percent and the cost to the government for the operation of ISA will likely decline with economies of scale from the current 6.5 percent (3 percent administrative costs + 3.5 percent premium subsidy) to around 5 percent of the premium written (1.5 percent administrative costs + 3.5 percent premium subsidy).

Can a national government such as Panama absorb the cost of a nationwide program? In Panama we have estimated that the administrative and premium subsidy cost to the government is about 6.5 percent of the total coverage written. For 1982, the value of production of agriculture and stockraising was $178.5 million (stated in 1970 dollars).[2] Using the wholesale price index for the agricultural sector to inflate this data, the 1982 value of production in current dollars is $575 millions. If ISA were to insure coverage for 1/2 of the value of the agricultural sector's production, this would imply a current dollar administrative cost of $8.5 million and premium subsidy cost of slightly over $10 million. It should be noted that no country has yet created an insurance program of this size, including the U.S.; likewise, the new risks accepted could vary significantly from those presently insured. Still, $20 million annually is an approximation of the administrative and premium subsidy cost of a large nationwide program. That sum represents about 3.5 percent of the total value agriculture's contribution to the Panamanian GNP. While the cost is quite high, it would not appear to be unsustainably high.

This is the average annual cost of operating the insurer. However, the Government of Panama would also have to assume a contingent liability. In 1982/83 drought produced losses which reached 20 percent of total agricultural coverage. A loss of this magnitude with an insurance program covering one-half of the value of production would imply that the government would have to supply ISA with over $60 million. This is almost surely beyond the ability of the government when revenues are severely reduced without major cuts in other areas. The only alternative is to either capitalize a reserve through annual budget appropriations and/or charge a reserve capitalization fee as part of the premium. It is the nature of insurance that a major drought may strike long before the reserve is in place. So government, perhaps with some assistance from reinsurers, must bear this risk while the reserve is capitalized. In Panama, the major problem is not the average annual cost (assuming that ISA future losses roughly parallel those of the first seven years). It is instead that a larger program necessarily implies a very much larger catastrophic loss risk which is likely beyond the government's ability to meet during a crisis*. There is no theoretical problem in capitalizing a reserve to meet the contingency. The problem presented is essentially that it would be very difficult to maintain a reserve of this size intact.

It hardly need be pointed out that a large, relatively liquid reserve of this size is an enticement for governments. A very high degree of fiscal restraint would be required to maintain a large pool of money for a disaster that may occur many years in the future.

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*At a 5% premium rate, the Government of Panama implicitly accepts a contingent liability of $20 for every additional dollar of premium received by ISA.

Clearly the major shortcoming of the Panamanian program has been the failure to recognize and provide for catastrophic losses. Either the insureds must be charged an additional reserve capitalization premium or the government must put up a reserve to cover these infrequent but certain losses. One of the primary characteristics of an insurer is that it possesses a reserve, likewise, one of the principal responsibilities of the management is the stewardship of these funds. A basic principal of insurance is that management's performance is measured in part by its investment policies and by the fact that it does not accept risk at premiums which decapitalize reserves. Unfortunately ISA fails this test. In this sense, ISA is a pass-through device for monies that the government would have had to expend in other ways (i.e., recapitalization of the lending bank).

The Government of Panama launched ISA with no reserve and only $1 million in guarantees. For the first few years experience was good and the losses were less than premiums. From 1976 to 1982 losses exceeded premium in only one year. Based upon this experience, ISA was able to obtain commercial reinsurance on favorable terms (for 1981/82 and 1982/83) as well as capitalize a small reserve of about $300,000. When a major disaster struck, the guarantee, the reinsurance, and the reserve were inadequate. The reinsurance was lost as a result. The government of Panama was forced to find funds to meet ISA's obligations. A disaster of this magnitude is predictable--even certain. It is really only a question of when. While the theory for ruinous losses in other lines of insurance is not directly applicable to agricultural insurance (as there

is no statistical independence of loss)* it is easily forseen that an insurer concentrated heavily in cereal grains will at some point suffer a very large loss. Even the approximately $3 million loss on $13 million of agricultural coverage is not the worst case. Larger losses can be expected. Again, the relevant question is only when they will occur. Theoretically they could occur any time including the next planting season. Likewise, a series of smaller annual losses in several consecutive years could produce a cumulative loss of similar magnitude. If the Government of Panama is to continue to offer agricultural coverage, this financial contingecy must be confronted at the earliest possible moment.

2) A review of the affordability of insurance for small commercial farmers and for the government leads us directly to the second set of issues that arise from the PP. If, as the PP argued, agricultural insurance is useful to farmers and affordable for government (and upon which the Panama's experience casts some doubt), can it be successfully operated as a public sector enterprise? It was assumed in 1978 that the public sector was the only alternative, the project was structured on this assumption.

Several distinct considerations weigh in the judgement of the efficacy of public sector enterprise. Above we have argued that the Government of Panama took a major financial risk and suffered a heavy loss as a result. It is furthermore still exposed to the same or even heavier loss. As part of the public sector, the issue of

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*While one cannot reasonably imagine all insured autos or airplanes being damaged or destroyed at one time, this is exactly the predicament of agricultural insurance. At the present time, both the incidence (frequency) and severity of loss are unknown. The problem is complicated by the fact that data is inadequate and time series are too short. Certainly 10 years of experience is too short to estimate accurately, 20 years and more, probably 50 to 100 years of data will be required. In our research we report the first attempts to develop a premium calculation based upon primarily yield data supplemented by climatological profiles of production zones.

premiums has to some extent been a political issue. ISA and the government are well aware that many premiums are too low (see Tables 3 and 4) yet no explicit subsidy has been provided to cover this gap. Likewise ISA has been under substantial pressure to not either raise the premium or not insure some farmers who, due to their isolation, are very costly to serve. While it certainly can be argued on grounds of equity that insurance should be extended to these farmers, one cannot have both insurance and high cost without some- one paying. This ad hoc financing coupled with political pressure on premiums would not appear likely to produce a strong, viable, or self-financing institution. In other countries where this strategy of financial improvisation has been attempted, the results have been a total financial disaster. An extreme example of the results of this policy of politically influenced premium rates is to be found in Costa Rica where a small rice insurance program (2,000 policies) has produced losses of $24 million between 1970 and 1979, with one loss of over $4 million in 1982, due to inadequate premiums.[3] In Mexico, thought at the outset of the project to be a model, costs have exceeded one-half billion dollars per year!. Paul Crawford and J. D. Von Pishcke have argued, there is a very real danger that agricultural insurance in the public sector will be converted into a farm income support payment. This is particularly true when the political milage is realized today and the costs are deferred until a future and unknown date.

In Panama, this is in fact occurring, albeit to a lesser degree. The system is extremely exposed to politically mandated decision-making. Premiums are kept artificially low, finances are ad hoc and no provision for major losses have been made, despite one severe loss which made clear the inadequacy of the present structure. To the extent that political pressure has been brought to bear on premiums and coverages, it has not yet proved to be too costly.

However, optimism that Panama will not joint the ranks of insurers who have become covert subsidy channels is not warranted.

Finally, Panama's experience raises the question of the quality and autonomy of public sector management. In the case of ISA, the same manager has been in charge since its founding. She is a strong and competent leader although bounded both by political considerations as well as bureaucratic rules. These have proved to be severe restrictions. It is fair to say also that entrepreneurship has been severely limited by a restrictive law and prohibitions not imposed on other insurers (i.e., ISA cannot issue life insurance). Under these circumstances, management's task is increasingly difficult. The management of many agricultural insurers around the world, contrary to the ISA experience, show little interest in their bottom line and act in bureaucratic as opposed to entrepreneurial fashion. It is certainly desirable that this rather unusual situation of strong, competent, fiscally conservative (though politically bounded) management continue.

B. Ecuador

The creation of the insurance company, named "Compañía Nacional de Seguros Agropecuarios " (CONASA) was both a lengthy and ardous task.

At the outset, the project staff began working with the Ministry of Agriculture (MINAG), as agricultural insurance would logically appear to fall within the administrative domain of the MINAG. In February 1979, the Ministry and IICA signed a letter of understanding. In the letter the Ministry agreed to lead the inter-institutional working group responsible for creating the insurer while IICA would supply technical assistance.

The Banco Nacional de Fomento (BNF) since 1974 had been authorized to create and develop agricultural insurance.[4] The new Agricultural Promotion and Development Law[5] had, at the strong recommendation IICA's technical staff, included an article authorizing the MINAG to develop a pilot agricultural insurance project on an experimental basis.

After the presidential elections the negotiations for the creation of CONASA halted for a while under the new government, the process was again initiuyitM Iqi %&ef&ujW ulthough of interest to the government, did not have a high enough priority to be scheduled for congressional action within a reasonable time. The alternative was to build a concensus among the members to establish an insurance company using the traditional route of seeking approval of the Superintendent of Insurance and placing the company under the corporate and insurance laws of Ecuador.

The experience of the project staff had by early 1980 begun to point out the danger of a public sector insurer. Early project work in Mexico and the initial experience in Panama, coupled with an extensive world-wide review of existing programs carried out by AID/Washington pointed out the danger of public sector insurance quickly turning to disguised subsidy. This undercut one of the fundamental assumptions of the project, i.e., that the government could and should run the insurance program.

The project had been designed as a pilot project and as a learning laboratory. One of the first lessons learned was that with one exception (Puerto Rico--which as of this writing has ceased to be an exception), government-run insurance programs had proved to be covert subsidy programs with decision-making based as much upon political criteria as upon technical considerations.

It was a time for rethinking the original structure of the insurer. In early 1981, N. Maurice in a memo[6] noted the problem and proposed using either a private or mixed capital insurer to provide protection against what we then believed was sporatic, politically-motivated decision-making.

If in February 1981 it was possible to argue for mixed capital company, by October N. Maurice could based upon this intensive review write that the:

> "Key elements... are that the insurer's management be private sector controlled... and that government subsidies to the system be contracted, specific and limited... (not) open ended guarantees to pay excess losses."[7]

As existing programs were reviewed, it also became apparent that managerial autonomy was severely limited by situating an insurer within the Ministry of Agriculture. In Latin America, the Ministry of Agriculture tend to receive a very small portion of the budget (on average about 3 percent) and as a result is usually understaffed and its personnel poorly paid. It likewise has little experience in managing complex financial programs like insurance.

In Ecuador, it was not possible to change the design of the insurer and leave the public sector. The project and AID had acquired commitments to the goverment that had to be honored. Instead, the project staff was able to convince the Government of Ecuador to establish a mixed capital insurer.

On October 1, 1980, CONASA was created with 94 percent of government capital and 6 percent of private sector capital. The private sector capital was subscribe by the following organizations:

1. Central Ecuatoriana de Servicios Agrícolas
2. El Fondo Ecuatoriano Populorum Progressio
3. La Caja de Crédito Agrícola who transferred its stock to la Asociación de Ganaderos de la Sierra because under Ecuadorian law a bank cannot be a stockholder of an insurer.

The BNF agreed to make an annual contribution to provide capital and cover administrative expenses not met by the subgrant, while the Banco Central would gradually capitalize a reserve with annual contributions.

The mixed capital structure was intended to open up board meetings to outside scrutiny and to help bring a more systematic concern for the financial results of the company. The initial plan was to gradually dilute the govern- ment's participation by selling more stock to the private sector. In this fade-out venture, the government's participation would gradually decline until it become a minority partner. The government's role would be to function as the ultimate garantor of the insurance scheme--in effect a catastrophic reinsurer.

The operational results of three years of CONASA operations are summarized in Table 5. In three years of operation CONASA has produced significant losses.

Its agricultural portfolio is composed of potatoes in the north of the country, rice and soft corn on the coast, and hard corn in the mountains. Its livestock portfolio, although still quite small, is composed mostly of dairy stock. The losses themselves are worrisome but can be explained in part by adverse weather, especially in 1983, and premiums of 4-6 percent which are obviously too low. It would appear that just to meet the pure loss costs these rates would have to be doubled.

TABLE 5. CONASA: Summary of Operations
June 1981 - June 1983[8]

Concept	1981	1982	1983	Total
TOTAL PORTFOLIO				
Number of policies	44	143	187	374
Coverage (000 Sucres)	4.937.0	26.148.7	36.230.0	67.315.7
Premium income (000 Sucres)	293.5	1.303.9	1.807.9	3.405.3
Indemnity (000 Sucres)	191.8	2.502	3.308.7	6.002.5
Loss ratio*	0.65	1.92	1.83	1.76
AGRICULTURAL INSURANCE				
Number of policies	44	114	128	286
Number of insured hectares	190	1.869	1.913	3.972
Coverage (000 Sucres)	4.937	20.026	27.748	52.711
Premium income (000 Sucres)	293.5	1.022.2	1.373	2.688.5
Indemnity (hectares)	10.51	317	412	739.5
Indemnity (000 Sucres)	191.8	2.389.6	2.906.1	5.487.5
Loss ratio*	0.65	2.34	2.12	2.04
CATTLE INSURANCE				
Number of policies	-	29	59	88
Number of head	-	221	272	493
Coverage (000 Sucres)	-	6.122.5	8.482.0	14.604.5
Premium income (000 Sucres)	-	281.7	434.5	716.2
Indemnity (000 Sucres)	-	112.5	402.6	515.1
Loss ratio*	-	0.40	0.93	0.72

$*\frac{\text{Indemnity}}{\text{Premiums}}$

More troublesome is that in 1981 operational costs were about S./6 million and S./8 million for 1982. The 1983 budget is S./10 million.* For the last two years the administrative costs have been about 1/3 of the total coverage amd almost 6 times premium income. Another measure of the severity of the problem would be to calculate the cost per policy of CONASA's insurance. At the current exchange rate, it costs CONASA $630 in administrative expense to issue an average policy worth $2,280, exclusive of loss costs. It is clear that CONASA need that measures are taken immediately to reverse and dramatically lower both the administrative cost and the losses.

It is not necessary to repeat the exercise performed in the Panama section of this report. Neither the Ecuadorian farmers nor the government can finance a system characterized by heavy and steadily escalating administrative costs and the issuance of a handful of small policies at a premium rate far below the actual loss costs. Down that road lies financial disaster. It is fortunate that CONASA is still quite small. Under the present system, as the number of policies grow arithmetically, the potential--and to some extent actual--losses grow geometrically. While CONASA is still in the pilot stage, some of these excessive costs are certainly understandable, but at the same time vigorous action must be taken to counter the vicious cycle of a small number of policies coupled with steadily increasing overall costs and a very high loss ratio.[9]

What can be learned from the Ecuadorian experience? It has been argued that agricultural insurance could reach and serve small farmers at an acceptable costs. The reality is that indeed it can reach small, principally commercial, farmers but cannot reach

*The Sucre exchange rate has gradually changed from S./24 to $1 to around S./85 to $1 between 1981 and 1983.

small, primarily subsistence, farmers at acceptable costs. Beside seeing insurance as a "service" to the agricultural sector and continue to emphasize the socio-economic benefits of extending coverage to small farmers, the inclusion of larger farmers and coverage of assets (machinary and buildings) and producers lives, can contribute to stabilize the financial performance of the portfolio and in this way CONASA could improve somewhat the operating results by including them in its insurance program.

It appears highly recommendable at this stage that CONASA redefine its market, vigorously sell its products, design new coverage for rural areas, develop realistic premiums based on an improved understanding of agricultural risks and upgrade some areas of management, specially operative and financial planning, in order to gradually bring healthier financial condition making possible a sustained growth and reducing its dependence on government subsidies and/or external aid.

C. BOLIVIA

The interest in agricultural insurance in Bolivia has a long history. In 1950 the Bolivian Congress enacted a law providing insurance against hail in the wine grape growing areas and provided for funds to cover the cost of the program. The insurance was to be administered by the Banco Agrícola de Bolivia. For reasons that are not clear, the program was never set up and the law was revoked in August 1953. One may assume that given the political instability of the time, it proved impossible to establish the program.

The issue of agricultural insurance lay dormant until 1967 when a special commission was created to prepare a hail insurance program in three month period. On September 7, 1967 the office of Agricultural and Livestock Insurance as part of the Ministry of Agriculture began operation. It operated only six months and then closed due to lack of funds.

Ten years later, in 1977, when USAID/Washington sent a person from Washington to discuss mounting a program, the Bolivian government was quite receptive to the idea. This was especially so since the model proposed, crop credit insurance, appeared to obviate one of the most severe problems of the two previous attempts to mount a program. Data on production, yields, and prices were virtually non-existent. As crop credit insurance insured part of a far more easily quantifiable and verifiable crop production investment or loan, the statistical demands appeared to be obviated. As the AID-funded program contemplated financing administrative costs and providing a reserve through P.L.480 to cover losses in excess of premium, the other major problem that had produced the failure of previous attempts was also solved.

The following year, on May 31, 1978, the U.S. Government and the Bolivian Ministry of Peasant Affairs and Agriculture (MACA) signed a P.L. 480 Title III agreement which provided a 25 million Bolivian Peso (approximately $1 million at the then prevailing exchange rate) reserve for a yet-to-be created insurer within MACA. This finance would cover any difference between the premium collected and the actual losses for the 1650 small farmers insured during the four year life of the pilot project.

A series of rapid changes in the government of Bolivia made it necessary to go through extended negotiations with several governments. An agreement was finally reached on July 11, 1979. The insurer, Aseguradora Boliviana Agropecuaria (ASBA) was established by a decree law. Its legal structure was a public sector institution with its own administration and assets but under the tutelage of MACA.

The actual structure of ASBA was somewhat different than that initially envisioned. In the process of negotiating it became quite apparent that a section within MACA could not effectively mount the

insurance program due both to the then current weakness and disorganization of the Ministry as well as the desire of several successive governments to use the insurer's P.L. 480 reserve to help reduce the level of rural discontent. As in Ecuador, it was not possible to back away from MACA entirely as understandings had been given and accepted.

To enable the insurer to function as autonomously as possible, it was structured first as an autonomous public institution. Its board of directors was weighted to mitigate the likelihood of political decision-making. The Ministry of Agriculture and the President of Banco Agrícola de Bolivia (BAB) represented the government; three seats were given to the cooperative movement and a swing vote seat to a represen- tative of the executive secretary of P.L. 480. Furthermore, an Executive Commission composed of one representative of the Board, the Manager of ASBA, the legal council of ASBA and the IICA technical advisor was created. This Executive Commission would oversee the daily workings of ASBA and would meet far more frequently (in fact, informally on an almost daily basis) than the Board.

In fact, what was created in Bolivia out of the demands of the political sector for insurance, was a largely autonomous management-run company. In legal fact, it was subject to the guidance of MACA, in reality the management had considerable autonomy. As a result, ASBA was able to operate with none of the personnel movements following government changes. ASBA was, however, far from a private sector insurer as its personnel from management down were under the public sector personnel rules. There were few incentives beyond personal satisfaction to promote empresarial behaviour. As in Ecuador, the project staff had modified the initial conception of the program in response to the conditions encountered. The problem of politically motivated decision-making was perceived although certainly not in all of its

ramifications. Likewise, there was a partial awareness that bureaucratic management could poise a problem. Both in Ecuador and Bolivia a partial answer was to bring in private sector members to help dilute the control of the insurer. In Bolivia, another layer in the form of an executive commission was added as further insulation for management.

In general, we believe that this structuring was relatively successful in containing political pressure on premium rates and on loss adjustments. There were sporadic attempts to override technical decision-making but no sustained effort until the project was several years old. As ASBA became larger and more visible, and as the project staff gained first-hand experience in other countries, it appeared increasingly likely that ASBA would come under pressure, if not directly from the government then from the insureds mobilized to pressure the government to force ASBA to pay unjustified indemnities after a disaster. Indeed, several attempts along these lines were made.

At this point, it is perhaps valuable to point out the very fragile financial balance that characterizes insurance--and particularly agricultural insurance. We earlier pointed out that agricultural insurance is a catastrophic loss business and that there is no independence of loss. Everyone can and frequently does lose at once. A new agricultural insurer, in return for a small premium (in the case of ASBA 5 %) accepts a contingent liability many times greater (20 times greater in the case of ASBA). Unable in its first years to obtain reinsurance, all this risk must be borne by the insurer. This situation in turn dictates a very cautious approach to selection of risks and adjustment of losses. Even very small changes in either underwriting (risk acceptance) and loss adjustment (indemnity payment) may be the difference between breaking even or adding marginally to the reserves and a disasterous decapitalization. There is very little room for mistakes and almost none for

TABLE 6. BOLIVIA, Cumulative Experience of ASBA

AGRICULTURAL INSURANCE

Year	No. of insureds (A)	No. of hectares (B)	Coverage ($B) (C)	Premium ($B) (D)	Premium Rate	Indemnity (E)	Loss Ratio $\frac{E}{D}$
1980/81	50	33-25	1,079,280	53,964	5%	0	0
1981/82	96	128.76	4,169,300	214,948	5%	315,800	1.47
1982/83	926	2,270.06	66,667,896	3,340,943	5%	8,237,655	2.47
Total	1,072	2,432.07	71,916,476	3,609,855	5%	8,553,455	2.37

LIVESTOCK INSURANCE

1982 - June 30, 1983

Number of head (A)	Coverage ($B) (B)	Premium ($B)	Premium Rate	Indemnity ($B) to date	Loss ratio
99	6,286,000	314,300	5%	173.188	.55

LIFE INSURANCE

1982 - June 30, 1983

Number of Insureds	Coverage ($B) (A)	Premium ($B) (B)	Premium Rate	Indemnities ($B)
1,660	216,175,159	1,707,753	.79%	289,680

In terms of complying with the conditions contained in the P.L.480 donation, ASBA had in three years and against very considerable obstacles, such the virtual closure of the BAB, already reached more than the 1,650 the farmers forseen for the four year life of the project. The geographical spread of risks had reached all the important agricultural areas of Bolivia . While insurance remained concentrated in potatoes and corn, the staples of the Bolivians diet, experimental coverages were being developed for 17 other fruits, vegetables, cereals, and tubers. This expansion is largely a result the ability of ASBA to cover losses through the P.L.480-donated reserve while AID-IICA grant provided $720,000 of administrative support and near $340,000 of technical assistance. This assistance in no way detracts from the very impressive performance of ASBA. The Bolivian program utilized the grant resources as they were intended an produced an expanding program.

There is another aspect of the successful Bolivian program that must be discussed before it is possible to reach a judgement. If the field operations, sales and new product development were marked successes, financial performance was not. Quite early in the program it became apparent that two emerging trends could destroy the insurer.

First, premiums were inadequate and management's response was too slow. It was clear from the research surveys and from the operations that a 5 % premium was too low for rainfed agriculture in the Bolivian highlands. The expan- sion to other areas and crops was a partial response but the funda- mental painful reality of an inadequate premium was not addressed, in part, one suspects, because doing so would slow the growth of the program to an extent that it could not reach its goals, those contained in the P.L.480 Grant. The losses given the size of the program were not substantial but

the loss ratio was over 2 and apparently increasing, although the experience is too short to draw a firm conclusion. This tentative results indicate that twice as much premium would be required to break even.*

Second, and far more serious, was the impact of accelerated devaluation on the real value of the reserve. This reserve was initially worth about $1 million at the then prevailing exchange rate of $b24=$1.00. Today the rate is near $b2.000=$1.00, and the reserve is worth only a fraction of its former value. The reserve of $b25 million has grown to $b40 million while the dollar value has fallen from $1 million to about $20,000.00. While investments in real estate increase the reserves by another $30,000.00, the sad fact is that a $1 million reserve is now worth 5 % of its initial value.

As a result of this massive devaluation and the fact that ASBA's reserve was invested in peso-denominated securities, ASBA can not continue to function as an agricultural insurer. Without a recapitalization, ASBA can not insure more than a few hundred farmers. While ASBA can continue to insure lives and cattle, as reinsurance is available, its ability to continue insuring crop credit has for practical purposes ended.

While such a massive devaluation could not have been forseen, it does point out a very serious problem of insurance. A substantial part of the reserves of an insurer must be in hard currency or assets (such as real estate) whose value keeps pace with inflation and devaluation. In the case of ASBA, as a public sector enterprise

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*It would appear that the figure is nearly three times as much premium but this disregards both high rates of inflation and high interest rates which produces substantial revenue. Even in the best of cases of 10 % premium on top of a high interest rate would make it difficult to sell coverage.

it could not hold hard currency. This problem was only solved in September 1982 when a decree authorized the transformation from a public sector entity to a private sector mutual company. It was almost a year later when the process was completed. By September 1983, very little was left of the reserve to convert to hard currency. On the other hand management had to invest part of the reserve in short term fix yield instruments available in the limited bolivian capital market, instead of less liquid more devaluation proof alternatives, because it had to respond quickly to claims when damages occur.

Drawing a clear picture of the Bolivian experiment is made difficult both by the short life of ASBA and the turbulent time in which it was founded. Still, there are several very important facts which should be noted.

In Bolivia, as in Ecuador and Panama, the project has found a large and unexpected demand for livestock coverages. Likewise, credit life insurance has been eagerly sought. Both of these covers are essentially the same in that they pay a death benefit. They are characterized by an ease of administration, lower inspection costs, almost automatic loss adjustments, relatively long policy lives and, with few exceptions, stable and reasonably predictable loss ratios. They also have the advantage of building up a reserve, thus providing a new source of investment capital. These covers could form the basis of a rural insurance company's portfolio. The products could be priced to reach a large market even when administrative costs are included. Both are easily reinsured. In fact, ASBA was able to obtain reinsurance from the outset for both the credit life and the livestock portfolios. Both should prove to be profitable. The challenge of moving these products into the rural areas is primarily one of marketing. They do not entail the complications of agricultural insurance business--as the insured, be

it human or animal, is either dead or alive. Nor is there the same degree of moral hazard as with agricultural insurance. Any future insurer operating in the rural areas would be well advised to begin with traditional insurance products such as life and livestock and gradually expand to other coverages such as casualty insurances (fire, machinery, etc.) before beginning to experiment with catastrophic agricultural covers characterized by stochastic (or at least unknown) variations in the loss ratio.

Second, an issue to arise from the Bolivian experience is that of adequate premiums. It is clear that many types of agriculture are inherently so risky that there may be no adequate acceptable premium. In the case of Bolivia, ASBA will begin to charge a 15 percent premium for rainfed agriculture in 1983/84. On top of a high interest rate, this will certainly be burden for the farmers. But, the simple fact is that even this rate may prove to be inadequate for large areas of highland Bolivia. "All risk" insurance in many cases is a substitute for the lack of infrastructure. While freezes and hail are unpreventable, drought can usually be prevented by irrigation as can floods by drainage. Yet, all risk insurance usually covers these hazards. If farmers had to pay the true cost, the premium would probably reach unsupportable levels. If these risks are removed, premiums can be halved, in the case of Bolivia to about 7.5 percent.* Yet it is precisely these risks that most affect farmers. It would appear questionable whether as a matter of public policy or sound business practice insurance should be used to salve the consequences instead of attacking the root cause--a lack of infrastructure. It is informative to note that there is a substantial body of opinion in agricultural insurance that certain risks are uninsurable. The

*These rates are the loss costs only, administrative costs are paid by the IICA-ASBA sub-grant. Without this support these rates would have to double at a minimum.

argument in Spain and France, for example, is that drought cannot be insured. A variation of this argument in Switzerland and Puerto Rico is that agricultural insurance should begin with a few limited risks (named perils) and gradually expand into other risks as experience is gained. The Bolivian experience seems to give further strength to this approach.

Finally in Bolivia and by analogy in many countries in similar circumstances, agricultural insurance simply put cannot serve the vast majority of small farmers. Its administrative costs are so high that is requires an administrative and premium subsidy of a very substantial magnitude. In Panama, farmers are relatively concentrated geographically and accessible. In Bolivia, the opposite is generally true. The terrain of much of Bolivia is so difficult that it appears unlikely that the administrative costs can be lowered to the present level of Panamanian costs, let alone aspire to reach a self-financing stage. While it is not possible to generalize from either the Panamanian or the Bolivian case, it is valuable to note that there is an inverse correlation between farm size and accessability on the one hand and administrative costs on the other.

One way of dealing with this problem would be to use existing multilines (casuality and life insurers are usually not separate companies in Latin America) to offer agricultural insurance (probably named perils), livestock insurance and other traditional products in the rural sector. The head office cost varies only marginally and the field man can sell a wider range of products thus reducing the administrative cost per policy. Whether this proves to be an adequate vehicle for moving agricultural insurance is open to trial and experimentation. What is clear is that a new company offering a limited product line to small farmers in developing countries will incur administrative expenses which in most cases cannot be borne by premiums.

D. Other Countries

The project's staff was able to assist several other western hemisphere countries. The funds for these collateral activities were derived from the overhead that IICA received from the project. IICA at the outset of the project decided to program part of its overhead to assist other countries which were not included in the project.

From 1980 to 1984 the project staff provided technical assistance to three countries which subsequently initiated programs. In December 1980, Venezuela established Agroseguros to insure the loans of farmers and cattlemen. The Venezuelan program has begun insurance operations but has in its first years confronted both bad weather and a 300 percentage devaluation. In 1983, the Dominican Republic set up the Aseguradora Dominicana Agropecuaria (ADACA). As of this writing ADACA has not initiated insurance operations.

The third country assisted by the project staff is perhaps the most interesting. In Chile, a private insurer, the Consorcio Nacional de Seguros, established a pilot insurance program on export fruits in 1982. The program was run on a for-profit basis. It was heavily reinsured in the London market. The first year it suffered substantial losses. The second year it showed a profit. At present the program is expanding to include cereal grains in its portfolio, and with another favorable year, should recoup its start-up costs.

This is perhaps the first experimental venture by a private company into agricultural insurance in Latin America. The scheme began by insuring large, well-run farms with yield records. In areas prone to drought, only irrigated land is insured. The coverage while broad is still specific risk or named peril. Approximately 2/3 of the expected yield is insured. The premium

rates as well as the expected yields are adjusted annually to bring them into line with the farmer's experience. Almost all of the technical services are contracted from private consulting firms. The small staff of the insurer checks the loss adjustments as well as recalculating the coverage that will be offered for the following year based upon the yield records that farmers must submit with their applications.[10]

With only two years of experience, it is premature to evaluate the scheme. However, there are several salient features that would recommend themselves to others contemplating initiating a program. First, the scheme was designed from the outset to be heavily reinsured. This had the dual advantage of protecting the insurer against a large initial loss (as indeed occurred) and protecting the insurer's reserve against devaluation (which also occurred). By paying a reinsurance premium the Consorcio was relieved of the obligation of holding a large Peso reserve, when losses occurred, the reinsurance indemnity was paid in hard currency which was converted at the new devalued rate to pay the indemnities. Lest this appear detrimental to the insureds, it should be noted that both premium and indemnities are stated in price level-indexed Development Units (Unidades de Fomento).

Chile's Consorcio Nacional de Seguros recognized from the outset that inspection costs were a major obstacle to reaching a very large market. The choice was essentially to seek niches in the overall agricultural sector that was able to pay these costs as part of the premium or to follow a more risky strategy of using fewer inspections to reach a larger market. The former was selected.

The Consorcio has contracted to pay 4.1 Unidades de Fomento (U.F.) per inspection. The current value of a U.F. is about 1,900 Chilean Pesos. With an exchange rate of 115 to one, each inspection

costs about 68 dollars. While the number of inspections varies depending upon whether or not the farmer suffers a loss, an average number of inspections would be about 1.75 per policy per year, implying an inspection cost of about 120 dollars. This 120 dollars cost is lower than the $175 figure we cited above in the Panama section. However in Chile the amounts insured per policy were many times that of Panama, thus the inspection cost per dollar of coverage was only a fraction of the 3 cents per dollar of coverage in Panama. In comparing the two cases, we can see very clearly that to a very large extent the cost of doing agriculture insurance is largely structured by the cost of inspections and that there is an inverse, and probably proportional, relationship between the size of the farm insured and the administrative cost per unit of insurance coverage.

A final observation on the Chilean program is that it reflects an apparently growing consensus that drought may not be an insurable phenomena. The French among others have long held this view. The Bolivian program has tripled premium from 5 percent to 15 percent for rainfed lands and the Chilean have found that droughts are so severe and extensive as to make it commercially impossible to sell a policy whose premium is weighted for the loss cost of droughts. Drought is not however totally excluded. It is covered in zones where irrigation has been installed but where the supply of water may infrequently proves to be inadequate. The premium for drought in unirrigated areas would have to be too large to make the policy commercially attractive to producers. Even if it could be sold, the insurer would require many years to build an adequate reserve. The reinsurers in London also showed similar reluctance as at an international level, the problem is the same as at the national level, drought is both catastrophic and widespread. For a reinsurer no spread or risk, however well spread around the world, would have been adequate for the losses arising from the "El Niño" phenomena.

End Notes

[1]The tables in the Panama section are adopted from Gustavo Arcia, El Seguro Agropecuario en Panamá. Mimeo, 1983 except for table 2 which is table 2.10 from the research section of this report.

Additional background information can be found in the following sources:

Arcia, Gustavo. Agricultural Insurance in Panama, Institutional Design and Portfolio Management. AGROCRED No. 14-82, July 1982, IICA, San José, C. R.

_______________. "El Seguro Agrícola en Panamá", typescript marked "Draft", Nov. 24 1983. Dr. Arcia is currently at RTI in Raleigh, N.C.

_______________. El Seguro Agropecuario en Panamá, (revision of the above) submitted to USAID/LAC/DR/RD, March 1983.

Washington Evaluation Associates Consulting Service, Evaluation of the LA/C Crop Credit Insurance Systems Project (598-0597) under contract No. 53-319 R-1-9 submitted to USDA/OICD, February 16, 1981.

ISA, Memoria, annual publication, ISA, Panama City, Panama.

República de Panamá, Ley No. 68 (del 15 de diciembre de 1975). Ley por medio de la cual se crea el Seguro Agropecuario y el Instituto de Seguro Agropecuario

[2]Banco Nacional de Panama. Informe Anual, 1983, p.25.

[3]William M. Gudger. Agricultural Insurance in Costa Rica, mimeo, San José, C. R., 1982.

[4]Art. 105, La Ley Orgánica del Banco Nacional de Fomento. Ecuador, Marzo de 1974.

[5]Art. 108, La Ley de Fomento y Desarrollo Agropecuario, Ecuador Marzo de 1979.

[6]Memorandum, "Briefing: Crop Credit Insurance Project", February 1981.

[7]Memorandum, "Status of the Crop Credit Insurance Project", October 30, 1981.

[8]Summarized from Luis Avalos, El Seguro Agrocrediticio en Ecuador, Quito, August 1983. Mimeo.

[9]An extendend, largely positive, evaluation of the Ecuadorian program is Gustavo Arcia, Michael Bronson, and Mitchell Cohen, "An Evaluation of the Compañía Nacional de Seguros Agropecuarios (CONASA)" prepared for USAID, LAC/DR/RD, May 5, 1983, typescript.

[10]An excellent description of the normal curve theory that forms the basis of the premium rate making is found in Ricardo Blanco Martínez, et.al., Desarrollo de un Producto de Seguro Aplicable al Sector Frutícola. Mimeo, Santiago, Chile, 1981.

IV. INSURANCE AND FARMERS

IV. INSURANCE AND FARMERS

A. Introduction: Setting the Hypothesis

B. Risk Exposure and Management by Small Farmers

C. Attitudes Towards Compulsory Insurance

D. Information and Time Perspective in the Demand for Insurance

E. Evaluating the Demand for Insurance under Different Attitudes Toward Risk

F. Credit, Insurance, and Technical Assistance on Technology Adoption and Income Stabilization

G. Insurance Demand Under Guaranteed Prices and High Financial Risk

H. Conclusions and Policy Recommendations

4. INSURANCE AND FARMERS

A. Introduction: Setting the Hypothesis

Agricultural production has always been a risky process, yet farmers have done it for centuries adjusting to risks by several means. It was with the advent of the development philosophy of this century, that a public concern emerged to offer protection for agricultural risks. The extent of the efficiency of public intervention to reduce risks or to increase the farmers capacity to manage them has been questioned (see for example Jhoda and Walker, 1983). But, to understand the possible effect of risk management alternatives it is proper to begin with an analysis of agricultural risks, and farmers attitudes towards them, as well as the implications for resource use, production and income.

Risk and uncertainty have been used synonymously in agriculture, yet it may be useful to recognize the slight difference. In principle production under risk implies that the farmer knows the expected value and probability distribution of his outcome. We could, to simplify, just say that production under risk implies that the farmer knows' the expected outcome and variability because of his own experience or from that of those wh he trusts. This is for example, the case of traditional varieties, cultivated with the farmer's own (or his ancestors) technology, where the risk emerges from those factors the farmer can not control. Yield inherent to agricultural production.

Uncertainty implies that the farmer does not know from own experience of from those he trust, about the expected outcome and its probability distribution. It is this uncertainty which has inhibited the adoption of new technologies. Researchers and extensionists claim that new technologies always have a larger expected value, yet they are less prone to recognize that almost always such technologies have a larger variance of output.

Risk in agriculture has always existed and it originates from many sources, yet some sources of risk have become more significant and some have different impacts depending on the farmers characteristics and activities in which they engage. Also, some risks are manageable while other are not, yet avoidance is in some cases possible. Figure No.4.1. shows the main risks in agriculture and their possible interrelations with government policies. This identification of risks and alternative policy options is important to latter recognize the potential benefits of insurance.

To the extent that production is marketed, price risk is relevant in determining the value of production income. But also considering that in the case of small farmers, the level of utility is a function of consumption (and not of production), higher prices, when production is lost, mean less consumption and hence less utility. The above reflects, the complexities in apprassing the benefits of price variability in farmer's utility, further conditioned by the correlation between yields and prices. As far as the generation of agricultural production income, farmers are said to be affected negatively by the instability of prices, hence the desirability for price stabilization policies or price guarantee programs. Much debate exists however, in relation to the long term effectiveness of such policies in terms of gains to producers and to society.

Production risks are probability the most important ones as they affect yields as well as areas harvested. In some cases production is totally lost in part or the total area, while in other cases, the yield is not totally lost, but all the area planted might be affected. Production risk originates from climatic instability, disease, pests or a conjuctive action of the above. All those could take the form of a catasthrope and result in total loss. In many cases, the characteristics of the soils and the absence of infraestructure, like drains or soil coverage, agravates the effects

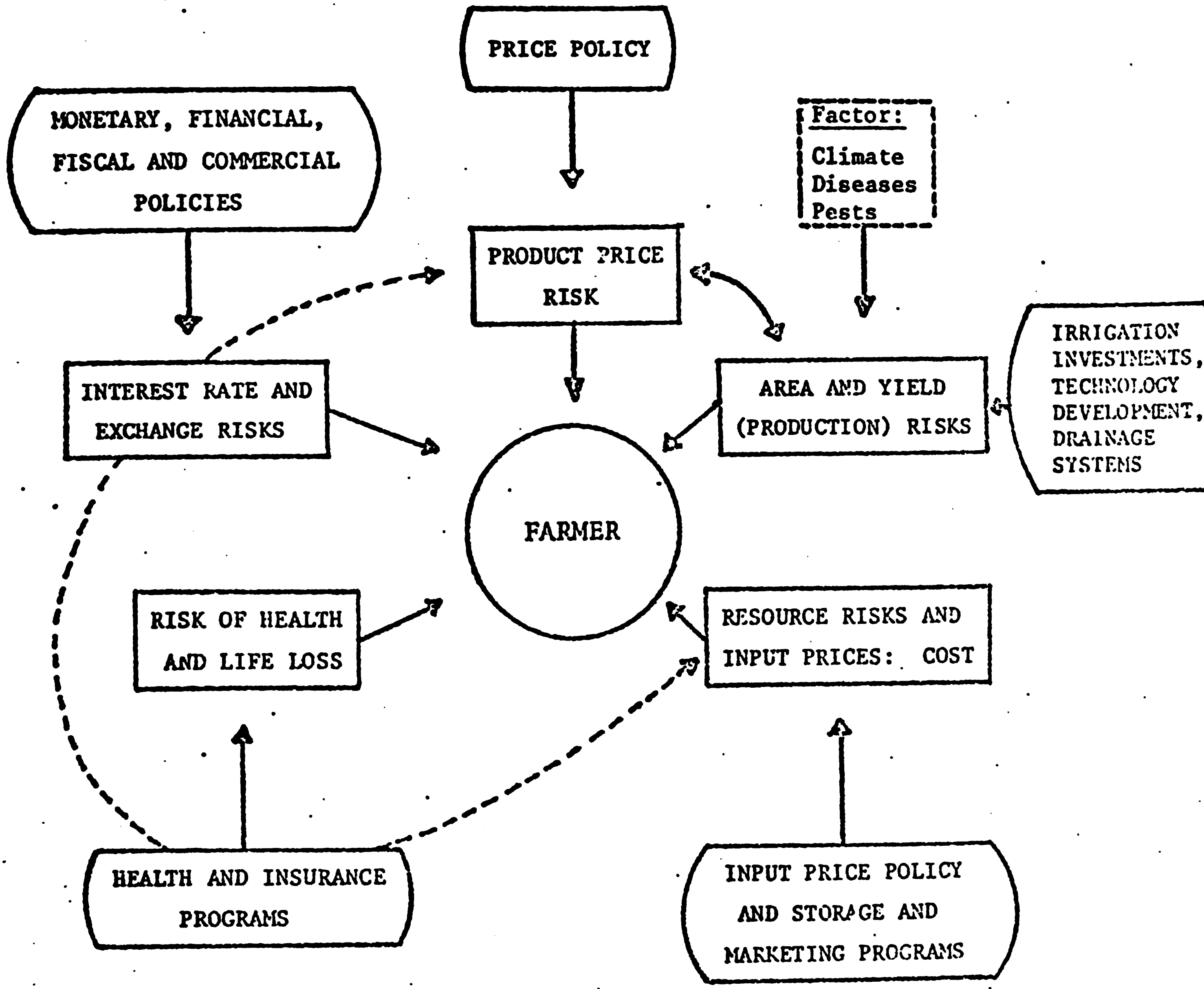

Figure 4.1. Agricultural Risks and Public Policy Alternatives for their Management

of excess rainfall, while in other cases the types of crops grown are not drought tolerant. In any event, these disasters usually affect crops differently depending on the specie, variety, stage of growth and small variation in ecological conditions. Considering the above, diversification by crops, varieties, time of planting, furrow spacing, etc., are important means of risk spreading.

In the analysis of production risks it is fundamental to know the time distribution of disasters as well as their intensity. Droughts and floods are two of the most commonly identified risks, yet there are drought prone areas where the availability of soil humidity during most of the years is below the minimum necessary for plant and fructification, hence harvests are never at desirable levels and will never be, unless more water is available. In other cases, topography, depth of cropping soil, thickness of subjacent impermeable strata and the absence of drains, determine that even with small amounts of precipitation, and excess of humidity acts in detriment of plant growth. In many cases this rapidly leads into problems of sanilization of the soils. Also in these cases no healthy crops will ever be grown, unless a drainage system is constructed or subsolation is practiced. Furthermore, it is likely that the problem of salinity will deteriorate over time. Irrigation and drainage would increase not only the average yields but the probability of a attaining them, not to mention their positive impact on the marginal productivity of other inputs.

The yield distabilizing effect of weather, diseases and pests is difficult to isolate from that of inadecuate policy incentives or just unfavorable economic conditions. Nevertheless in the analysis of yield variability it is important to observe its pattern over time to determine is insurability. Four cases are presented in Figure No.4.2. Cases A and B reflect usual yield instability because less than ideal conditions, but this could be considered normal. However, we can point out that if A and B were different

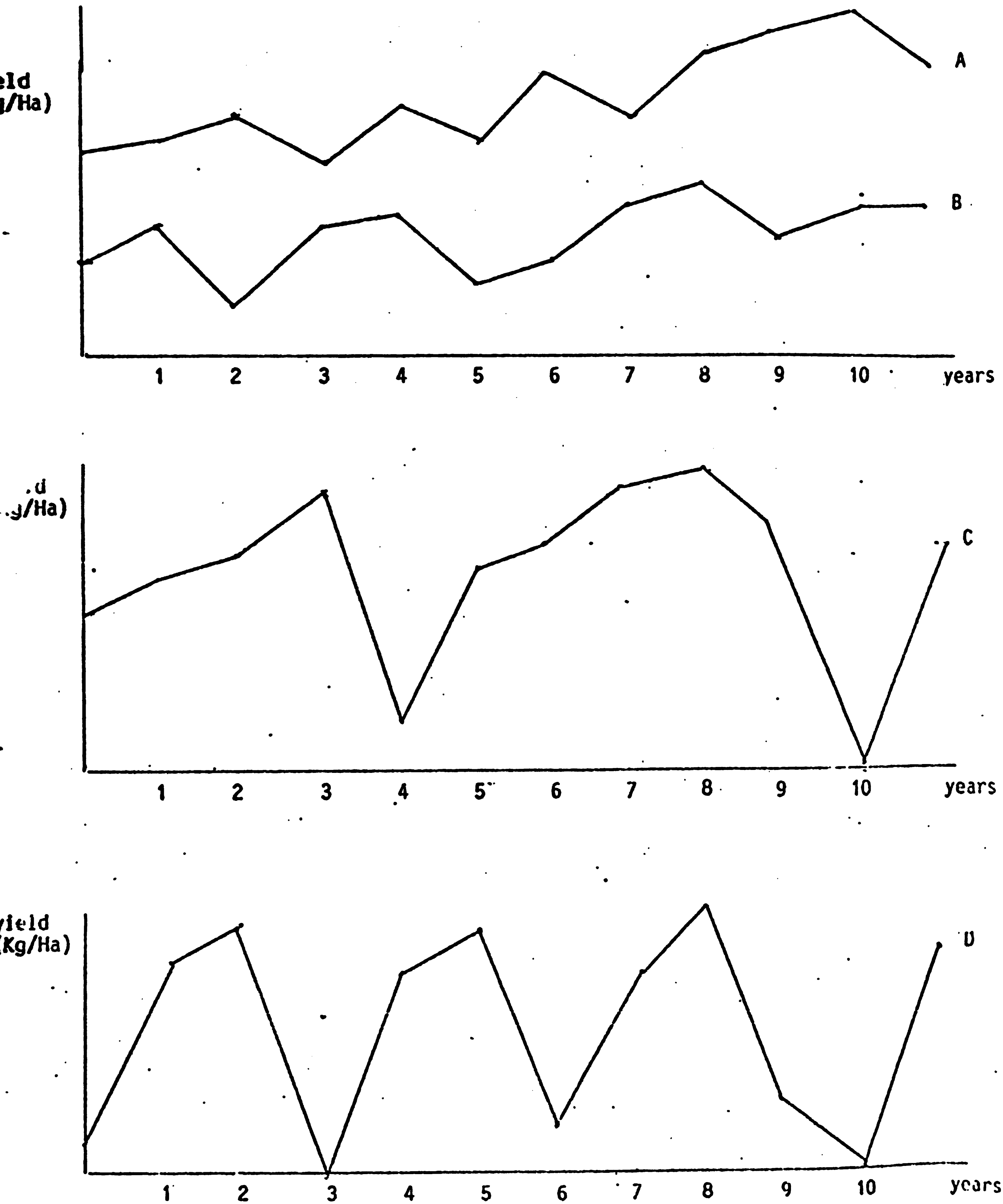

Figure 4.2. Types of Yield Variability.

technologies for the same crop, B will be simply a reflection of low productivity. Case C is the case of a risky crop were two out of ten years there is a dramatic loss. This could be a insurable case. Case D shows an extremely risky crop for which five out of ten years a disaster occurrs. Such a case would not qualify for insurance, unless of course, premiums were extremely high. Farmers would pay them only if returns on normal years were also extremely high.

Costs of production are also risky and conditioned by several interrelated factors. In the presence of diseases, pests or disasters, farmers without exception will try to control them if they do not have insurance protection. They will purchase insecticides, herbicides and fungicides before the diseases or pestes destroy the harvest and they will try to save a cow from a broken leg before it dies. However, although all the above is possible and it will allow to maintain productivity, it will result in increases of costs. Hence, because of the nature of disasters, costs are uncertain, but input supply, therefore any increases in demand and speculation, rapidly raise input prices.

The above discussion highlights the complexities in arriving at conclusions about the benefits of crop insurance for farmers. Evidently the benefits will accrue in different magnitude for every farmer, depending on the exposure to risk, the risk management alternatives, the type of government policy that affect the effectiveness of those alternatives, and it will also depend on the farmer's own attitude towards risk and insurance. In this latter case it is of particular interest the farmer's attitudes towards compulsory credit insurance, and even more important the attitude towards public insurance.

The hypothesis presented and tested here include the following:

a. Farm level decisions are made in an invironment of uncertainty, yet farmers chose among alternatives and produce to satisfy family needs and to generate income. The riskness involved in a set of choices of investment alternatives in handled by farmers in several ways which include complete avoidance of the risky enterprises and diversification of alternatives with negative of low positive correlation in their returns. It is hypothesized that if the danger of a disaster is not manageable by other means, farmers will opt voluntarily for crop insurance.

b. The risk premium that a farmer will pay for insurance is a function of the expected loss, but the demand for insurance can be strongly affected by costs of production, expected profit and the effectiveness of collateral requirements in the case of credit insurance.

c. The adoption of modern-high input technologies is limited by various factors. The expected output of new technologies is not known with certainty, while that of traditional technologies is only subject to risk. In addition, it is usually asserted that the variability in yields under non-optimal conditions is greater for input intensive technologies. Third hypothesis are presented. First, given the degree of farmers' risk aversion, the availability of insurance will induce a rapid adoption of modern technologies, particularly hybrid seeds, fertilizers and chemicals. Second, because the use of such inputs requires financial resources and hence the danger of financial risk insurance will increase the demand for credit. Third, as risk aversion increases this leads to a larger demand for insurance.

d. Credit insurance is being considered as a requisite for obtaining public low interest rate credit. The hypothesis is that if insurance is not compulsory, many farmers will not

purchase the insurance because they "feel" that they do not need it. It is hypothesized that farmers will reject compulsory insurance.

e. It is also hypothesized that compulsory insurance or a credit insurance package will stabilize farm income but it will also distort the composition of the portfolio of the farm, the use of inputs, the allocation of time, and it will make production more unstable.

f. Insurance is an effective risk management tool in the long run, therefore unless farmers understand how insurance is expected to work there will not be a genuine demand for insurance. This insufficient knowledge will lead the insurer to a constantly changing clientele retaining only those who are more often affected by disasters, hence leading into adverse selection. This is aggravated when premia area averaged over large areas among high risk and low risk farmers. The later would not remain voluntarily in the program.

The answers about the benefits of insurance for farmers provided by the research results will only be applicable for a given scenario. Hence these results can not be assumed as a rule for the desirability of insurance, neither are they the basis to jump into conclusions about generalized benefits of insurance for farmers. With the background referred above, which guided the farm level research of this project, the following sections present evidence on particular issues. In section 2, we analize risk management options by Bolivian farmers. Section 3 describes the attitude of Panamanian farmers towards compulsory credit insurance, and section 4 explains the demand for insurance under unfulfilled expectations of farmers in Ecuador. The interaction between insurance coverage and prices with other policies, and for different attitudes towards risk and farm conditions is addressed in section 5, using a lineal

programming model applied to two regions in Panama. Accepting the problems definition and identification of an agronomically optimal technology, section 5 presents the result of a four-year research on the impact of credit, insurance and technical assistance for two group of farmers in the highlands of Bolivia. In the absence of price risk, the benefits of insurance can be more easily measured as demonstrated by the experience of tomato producers in Panama, which is presented in section 7.

B. Risk Exposure and Management by Small Farmers[1]

Agriculture in the Peruvian-Bolivian plateau is highly exposed to climatological risks including drought, hail and frost. Farmers work between 2 and 5 hectares. The main crops are: potatoes, quinua, cañihua, oca and izaño, which are originally from this region and well adapted to the ecological conditions.

One recent example of the hazardous conditions prevailing in the area was given in 1982/83 when the crop cycle was affected by a severe drought. According to the farmers and the Bolivian National Academy of Science, this was one of the worst droughts in many years. This disaster created a severe food shortage as well as lack of seed (particularly of potatoes).

The objective of the study presented in this section was to measure the frecuence of disasters and the risk management strategy used by small farmers in Melga-Colomi, Department of Cochabamba, Bolivia. Melga is characterized by having a climate similar to other areas of the Bolivian high plateau.

The main hypothesis is that these famers who have lived here for generations have developed sufficient knowledge about risks and the capacity to manage some of these risks. The climatological risks of

drought, hail, and frost, are the most important in term of their occurence and damaging effects on agricultural production.

This analysis is based on daily data of minimum temperature, rainfall and hail. The probabilities of occurrence are for two-weeks periods. A year was divided in 24-2 weeks. Data comes from Tiraque A, a meteorological station that has similar ecological characteristics to those in Melga-Colomi.

The frequency of climatological risks of frost, drought and hail are presented in figures No.4.3 and 4.4. The abcissa represents probabilities (varying from 0-1) or frequency of occurrence and the ordinate represents the elemental periods on which a year was divided. The computed probabilities for drought, hail, frost and a joint probability of any of the previous risks are presented in Table No. 4.1.

Drought. The probability of drought was computed by comparing the amounts of rainfall with potential evapotranspiration divided by two (ETP/2), for a given period. The probability of drought is computed by taking the years with drought wich is divided by total number of years analyzed, all of this is for the same elemental period of analysis.

Hail. A period is consider with hail when in an elemental period hail has occurred at least once. Hail's intensity was not taken into account.

Frost. In this study frost is said to have occurred in a given period when temperature drops bellow zero degrees centigrades. This climatological risk is significant from mid May to mid August, having probabilities up to 0.8.

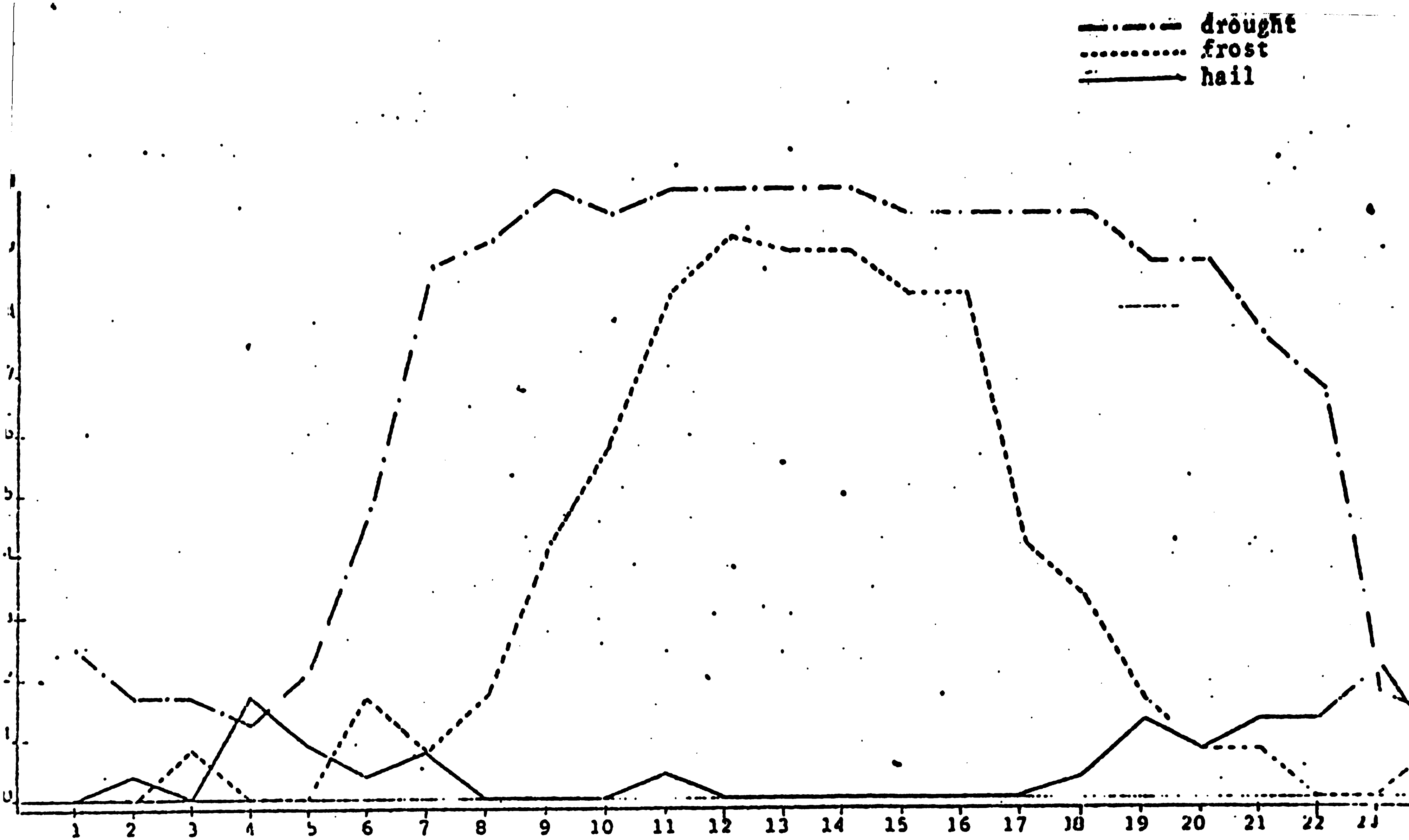

Figure 4.3. Frequency of the ocurrence of at least drough or frost or hail during the year, with 2-week periods of analysis.

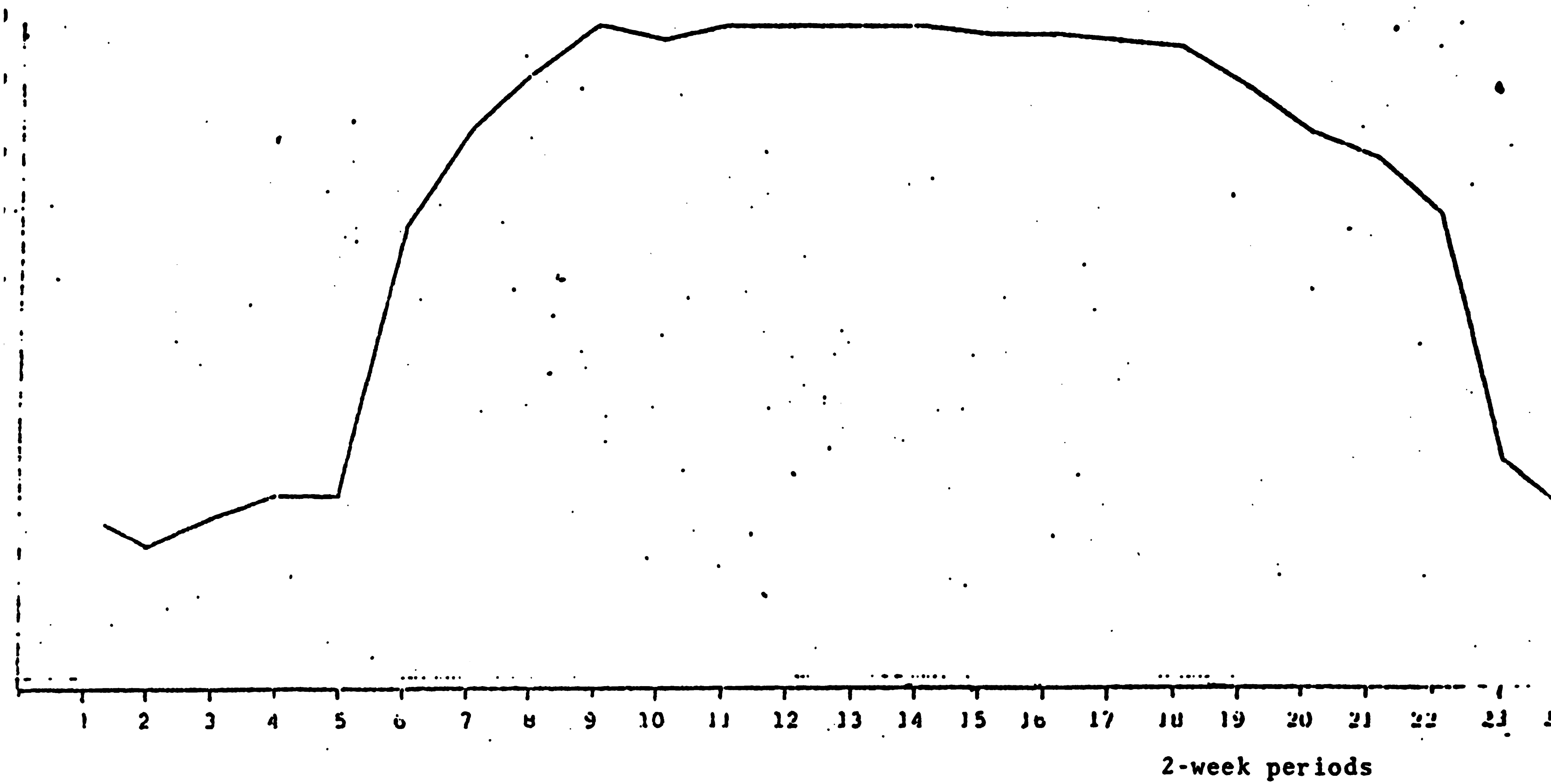

Figure 4.4. Frequency of the occurrence of at leas drough or frost or hail during the year, with 2-week period of analysis.

Table No. 4.1.

TIRAQUE A, COCHABAMBA, PROBABILITY OF THE OCCURRENCE OF CLIMATIC RISKS DURING THE YEAR

MONTH	JOINT RISK	DROUGHT	FROST	HAIL		
September	0.97	0.33	0.96	0.04	Planting and germination	Planting and germination
	0.91	0.17	0.88	0.13		
October	0.98	0.08	0.88	0.08		
	0.80	0.08	0.75	0.13		
November	0.71	0	0.67	0.13		
	0.34	0	0.17	0.21		
December	0.26	0.08	0.13	0.08		Growth
January	0.25	0	0.25	0	Growth	
	0.20	0	0.17	0.04		
February	0.24	0.08	0.17	0		Flowering and tuber formation
	0.28	0	0.13	0.17	Flowering and tuber formation	
	0.28	0	0.21	0.09		
March	0.69	0.17	0.48	0.04		
April	0.84	0.08	0.88	0.08		No crops are grown
	0.93	0.17	0.92	0		
	1.00	0.42	1.00	0		
May	0.98	0.58	0.96	0		
	1.00	0.83	1.00	0.04	No crops are grown	
June	1.00	0.90	1.00	0		
	1.00	0.90	1.00	0		
July	1.00	0.90	1.00	0		
	0.99	0.83	0.96	0		
August	0.99	0.83	0.96	0		
	0.98	0.42	0.96	0		

Joint probability: The joint probability that at least drought, frost or hail, will occur is over 0.93 from April to September; but during these months no crops are grown. Therefore the climatological conditions limit the agricultural crop cycle from October to May.

It is amazing to observe that given in those rather difficult and hazardous conditions for agriculture in this area, small farmers have developed knowledge and practice that minimizes the negative effects of adverse climate, disease and pests.

In an informal interview in Melga-Colomi 36 farmers participated and were questioned on the following topics:

Ecological zones, where they own land and farm.

Different agricultural products they farm in each ecological zone.

Number of plots they ownes and crops grown in each plot.

Distance betweeb plots.

Their reactions under the menace of a climatological risk.

The results of these interviews are presented in Table No. 4.3. We can observe that small farmers diversify risk over time and space in the following forms:

a. Farming in several ecological zones.

b. Producing several crops in a given plot (usually they own several plots in different places).

c. Coordinating different planting dates, according to the crop and ecological zone.

d. Using crop credit insurance (since 1980).

Most of the interviewed farmers (73%) indicated that they also farm in other ecological zone, besides Melga-Colomi, mainly in the area of Chapare.[2] Chapare is basically free of hail and frost, but not of flood, it has a tropical climate, where the main crops are coca, rice, banana, yucca and citrus and farmers have access to larger areas of land, approximately 12 has. on average. The recent intensive temporary migration to Chapare is due to a new paved road and land colonization plans (starting about 1940's).

Some farmers also cultivate in the lowers parts of Melga, where climate is more benign. The most important crops are potatoes, broad beans, oca barley, wheat and corn. However, cultivable land is very limited and on the average farmers own 1.3 has. With a limited access to irrigation it is possible an early produce of potatoes, called "miska".

Other few farmers cultivate also in the upper part of Melga which is an ecological zone with a climate of "altiplano". It presents harsh conditions for agriculture. The most important crops here are potatoes, oats, oca, broad beans and barley. Similarly, cultivable land in this zone is scarse and farmers own 1.5 has on the average.

Most of the farmers (96%) indicated that the most common risk management device was diversification, mainly producing several crops in a given plot. Farmers in Melga are used to plant two or more crops in a single pot at the same time. In the event of climatological disaster, crops are not affected in the same magnitude. Farmers of this area also practice crop rotation and

Table No 4.2

TIRAQUE A, COCHABAMBA, PROBABILITY OF OCCURRENCE OF CLIMATIC RISK DURING THE CROP CYCLE (SEPTEMBER 15 - MAY 15)

	JOINT RISK			FROST			DROUGHT			HAIL		
	n	Σ	$\bar{X}$	n	Σ	$\bar{X}$	n	Σ	$\bar{X}$	n	Σ	$\bar{X}$
Planting and Germination	6	4.57	0.76	6	0.66	0.11	6	4.31	0.71	6	0.72	0.12
Growth	3	0.71	0.23	3	0.08	0.02	3	0.55	0.18	3	0.12	0.04
Flowering	4	1.49	0.37	4	0.25	0.06	4	0.99	0.24	4	0.30	0.07
Harvest	3	2.77	0.92	3	0.67	0.22	3	2.80	0.93	3	0.08	0.02

Table No. 4.3

CHARACTERISTIC OF ECOLOGICAL ZONES

VARIABLE	CHAPARE-VILLA TUNARI (1)	MELGA-COLOMI (2)	MELGA-COLOMI (3)
Average area growth (has)	12.15	1.25	1.45
Altitude (Mosl)	370	2658	3200
Average Temp. (°C)	25.1	15.7	9.5
Precipitation (mm)	4920	1282	5428
Climatic Risks	Floods	Hail, drought frost	Hail, drought frost
Crops	Coca, rice, cassava plantain, citrus	corn, barley potatoes, haba wheat	Potatoes, oats haba, barley
Crop cycle	Oct/Nov.-Mar/Apr.	Apr/Jun-Oct/Jan Oct/Nov-Apr/May	Oct/Nov/Apr-May

after three years of farming they leave the land. This practice also contributes to breakdown of the disease cycle. This agricultural practice is an old one transmitted from one generation to the next. Farmers who own land in a single ecologycal zone and within it grown a single crop are more affected by climatic disasters.

About 77 percent of the farmers plant in more than one agricultural period. For instance, in Chapare farmers have permanent, semi-permanent, and annual crops. In lower parts of Melga, farmers with access to irrigation have possibilities to choose up three plantings per year. These periods are: Miska (an early planting), annual crop of dry farming and Chaupimiska. In the third ecological level (upper part of Melga) it is possible to have only a single crop per year. Small farmers perceive the occurrrence of climatological risk, consequently they have adapted systems of production that minimize the negative effects of risk by farming in different periods of the year.

In 1980/81 crop credit insurance was offered by ASBA to small farmers. This program offered an alternative way to diversify risk while at the same time it offered a technological package, credit and insurance. During the crop cycle of 1980/81, 50 farmers purchased insurance which allowed them to gain access to credit. This year was characterized by an absence of climatological disasters, therefore, no indemnities were paid by ASBA to farmers. During the crop cycle of characterized as an average year and some disasters were reported, hail (60%) and drought (20%). The crop cycle of 1982/83 was a poor year affected by a severe drought.

The results of the study indicated that farmers took insurance to access credit and to take the new technology. Once they learned the new technology, they adapted to their own beliefs, they had capitalized and finally decided not to stay in the program. These

results have very important implications. First, farmers took insurance mainly because of the uncertainty in the new technology and not because risks, which they had shown could be managed. Second, after uncertainty was removed, the prevailing premiums (of only 1 percent) were considered too high hence the credit-insurance package was no longer necessary. It should be mentioned also that at the beginning of the their year, to compensate partially for high inflation, the BAB increased interest rates. In this as in the following cases there seems to be a short term view of insurance hence if insurance indemnities were in three years below premiums paid, farmers will prefer to stay away from the program.

It is evidenced in this work that even in the most risk exposed areas, farmers have developed risk management options that allow them to savoid significant fall in production consumption and income. More discussion of the conclusions of this and the following sections are presented at the end of the chapter.

C. Attitudes Towards Compulsory Insurance[3]

It is generally viewed that farmers recent what is imposed on them. The purpose of this research was to test the existence of a demand for the credit-insurance package and how this demand could be affected by the farmers environment, age, composition of income and understanding of insurance.

a. Attitudes Towards Crop Insurance.

The studies were performed among farmers and livestock producers, clients of the Bugaba agency of the Agricultural Development Bank of Panama. Two groups of farmers were selected one in Bugaba and the other in Barú Alanje.

The area of Bugaba is located between 200 and 400 mosl. annual precipitation ranges between 2.500 and 4.000 mm. and the topography of the area is quite a problem for agricultural production. The cropping season begins in mid March. The main cash crop is rice, but some producers grow small areas of corn and beans for home consumption and sorghum. This crop was said to perform better during the summer, hence it allowed to spread risks. Off-farm labor is not sold, as the farm absorbes all family labor and some hired labor. The area of Barú-Alanje is a lower plateau with annual precipitation between 1.500 and 2.000 mm. and exposed to a prolonged drought period in the middle of the season. This represents a danger of insufficient humidity for plant growth.

Both groups of producers use current methods of production that represent innovations over the slash and burn practices, but they use their own technology for continuous crop production. Both groups also consider seriously the abandonment of rice production and even leaving farming, as they find it too risky. This exit could be facilitated by the fact that, on the average, they own only about 26 percent of the land they cultivate, and their appreciation is that land rentals are too high.[4] All farmers have been for several years (between 5 and 12) clients of the BDA and they do recognize the institutional problems and low quality of service, but they also agree that this is still the best alternative they have. Their attitude towards the BDA was summarize by one farmer who stated,

> "...The BDA has treated me well. Private banks provide a faster service, but the interests charged are higher and so is the collateral requirement. The BDA is more considered with the producers and if one fails, the bank gives you a chance to recoup. With the private banks, you have a 90 percent chance of losing your land..." (Heckadon, 1981, p.19).

The main criticism of the BDA was the long gestation period until a loan is approved (between 2 and 3 months), and the many trips it requires (between 3 and 4) to "push" the credit request. Also additional time is needed to collect loan disbursements. Farmers agreed that in general too many loans had to be processed by a loan officer and he and his agency chief had little authority for decisions about loan approval, hence this demands permanent dependence from the headquarters.

Farmers recent that "without asking for their opinion, insurance was made compulsory on the BDA credits". They showed mixed feelings about insurance. They dislike it because of:

a. its compulsive nature to obtain BDA loans,

b. the high premiums,

c. the fact that premiums had to be paid in advance,

d. the payment of indemnities for total loss, which they said was not common, but rather partial disasters were the general case, and finally,

e. they thought that insurance protected only the bank and not the farmer.

This recentment (in fact a complaint typical of farmers approached by anyone they feel has something to do with the government!) was accompanied by resignation, as they feel that without credit, their possibilities are limited. They viewed insurance as a way to raise the interest rate...and they agreed that "...given the circumstances, who gives the money puts the conditions", a point which, one more time, evidences the segmentation and imperfections in rural capital markets.

Most of the attitudes towards insurance had an argument of cost. In the wise opinion of a farmer it reads: "If ISA charges the premium on a per hectare basis, they should pay the indemnity on the same basis". The farmer clearly recognized that when loses are averaged over the farm, his chances for collecting indemnities are reduced. In all cases there was a narrower short term view of potential benefits from insurance, which obviously is not the view to take, as insurance is a means to manage farm income stability in the long-run. This reflects that, farmers had little information about how insurance works, or else, they have a very short term planning horizon.

There has been agreement that agricultural insurers should not provide technical assistance (IICA, 1983). In the case of Panama, TA is provided by the BDA and other government institutions, but farmers in general agreed that this assistance was of low quality and of little help, especially when new diseases appear, which in turn lead into conflict for the crop appraisals made by ISA.

Another dislike referred to the fact that the coverage began after the crop had emerged and ended at harvest time. But, before emergence, the farmers said, many resources had already been locked in, including land preparation, seeds and fertilizer applied at planting date. Also, significant loses accrue after the crop is harvested because of unreliable truckers to pick the produce when ready for delivery to the buyers.

This analysis shows on one hand a lack of understanding of farmers about how insurance works, while on the other hand it also evidences that general insurance policies, even when taylored for an area, will leave some individuals unhappy.

b. Attitudes Towards Livestock Insurance.

Attitudes towards insurance are notably different among livestock producers in comparison with crop producers; and a lot of this is explained by their reasons for holding cattle, namely as a source of wealth. Interviews were carried among 15 producers in the pacific coast of Panama, in the provinces of Herrera and Los Santos. Producers do not see themselves as ranchers, but rather as "farmers who raise a few cows". The typical enterprise includes crops and a mixed dairy-fattening production production system; and all these activities seem to complement each other.

The smallest ten producers planted rice, beans and corn for family subsistence, but the five largest producers had abandoned grain production because they considered it too risky. All farmers in the area had adopted a strategy of diversification of activities that revealed a strong attitude against risk. All of them kept a small flock of hens and chickens; they hold a small store or a bar; all had off-farm jobs and they had a small back garden for fruits and vegetables, part of which were sold.

Heckadon (1981) points out that producers see themselves as "poor men" and recognize this as the dominant feature of a man that tills the land; but also recognize that they are not among the poorest in rural areas. The reason to move into livestock was that it produces a more continuous source of cash, it demands less effort and it is less risky. Furthermore, the topography favors this type of activity because mechanization was not possible; and they thought only mechanized agriculture could be profitable. Capital accumulation was given as an important reason to hold cattle, which they thought it was a very liquid asset.

Farmers indicated that drought periods are quite common, but cattle could survive these periods although it may lose a lot of weight, but crops were more endangered and usually all of the harvest will be lost.

It was quite evident that as farmers got older, they moved away from crop production into cattle raising, by necessity and as a natural evolution, seeking least effort and the lowest risk. This is consistent with the findings of Pomareda and Pomareda (1981), in the southern coast of Perú.[5]

Among the panamanian producers, credit is considered indispensable and it has substituted for the system of "medias" or partnership. Producers have lost their fear of indebtness, mainly through the influence of friends. Thirteen of the farmers began working with the BDA in the early 70's, but with very small amounts. Their credit demands increased as they developed trust on one of the bank's employees. But inspite of their desirability for credit, they complaint that "the rental price of money"(the interest rate) of 12 percent, was too high. This rate was, however, slightly above the inflation rate of 10 percent.

About insurance, eight producers argued that it should be voluntary and four that it should be compulsory; the other three did not have an opinion. Those against insurance were mainly the ones in the cattle fattening business, and they indicated that the risk of loss was too small because they bought healthy cattle and retained it for only 7 or 8 months. Those that favored the compulsive nature of insurance were those raising pure breeds, sementals and dairy cows. Two farmers who lost their animals in accidents strongly favored insurance.[6]

Again in this case conclusion is that if in the short run collected indemnities are larger than premiums paid, insurance is

favored. This reveals again as in the previous section the short term expectancy of insurance benefits. The issue of definite importance for the insurers is to explain better how insurance is supposed to work. Yet, consideration must be given to the fact that under current economic crisis, and severe inflation, the planning horizon of investors is getting shorter, hence suggesting that this may not be a good time to promote insurance.

D. Information and Time Perspective in the Demand for Insurance[7]

Studies in Panama, Ecuador and Bolivia, reveal important attitudes towards credit insurance because of the farmers perceptions of costs and benefits. This perception was evidently not the same that the insurers and the banks in those countries, had when trying to sell a credit-insurance package. We present here a case in Ecuador.

Farmers will demand crop credit insurance at a given price if the expected benefits of the credit-insurance package equal or exceed the costs of credit and insurance that they pay. The benefits of credit are understood by the farmer as an available amount of cash that allows production investments and consumption. Furthermore given that public credit is subsidezed, farmers will take it rather than obtaining it at a market price. In addition, of course, further gains can be derived if the farmers knows that he can default without putting at risk the value of his assets. This is not a rare case and it reflects the failure of collateral markets (Binswanger, 1983) or just the inability of banks to enforce collateral conditions (Von Pischke, 1983). The benefits of crop insurance are not easily understood by farmers because such benefits are not well explained by insurers. Also, these benefits are uncertain, depending on the magnitud of the disaster and the final appraisal made by the inspector in regard to how much of the crop is lost.

As shown in Figure No.4.5. the financial cost of insurance is immediate, since premiums are paid in advance. Other costs include the value of the farmer's time to request insurance, filling application forms, reporting disasters and accompanying inspectors in the field. In the case of credit, the financial cost is paid in the future, and it is equal to the interest paid on the loan, usually collected when the loan is due. Other costs include the same ones for obtaining insurance protection.

Farmers in the area of Carchi, Ecuador were provided with technical assistance, credit and all risk (production) insurance for the production of potatoes. The area is typified by small valleys with medium to high slopes, temperate to cold weather (10°C to 18°C) typical of the region's altitude which ranges between 1.600 and 3.600 mosl. Although temperatures are on the average quite mild there is a small probability of frost and hail and prolonged drought periods. There is not an in depth study of the likelihood of these events, but insurance was offered against these disasters because farmers indicated that they were important. A survey in 1982 indicated that 30 percent of the farmers signed frost as the most important risk in the last five years, and 37 percent of the farmers signed drought. About diseases, 73 percent of farmers indicated that phytophthora was the most damaging disease. However, when asked about the most important disaster in the current year, 36 percent of farmers indicated it was drought, and 40 percent indicated it was excess humidity. Which could reflect highly localized disasters, and probably high indemnity payments if all-risk insurance was offered.

About the reasons to purchase insurance, 73 percent of the farmers indicated that they took it to protect against risks, but 17 percent indicate that they purchased insurance so they could obtain credit. This stated preferences clearly indicated aversion to risk and hence high expectations on the results of the insurance program.[8]

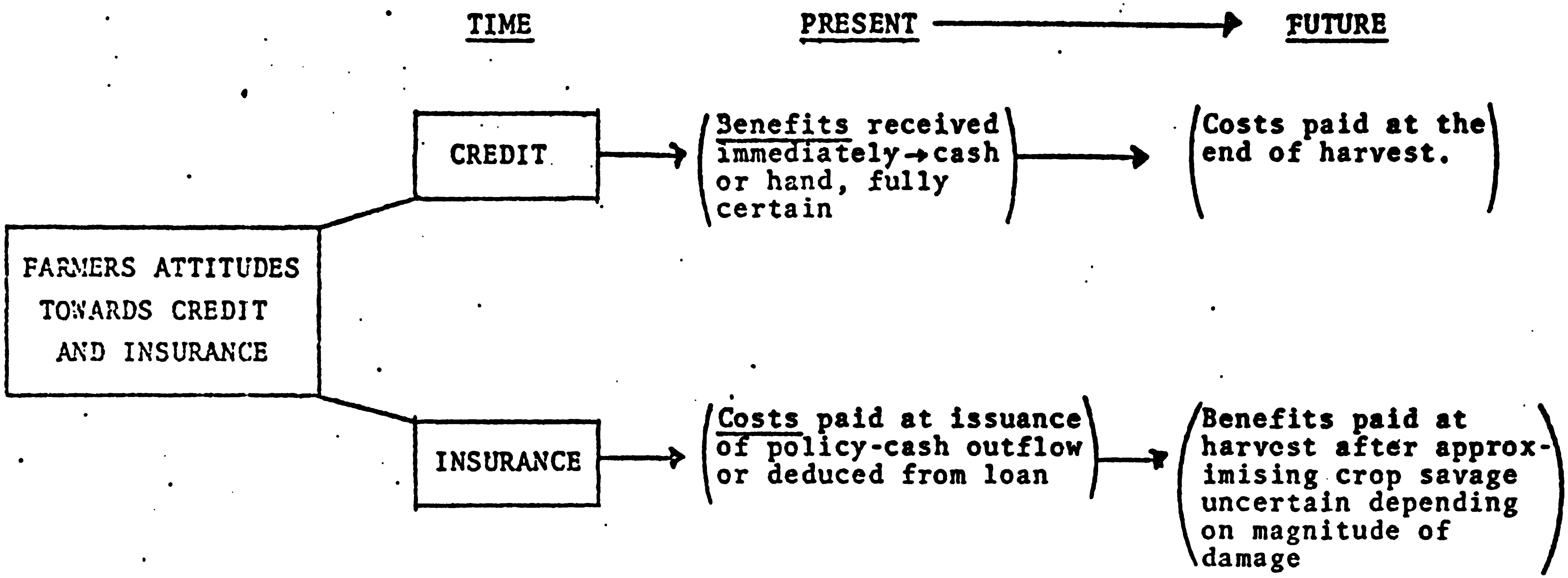

Figure 4.5. Farmers' Rationale of Benefits and Costs of Credit and Insurance in a Time Framework for Decision Making

In the 1981/82 crop cycle 74 farmers purchased insurance in the area of Carchi. Forty two of these farmers were surveyed and the data in Table No. 4.4 refer to this group of producers. Although they show various levels of technology, they were in general quite labor intensive and the levels of use of fertilizer and other inputs were relatively high. Average yields and quality distribution is given in Table No. 4.5. Among the insured producers, 64 percent reported the occurrence of disasters, and according to their estimates 34 percent of the crop was lost.

[illegible] from CONASA is used to appraise the two year costs and benefits of insurance to farmers in Carchi. The number of policies issued is larger than the number of farmers, as more than one plot (hence more than one policy) was insured by some farmers. In 1981/82 twenty seven policies received indemnities and on the whole the indemnity income received was larger than the premium paid, hence the average loss ratio equaled 1.79.[9] Things worsened for CONASA for 1982/83 since the loss ratio grew to 4.53.[10]

This would indicate that CONASA paid for all those loses requiring and indemnity, but a recent survey of farmers in the area of Carchi revealed some problems and reasons for concern. Avalos and Dousdebes (July, 1983), indicates that "in 1981/82 the number of policies issued was 74 and a survey in December of 1982 revealed that 95 percent of surveyed farmers wanted to use insurance again, or for the first time". During the crop cycle for 1982/83 (until December 1982) only 37 policies were issued.

Avalos and Dousdebes present the reasons for a decline in insurance demand and these are summarized in Table No. 4.6. Even though most of the interviewed farmers had received indemnities, the main reason for not purchasing insurance again was their dissatisfaction with the indemnity received. On this basis the authors recommended two actions:

Table No. 4.4.

CHARCHI, ECUADOR, MAIN CHARACTERISTICS OF INSURED POTATO PRODUCERS AND TECHNOLOGY FOR POTATO PRODUCTION

VARIABLE	CARCHI-ECUADOR 1981 - 82
Age	49
Family labor force	2.4
Farm area[1] (has)	40
Area of potatoes (has)	5.9
Area of other crops (has)[2]	6.5
Heads of cattle	45
Heads of sheep[3]	8.0
Potato production	
1° (highest grade)	5.729
2°	1.686
3°	912
4°	803

1/ Mainly in pastures.

2/ Mainly corn, broad bean and green pea

3/ Only 25 producers owned cattle while only 5 owened sheep and goats.

Table No. 4.5.

CONASA, RESULTS OF INSURANCE TO POTATOES IN CARCHI 1981/82 AND 1982/83

	JUNE 81/MARCH 82 1981/82	JUNE 82/DEC.83 1982/83[1]
Policies issued	74	37
Area covered (has)	289.5	149.5
Average area/policy (has)	3.9	4.0
Coverage (1000$)	8.784.9	4.515.9
Coverage/hectare (1000$)	30.345	30.206
Premiun Income (1000$)	526.7	270.9
Indemnities (1000$)	744.0	1.226.7
Number of Indemnities	27	n.a.
Loss Ratio	1.79	4.53

1/ Until December '83.

Table 4.6. Carchi, Ecuador; Reasons Given by 15 Farmers Insured in 1981/82 for not Insuring Potatoes in 1982/83.

		Received Indemnities in 1981/82	
		Yes	No
Reasons for not Using Insurance	Unsatisfied with previous year Indemnity received	5	2
	Did not plant potatoes	3	-
	Other reasons[1/]	3	2

Source: Avalos and Dousdebes, July 1983

[1/] Planting was shared with other farmer, lack of interest and rejection

A. When a harvest evaluation is a practiced, this should require the presence of the farmer, the inspector of CONASA and an employee of the bank, and,

B. Requested the Directorate of CONASA to proceed to a readjustment to upgrade the image of the institution.

Evidently the farmers attitude towards insurance is based on their understanding of it, and also in this case, as in Panama, there is a short term view of insurance. In fact it is seen as a one year investment in which at the end of period, returns should be greater than premiums paid. What is most striking is the researchers' recommendations, which can be interpreted as an agreement with the attitude of farmers. Recommendations (a) implies increasing the cost of the appraisal and letting the bank "intrude" in what is a responsibility of CONASA. Recommendations (b) implies opening the door for farmers to get a free ride at the expense of CONASA's budget.

The results of this study reveal a lack of understanding about institutionally offered insurance as a long term financial mechanism. Farmer rather see it as a yearly investment, where the rturns (indemnities) ought to be larger than the capital deposited (premium). It would imply that a farmer's demand for insurance could be more stable over time if the insurers were to explain better how insurance is supposed to work, their voluntary first insurance policy will never be purchased.

E. Evaluating the Demand for Insurance Under Different Attitudes Towards Risk[11]

a. Introduction

Farmers demand for insurance is affected by a number of factors, but in general a farmer will purchase insurance if expected benefits exceed the cost. In the previous section we saw that there is a myopic view of the benefits of insurance, hence farmers would purchase insurance only if short term benefits exceed the purchase costs. Looking at an average year, the demand for insurance can be analyzed with proper account of the variance and covariance of return of production alternative given the farmers attitudes towards risk. In this analysis it is necessary the specification of a behavioral rule which recognizes that farmers will satisfy basic subsistence needs before repaying debt obligations.

These elements were taken into account in a farm model of decision making elaborated by Peter Hazell and Gustavo Arcia. Details about the model can be found in the work of Hazell, Bassoco and Arcia (1983) which also included applications in Mexico. Here we present a brief discussion of the model and the main findings for two districts in Panama.

b. Brief Review of a Model for Evaluating the Demand for All-Risk Crop Insurance

Expected utility theory offers a useful way of formalizing a farmer's distaste for fluctuations in income. This theory postulates that each individual considers when choosing among strategies with risky outcomes. For example, if his utility function for money is quadratic, then a farmer will choose between farm plans solely on the basis of their mean and variance of income (Markowitz, 1959). It was assumed that farmers behave according to

a closely related decision criterion, the mean income standard deviation criterion. Specifically, the model uses Baumol's approach (1963) and assumes that farmers maximize an expected utility function of the form $E(u) = E(y) - \emptyset 6y$, where $\emptyset$ is a risk aversion parameter.

This criterion implies that for a given level of mean income E (y), a farmer will always prefer the plan with the smallest standard deviation o_y. Further, he will be willing to sacrifice mean income in order to reduce o_y to the point where the marginal trade-off is exactly $\emptyset$. The chosen decision criterion provides a direct rationale for a farmer to purchase crop insurance, Crop insurance should act to reduce o_y for each level of E(y). Of course if crop insurance is to be effective in this way, then the reduction in 6y obtained multiplied by $\emptyset$ much more than compensate for premium which is to be charged to E(y).

The choice of o_y as the measure of risk also happens to be useful for formalizing the avoidance of disastrously low income outcomes. This objective can usefully be written as a probability criterion of the form, Pr (Y_t S) (1 - 6) where Y_t denotes the t^{th} possible outcome for income net of all production costs, and any interest charges on borrowed credit, S denotes the minimum amount of income required by the farm family to meet essential living costs, and o is a pre-assigned level of risk. Since a positive income implies that all input costs financed with credit are recovered, then the criterion requires that a farm plan be chosen so that income is adequate to cover debt repayment and family subsistence at least 1 - o proportion of the time. Since a farmer is likely to give greater priority to the survival of himself and his family than to the repayment of debt, we shall assume that when the above condition is not satisfied, the farmer defaults on his loan.

The model also includes constraints to account for the availability of resources. Therefore the farmer is assumed to seek the maximization of utility, given certain constraints on home consumption, default on credit possibilities and physical restrictions. Clearly the attitudes towards risk (reflected in β) will affect the choice among alternatives, the demand for insurance and the resulting levels of resource use.

The model can be used to evaluate the effects of alternative insurance schemes on a farmer's decisions including his demand for an repayment of credit. Insurance will affect the model by changing the coefficients of the covariance matrix of activity returns. This will lead to changes in o_y affecting both, the model maximand and the debt repayment conditions.

For each crop it is assumed that a time series of revenue data exists corresponding to the uninsured situation. When expressed as deviations from the mean, these data provide the initial basis for estimation o_y. To simulate the effect of insurance, a new set of revenue deviations must be calculated corresponding to what the initial time series would have been had the crops been insured. These calculations involve the derivation of new series of crop revenues which differ from the original service in those years in which indemnities would have been paid. The mean of the new series are then calculated, the revenue deviations obtained, and the relevant elements of calculated for he insured crops.

c. The Demand for Insurance in Guararé

Data for the first analysis were collected from representative farms in Guararé district. Located just above sea level on the Azuero peninsula in the midsection of Panama, this district is characterized by frequent droughts. Rainfall varies between 800 and 1.200 millimeters per year. On average it is distributed quite

evenly between the months of July and December. This rainy period however, is somewhat erratic, sometimes starting as early as May, and sometimes ending as late as January. The end result is a farming system which is much riskier than most areas of Panama, and one which should be most benefited by the crop insurance program. The model was constructed for a representative farm having 40 hectares of land, and it included all the principal activities produced in the district: corn, sorghum, tomatoes, green pepers, plantains, cassava, and livestock. Tobacco is not included since this is grown on specialized farms. Alternative production activities are identified for most crops, reflecting different planting dates, and in the case of corn different levels of labor, fertilizer, and pesticide use. However, not all the land is suitable for all activities, and three land types are differentiated: 20 hectares of land are suitable for rainfed maize and sorghum only; 2 hectares are irrigated and can be used to grow tomatoes, peppers, plantains, and cassava; 18 hectares are only suited for pasture and livestock production. Labor requirements are specified on a bimontly basis and can be met from farm family sources (at zero cost), or by hiring labor at a fixed wage.

Family food constraints are imposed for corn, cassava, milk and beef. Beef must be home-grown, but the requirements for corn, cassava, and milk can be met from either hom production or through local purchases.

Credit is required in the model to cover the costs of seeds, fertilizers, pesticides, machinery hire, and wage labor. Since very few farmers own machines, all machinery services are assumed to be hired in. The farmer is assumed to have some own funds ($500) for on farm investment. Otherwise the credit needs must be met by borrowing from commercial or government banks at an interest charge of 14 percent. In the case of tomatoes, sorghum, and input-intensive maize techniques, the model can choose between

insured or uninsured loans. However, only uninsured loans are offered in the model for all the other production activities.

The debt repayment constraint in the model limits the amount of credit borrowed to the amount where the probability of default is equal to 10 percent (i.e. o = 0.10). The minimum income requirement which includes the value of home-grown foods, but is net of any subsistence foods purchased from local sources.

Since prices are fixed by the government each year, the risk coefficients are calculated to reflect yield risks at 1981 prices. Revenue data per hectare for the year 1977 to 1981 were obtained from six individual farmers in the district for the important insured and uninsured crops grown. These were adjusted to 1981 prices and averaged to obtain the series in Table No.4.7. Time series data could not be obtained for plantains, cassava, or livestock. Since these activities are known to have very low yield risks, we simply assumed that they had zero risk. Data could not be obtained on uninsured tomatoes because (virtually none are grown) so we have not included this activity in the model.

A drought in 1977 was responsible for a complete yield failure for maize, and only farmers with insurance coverage received any return that year. Similarly a late rainfall in 1979 was responsible for a sorghum failure, and only insured sorghum and a non-zero return. The coefficients of variation of the uninsured crops are very large.

Fortunately, the returns from the different crops are not highly correlated, and there is considerable scope to diversify across activities to reduce the coefficient of variation of total farm income. Indeed as Table No.4.8 shows, there are some very healthy negative correlations between maize and sorghum, and between insured maize and insured tomatoes. It is also apparent that the insured

Table 4.7. Guarare, Panama; Revenue Outcomes for Key Crops in Different Years (million US$).

	Maize		Insured Modern Maize	Sorghum	Insured Sorghum	Insured Tomatoes	Peppers
	Traditional	Modern					
1977	0	0	489	581	581	3 325	1 760
1978	378	540	540	465	465	3 500	3 000
1979	427	610	610	0	464	3 150	2 100
1980	469	671	671	768	768	3 300	1 800
1981	436	623	623	505	505	3 000	5 500
Average	342	489	587	464	557	3 255	2 832
Standard Deviation	194	277	72	284	127	189	1 573
Coefficient of Variation (percent)	56.7	56.7	12.3	61.3	22.9	5.8	55.5

Note: The insured crop returns are gross of the annual premia.

Table 4.8. Guarare, Panama; Correlation Coefficients Between Crop Revenues.

	Maize	Insured Maize	Sorghum	Insured Sorghum	Insured Tomatoes	Peppers
Maize	1.0					
Insured Maize	0.86	1.0				
Sorghum	-0.17	0.06	1.0			
Insured Sorghum	0.03	0.43	0.75	1.0		
Insured Tomatoes	-0.29	-0.48	0.28	0.12	1.0	
Peppers	0.35	0.20	0.06	-0.41	-0.57	1.0

options for maize and sorghum have quite different patterns of association between themselves and with other crops than do their uninsured counterparts.

The results of the simulations are given in Table 4.9. The basic solution was obtained by excluding all the insured options for maize and sorghum from the model. The debt default risk was set at 0.1 percent, and solved for different values of the risk aversion parameter Ø. Under the risk-neutral assumption (Ø = 0), the model calls for generous amounts of the riskiest crops to be produced, maize, sorghum, and tomatoes. However, because of the negative correlation between the revenues of these crops (Table 4.8), the coefficient of variation of income is only 20 percent. This is considerably less than the coefficients of variation of revenues reported for the individual crops in Table 4.7. The amount of maize, sorghum, and tomatoes produced declines rapidly as the risk parameter increases, while cassava production increases. These changes lead to a dramatic decline in the standard deviation of income, but only at the expense of some sacrifice in average income.

The debt default constraint is binding for Ø values of 0.5 and less. In these cases the farmer is forced by the bank to act in a risk-averse way in order to obtain as much credit as he can profitably use.

The amount of uninsured credit borrowed declines significantly between risk-neutral (Ø = 0) and "reasonably" risk-averse (Ø = 1.0) behaviour, largely as a reflection of the decline in maize and sorghum production. Insured credit is borrowed exclusively for tomatoes since the insurance options for maize and sorghum have been deleted.

Finally, it should be noted that maize is produced exclusively with traditional techniques (low fertilizer and pesticide

Table No. 4.9

GUARARE, PANAMA, RESULTS FOR VARIOUS LEVELS OF RISK AVERSION (NO INSURANCE FOR CORN AND SORGHUM, DEBT DEFAULT RISK 0.1 PERCENT)

VARIABLE	VALUE OF Ø				
	0	0.5	1.0	1.5	2.0
INCOME AND UTILITY MEASURES (Dollars)					
Expected utility	4.719	4.249	4.057	4.012	4.010
Average income	4.719	4.719	4.234	4.017	4.015
Standard deviation	942	942	178	3	2
Coefficient of variation (percent)	20.0	20.0	4.2	0.1	-
SALES (Quintales)					
Maize	186.1	186.1	10.0	0.9	0.4
Sorghum	35.9	35.9	-	0.2	0.6
Tomatoes	587.0	587.0	565.4	34.9	32.8
Peppers	-	-	31.3	-	-
Plantains	-	-	-	-	-
Cassava	90.3	90.3	83.6	241.4	242.6
Milk (litres)	25.520	25.520	25.520	25.520	25.520
Beef (kilograms)	8.700	8.700	8.700	8.700	8.700
INPUTS					
Employment (days)	525	525	452	328	328
Uninsured credit	4.569	4.569	3.344	3.239	3.239
Insured credit	2.163	2.163	2.083	129	121
TECHNOLOGY CHOICE (Percent area)					
Traditional maize	100.0	100.0	100.0	100.0	100.0
Modern maize	-	-	-	-	-
SHADOW PRICES (Percent return)					
Credit requirement	17.38	14.57	14.0	14.0	14.0
Debt default	24.12	4.10	-	-	-

applications), rather than with modern (or more input-intensive techniques) in all the solutions in Table No.4.9. Since one of the objetives of the ISA scheme in Panama is to encourage the use of modern technologies, it is of interest to see if there is a switch in the choice of technique when the insurance options are introduced.

Table No. 4.10 summarizes the impact of insurance for maize and sorghum for Ø values of zero and 1.0 corresponding to risk-neutral and "reasonable" risk-averse behaviour. The experiments are also conducted assuming that the administrative costs of insurance are fully subsidized. That is, the average indemnity is assumed to exactly equal any premium paid.

With Ø = 1.0, crop insurance leads to a gain in expected utility of $256, or $34.5 per hectare of insured maize. The actual premium charged by ISA is about $17 per hectare, and this is gross of any indemnities paid. Insurance then for maize is clearly a viable proposition for the representative Guarare farmers. In fact additional model results firm that the maize crop would be fully insured on a voluntary basis for premium levels net of indemnities as high as $50 per hectare. However, the area of maize grown would decline rapidly for net premium rates above $35 per hectare. Insurance for sorghum turns out not to be atractive even when offered at zero cost. However, it would be purchased voluntarily by risk-neutral farmers.

Maize insurance leads to a very signficant increase in maize production when Ø = 1.0, and this is accompanied by a complete switch to the more intensive production techniques. This leads to a 21 percent increase in the amount of credit borrowed, particularly of insured loans.

Insurance also leads to a significant reduction in the standard deviation of income for given levels of average income. Also the

Table No. 4.10

GUARARE, PANAMA, RESULTS FROM VARIOUS CROP INSURANCE EXPERIMENTS FOR MAIZE AND SORGHUM (DEBT DEFAULT RISK 0.1 PERCENT

VARIABLE	RISK NEUTRAL BEHAVIOR (Ø = 0)		RISK AVERSE BEHAVIOUR (Ø = 1.0)	
	NO INSURANCE	WITH INSURANCE	NO INSURANCE	WITH INSURANCE
INCOME AND UTILITY MEASURES (Dollars)				
Expected utility	4.719	5.325	4.057	4.313
Average income	4.719	5.325	4.234	4.685
Standard deviation	942	1.108	178	373
Coefficient of variation (percent)	20.0	21.2	4.2	8.0
SALES (Quintales)				
Maize	186.1	702.0	10.0	361.7
Sorghum	35.9	136.1	-	3.1
Tomatoes	587.0	337.1	565.4	584.7
Peppers	-	-	31.3	5.2
Plantains	-	-	-	-
Cassava	90.3	158.7	83.6	88.9
Milk (litres)	25.520	25.520	25.520	25.520
Beef (kilograms)	8.700	8.700	8.700	8.700
INPUTS				
Employment (days)	525	607	452	548
Uninsured credit	4.569	3.165	3.344	3.178
Insured credit	2.163	7.403	2.083	4.838
TECHNOLOGY CHOICE (Percent area)				
Traditional maize	100.0		100.0	-
Modern maize	-	100.0	-	100.0
SHADOW PRICES (Percent return)				
Credit requirement	17.4	17.7	14.0	14.0
Debt default	24.12	26.2	-	-
INSURANCE (percent area)				
Maize	n.a.	100.0	n.a.	100.0
Sorghum	n.a.	100.0	n.a.	-

range of efficient plans, that the farmer can consider, is also increased by insurance.

d. <u>The Demand for Insurance in Bugaba</u>

Data for the second analysis were collected in the district of Bugaba, about 450 kms. northwest of Panama City. The district is located on a plateau about 300 mosl, with a mean temperature of 26^{o}C. Annual rainfall is 4.200 mms and it is well distributed throughout nine months of the year. The rainy season runs from April to December, followed by a dry spell from January to March. Soils are of volcanic origin and of medium to high fertility. About 30% of the district is suitable for mechanization, the rest being either too steep or too rocky, and therefore more suitable for livestock. Bugaba has a population of about 11.000 people, with good access to adequate health and education facilities.

Sixty four percent of the farms in the district are of less than 5 hectares, occupying about 5% of the land. Approximately 85% of all farms are less than 20 hectares. All small farms produce both for home consumption and market. Rice, corn, pole beans and tobacco are the main annual crops and sugarcane, plantains, oranges, coffee and avocados are the main permanent crops. Tobacco and sugar are grown under quota arrangements with local processors, and farms without such contracts do not grow these crops. In addition, the family plot often includes one to three cows, three to four pigs and some chickens, all kept mostly for home consumption. The level of crop technology used is intermediate to high relative to other Latin American Countries. Land preparation is usually mechanized, pesticides and herbicides are use widely but harvesting is mostly done manually. Mechanical harvesting of rice and corn is found only on medium to large tracts (i.e. 10 to 50 hectares) but is not widespread. Marketing is done locally. Farmers sell their grains to the government marketing board at a fixed price or to

intermediaries who offer a lower price but pay more promptly. Fruits and other perishables are sold at the farm to local intermediaries at prices fixed by the government.

Farm credit is obtained through the Agricultural Development Bank (BDA) at interest rates approximating 14 percent. Credit is rationed depending on the geographic area, the type of loan, and the farmer's credit record. Generally, loans do not include labor costs if the area planted is small (i.e. 2 ha.). Net farm incomes for the area oscillate between $3.000 to $5.000 per year for a 5 ha. farm, to $6.000 to $10.000 per year for farmers cultivating around 20 ha.

In evaluating the crop insurance scheme the focus was on its potential impact on the smallest two thirds of the farms. The farm model is constructed for a typical 5 ha. farm. All the activities in the model are currently found in the district of Bugaba. In the case of rice, corn, and intercropped corn and beans, several technologies were identified for each crop. Differences between technologies relate to the use of machinery at planting and/or harvesting, intensity of pesticide use and the degree of substitution between labor and machinery. Table No. 4.11 describes the corn and rice technologies in more detail. Corn and beans are often interplanted, with corn being used as a support for the climbing beans. Again, different technologies are identified in the model based on seed quality, fertilizer and pesticide use, and the degree of mechanization. Tobacco and sugar are technically feasible on many small farms, but few have the necesarry contracts with local processers. Consequently, these crops are not included in the model for our typical farm.

Labor intensive crops are grown in the family plot around the homstead. Yams and the care of pigs account for most of the labor used in this plot. However, small quantities of oranges, plantain, bananas and coffee are produced together with the care of a few

Table 4.11. Rice and Corn Technologies in Bugaba District, Panama

Technology	Cultural Technique						Average Yield	Coefficient of Variation of Yield (%)
	Land Preparation	Planting	Fertilizer	Pesticides	Herbicides	Harvest		
Corn 1	manual	manual	no	no	no	manual	26.0	6.3
Corn 2	manual	manual	no	no	yes	manual	28.0	5.8
Corn 3	mechanized	manual	no	no	yes	manual	33.0	11.2
Corn 4	mechanized	mechanized	no	no	yes	manual	41.2	11.2
Corn 5	mechanized	mechanized	yes	yes	yes	manual	52.0	7.2
Rice 1	manual	manual	no	no	no	manual	48.0	16.2
Rice 2	manual	manual	yes	no	yes	manual	55.0	15.0
Rice 3	mechanized	manual	yes	yes	yes	manual	70.0	11.8
Rice 4	mechanized	mechanized	yes	yes	yes	manual	82.1	10.1
Rice 5	mechanized	mechanized	yes	yes*	yes*	manual	85.2	11.2

*With tractor

poultry and a cow or two. Most of these products are retained for family consumption, but small amounts are sold. All these possibilities are incorporated in the model. Minimum constraints are imposed on each house lot product to ensure that adequate amounts are grown for family consumption, and limits on selling are imposed where local marketing is limited.

Credit is required in the model to cover the cost of seeds, fertilizers, pesticides, machinery renting and wage labor. Small farmers do not generally own machines, and must choose between manual techniques or renting machinery services from contractors or large farms. Credit is available in the model either from own family funds, or from the agricultural bank at an interest charge of 14 percent.

Since prices are fixed by the government each year prior to planting, the only risk confronting farmers is yield risk. Suitable yield data were available for the years 1976 to 1981, and led to the revenue calculations in Table No. 4.12 for the more important crops-corn, rice and interplanted corn and beans. These data are based on district level averages, and are calculated using 1981 prices, this being the year for which the model is specified.

Table No. 4.12 shows that, for the less intensive techniques, rice is the more risky crop with a coefficient of variation of revenues exceeding 15 percent. Surprisingly, intercropped corn and beans are relatively more risky than sole cropped corn when grown with less intensive techniques.

However, these relationships change with more intensive production techniques. Corn 4, for example, is more risky than rice

Table 4.12. Revenue Outcomes for Corn, Rice and Interplanted Corn and Beans in Different Years, Bugaba District, Panama.

	Corn 1	Corn 2	Corn 3	Corn 4	Corn 5	Rice 1	Rice 2	Rice 3	Rice 4	Rice 5	Corn/ Beans 1	Corn/ Beans 2	Corn/ Beans 3	Corn/ Beans 4	Co Bea
1976	264	285	325	401	530	563	611	784	922	952	234	255	331	442	57
1977	298	320	360	498	564	430	477	649	787	810	261	282	359	477	60
1979	294	315	355	431	561	612	659	831	975	991	268	290	356	473	60
1980	260	282	322	397	526	652	700	872	1 009	1 032	273	296	331	439	57
1981	288	310	421	497	626	496	711	883	1 021	1 107	301	324	351	539	67
Average	281	302	356	445	561	551	632	804	943	978	267	289	345	474	60
Standard deviation	17.6	17.6	39.9	49.9	40.1	89.1	94.8	94.7	95.2	110.2	24.1	24.9	13.6	40.3	3
Coefficient of variation (%)	6.3	5.8	11.2	11.2	7.1	16.2	15.0	11.8	10.1	11.3	9.0	8.6	3.9	8.5	6

4, whilst corn/beans 4 is least risky. In the case of rice, adoption of more intensive techniques reduces the coefficient of variation of revenues, because the average return increases faster than the standard deviation.

The revenue series for different techniques of production of each crop tend to be highly correlated (Table No. 4.13). However, they often have different correlations with other crops. The revenue series for rice also tend to be negatively correlated with corn and interplanted corn and beans. This bodes well for a rational diversification between these crops to reduce whole farm income risk.

Suitable risk data were not available for the crop and livestock activities produced in the house lot. However, since these activities account for only a small share of the total land use, and since the products are largely home consumed, then ignoring risks in these activities should have little effect on the standard deviation of total farm cash income. This does mean, however, that the model cannot be used to evaluate livestock insurance policies.

Table No. 4.14 contains some basic model results for different values of the risk aversion parameter Ø. These results are based on default risk of 5 percent and derived assuming that no insurance options are available.

Since no reservation wage is charged on family labor in this model, expected utility is simply average income less the risk cost Ø 6y. Expected utility declines as Ø increases, but not by very much. Average income is also relatively stable for different values of Ø, and only declines by 11 percent as Ø increases from zero to 2.5. Apparently, risk is not very costly to our typical Bugaba farm.

Table 4.13. Correlation coefficients Between Crop Revenues, Bugaba District, Panama.

	Corn 1	Corn 2	Corn 3	Corn 4	Corn 5	Rice 1	Rice 2	Rice 3	Rice 4	Rice 5	Corn/ Beans 1	Corn/ Beans 2	Corn/ Beans 3	Corn/ Beans 4	Corn/ Beans 5
Corn 1	1.0														
Corn 2	1.0	1.0													
Corn 3	0.62	0.63	1.0												
Corn 4	0.81	0.82	0.83	1.0											
Corn 5	0.63	0.64	1.0	0.82	1.0										
Rice 1	-0.64	-0.65	-0.56	-0.87	-0.55	1.0									
Rice 2	-0.42	-0.42	0.19	-0.36	0.19	0.67	1.0								
Rice 3	-0.42	-0.42	0.19	-0.36	0.19	0.67	1.0	1.0							
Rice 4	-0.41	-0.41	0.19	-0.36	0.19	0.68	1.0	1.0	1.0						
Rice 5	-0.32	-0.32	0.38	-0.17	0.38	0.49	0.97	0.97	0.97	1.0					
Corn/Beans 1	0.35	0.36	0.78	0.54	0.78	-0.10	0.52	0.52	0.51	0.62	1.0				
Corn/Beans 2	0.33	0.34	0.77	0.52	0.77	-0.08	0.54	0.53	0.53	0.63	1.0	1.0			
Corn/Beans 3	1.0	1.0	0.62	0.80	0.62	-0.60	-0.40	-0.40	-0.38	-0.30	0.39	0.37	1.0		
Corn/Beans 4	0.63	0.64	1.0	0.83	1.0	-0.55	0.19	0.19	0.19	0.38	0.78	0.77	0.62	1.0	
Corn/Beans 5	0.62	0.63	1.0	0.82	1.0	-0.55	0.20	0.20	0.20	0.39	0.78	0.77	0.61	1.0	1.0

Table No. 4.14

RESULTS FOR VARIOUS LEVELS OF RISK AVERSION, PANAMANIAN MODEL (NO INSURANCE, DEBT DEFAULT RISK 5%)

	Ø = 0	Ø = 0.5	Ø = 1.0	Ø = 1.5	Ø = 2.0	Ø = 2.5
INCOME AND UTILITY MEASURES (Dollars)						
Expected utility	3.326	3.203	3.083	3.021	2.985	2.958
Average income	3.326	3.326	3.242	3.180	3.102	3.079
Standard deviation	247	247	159	105	58	49
Coefficient of variation (percent)	7.4	7.4	4.9	3.3	1.9	1.6
SALES (Metric Tons)						
Corn	28.0	28.0	29..3	40.7	58.9	60.4
Rice	145.3	145.3	123.8	108.0	68.1	55.4
Beans	10.1	10.1	9.6	3.4	3.7	3.7
Tubers	30.9	30.9	30.9	30.9	30.9	30.9
INPUTS						
Uninsured credit($)	973	973	863	822	670	553
Hired labor	-	-	-	-	-	-
Total labor use on farm	358	358	352	363	357	352
Labor sold	138	134	136	144	144	138
TECHNOLOGY CHOICE						
Corn 1						
Corn 2						
Corn 3						
Corn 4				0.74	1.17	1.20
Corn 5				-	-	-
Rice 1	0.40	0.40	-	0.49	0.44	0.43
Rice 2	1.17	1.17	1.24	0.45	0.48	0.80
Rice 3						
Rice 4						
Rice 5	0.83	0.83	0.76	0.81	0.35	
Corn/Beans 1			-	-	-	
Corn/Beans 2			0.83	0.81	0.86	0.87
Corn/Beans 3						
Corn/Beans 4						
Corn/Beans 5	0.90	0.90	0.47			
SHADOW PRICES (%)						
Credit	14.00	14.00	14.00	14.00	14.00	14.00
Debt default	-	-	-	-	-	-

The coefficient of variation of income is 7.4% for Ø = 0, and declines to 1.6% for Ø = 2.5. This contracts with Guarare results where the coefficient of variation of income was about 20 percent. But in this latter case it declined more significantly for higher levels of risk aversion. Farming under the agroclimatic conditions of Bugaba district it clearly a less hazardous undertaking than in the area of Guarare.

Rice proves to be the most risky crop in the model, and total rice sales decline as risk aversion increases. The choice of production techniques is only weakly related to the level of risk aversion. There is a switch away from more intensive technologies for rice and intercropped corn and beans as Ø increases, but this is not offset by any increase in the less intensive technologies for these crops. Credit use does decline as Ø increases, indicating less use of modern inputs overall, but total labor use changes very little.

Because of the low level of income risk in all the model solutions, the debt default constraint is not binding at the 5% risk level. This means that credit is borrowed to the point where its marginal rate of return is equal to the interest charge of 14%. Since the debt default, constraint is not binding, then crop insurance will not affect the farmers' ability to borrow credit. Experiments with the model at even lower debt default risk led to similar findings. Indeed, the debt default risk constraint only became binding, (and marginally so), when the debt default risk was reduced to 0.0001%.

The only potential benefit from crop insurance, therefore, lies in enabling farmers to act in a more risk neutral way. Assuming a risk aversion parameter 0.15 for the typical farmer, then an ideal insurance scheme which removed all income fluctuations would have

the effect of moving the farmer from the fourth to the first column in Table No. 4.14.[12] This would lead to a gain in average income of only $146.

If the maximum possible gains from insurance are so small, then the returns from realistically designed schemes--which would be less effective in stabilizing incomes-- can not be encouraging. Indeed, the income gains are unlikely to cover the require premia.

The current crop insurance schemes in Panama cover the farmer for 80 percent of the approved costs of production. Indemnities are paid in the event of yield disasters. In the model the insurable crops are corn and rice, though the less intensive technologies of corn 1, corn 2 and rice 1, can not be insured since they do not qualify for loans from the agricultural bank. The insured coverage is about $340 per hectare for corn, and $500 for rice. The annual premium is $17 per hectare for corn and $25 per hectare for rice.

In turns out that in the revenue series in Table No. 4.12, no indemnities would have been paid for the more intensive corn and rice technologies during the period 1976 to 1981. Only in the case of corn 3 and rice 2, do the revenue outcomes ever fall bellow the covered amounts. In the case of corn 3, indemnities would not have been paid because yields were within 10 percent of their means in the years in which revenues were low. Rice 2 might have qualified for an indemnity in 1977 (the yield was 75 percent of its mean that year), but the indemnity would only have been $23, and which is less than the annual premium of $25.

In short, the typical farmer in Bugaba would not have received any net indemnities from the existing insurance schemes between 1971 and 1981, and there is no need to run the model to predict that he would not have purchased such insurance on a voluntary basis. The risk calculations are based on district level data, and individual

farmers in Bugaba may have experienced rather different yield and revenue outcomes each year. While insurance may not have been worthwhile for a farmer experiencing the average yield each year, individual farmers may have received worthwhile indemnities on occassion. Nevertheless, it may be difficult to justify an insurance scheme which is uneconomic for the average of the farmers it is intended to benefit.

F. Credit, Insurance and Technical Assistance on Technology Adoption and Income Stabilization.[13]

a. Introduction

The adoption of input and management intensive technologies is advocated primarily as a way to increase small farmers' income. Nevertheless, the diffusion and adoption process has been rather slow and costly. Uncertainty in yields and prices and farmers' attitudes towards risk have been recognized as important factor that inhibit borrowing, investment and the adoption of technology.[14]

Insurance offers and indemnity payment when yields are below proportion of the expected levels. In such case, insurance indirectly offers protection against price risk, as the crop coverage is calculated on the basis of and expected price. However, in spatially isolated markets and in the case of non perishable products, insurance that induces technical adoption which results in higher yields (and acreages planted) may contribute to lower incomes because of excess supply which lowers market prices. In such case, if there is not crop loss, insurance does not offer any guarantee of price.

A third point relates to the area substitution effect induced by insurance. Increased income expectations on the insured--presumably riskier and on the average, more profitable crop--could result in

area expansion at the expense of other less profitable, but also less risky crops. Yet, if there are no disasters, the expansion of the insured crop to be sold at a lower than anticipated price may have a pervasive effect on farm income. This would occurr because of lost opportunities on other crops for which prices have increased as a response to a decline in production.

b. Crop Credit Insurance (CCI) in Bolivia

CCI was offered first in Bolivia for potato production among farmers in Cochabamba in 1980/81. The public sector insurer (ASBA) offered protection to the credit issued by the public bank (BAB) for the production of potatoes under the technology recomended by the government Institute of Agricultural Technology (IBTA). Without insurance BAB would have not issued the credit, but also without insurance and credit, farmers would have not used IBTA's technology.

The insurance program guaranteed that if crop failure ocurred, the farmers' debt with BAB was paid by ASBA. The maximum indemnities for the amount disbursed by BAB, plus other investment supplied by farmers (such as organic fertilizer) and a compensation that the farmers receives for the value of his time (prices at the market wage). Hence, under total loss the farmer would receive not hte value of the harvest, but the total value of his labor and other costs. His debt will be paid to the bank.

The area were the program was implemented between 1980/81 and 1982/83 is not atypical of highland-semicommercial agriculture in Latin America. It should not be taken by any means as representative of a backward underdeveloped agriculture in remote places in Bolivia. The area is serviced by a paved road and some of the farms are less than 30 minutes distance from this road, however, others area faraway. Average temperatures are mild, however, over the past 11 years the average minumum has been 23°F (-4°C). The

probabilties of frost and hail are significant. The average annual railfall (over 17 years) is of 713.5 mm, yet periods of long drought are possible. The combined effects of drought and frost expose the crops to high yield risks, yet the severity varies among farms depending on their altitude and the direction of the winds. Therefore, those farmers with larger plots are not likely to be affected in the same intensity in all area planted. In addition, not all the land is planted the same day, hence intertermporal diversification is helpful to the extend that frost varies its damaging effects depending on the stage of growth, being more serious at flowering.

The average size of crop land is of 1.3 hectares per farm, of which potatoes account for approximately 56 percent of the area. Potatoes (Solanum Andigenum) are grown by all farmers. Othe important crops are broad beans (Vicia Faba), barley (Hordeum Vulgare), wheat (Treticum sp), oca (oxalis Tuberosa), papaliza (Ullucus Tuberosum), and onions. Potatoes are produced for home consumption (20%) and as a cash crop. Very few farmers grow onions, the most profitable and most price risky crop. If farmers have access to irrigation and early potato crop (misca) can be farmed. The misca potato crop is grown in part in the winter, making it susceptible to frost. The rain-fed cycle of potato, October-May (año) is the most important, making up 64% of the total are planted of potatoes. The experimental credit insurance has been offered only for rain-fed potato plantings.

c. Income from Potato Production Among Insured and Non-Insured Farmers, 1979/80 - 1982/83

The farm level analysis had the explicit purpose of evaluating the combined effect of credit, insurance, prices and technical assistance on the adoption of technology and farmer's income. This was made possible by data obtained over three years among insured

farmers and four years among non-insured farmers. The surveys' samples are summarized in Table No. 4.15. The unanticipated withdrawal of farmers from the program and impossibility of locating some farmers the days of the surveys, did not allow a more symmetric set. In 1980, 122 farmers were surveyed to detemine their characteristics before the beginning of the insurance program. Out of the original sample 38 farmers where insured and surveyed, and 36 farmers were not suveyed. The most interesting translocation of farmers among groups took place in 1982. From the 38 insured farmers in 1981, 15 took insurance for the second time, 7 did not take insurace and 16 were not located. From 33 insured farmers in 1982, in 1983 6 took insurance for the third time, 10 took insurance for the second time, and 17 did not take insurance. The following paragraphs describe the main results of the surveys, providing a comparative analysis of performance of groups over time.

The 1979/80 crop cycle was described by farmers as a fair year. Rainfall was close to average and opportune. Freezing temperatures occurred for very short periods of time, not a critical points in the crop cycle. Nevertheless, as shown in Table No. 4.16, yield of potatoes was rather low in comparison with other parts of the world (CIP, 1980). Low yields are the result of using a traditional technology, typified mainly by a low quality seed, and very spare use of chemicals for controlling nematodes and diseases; however, farmers used relatively high levels of organic and chemical fertilizers.

The improved technology was introduced in the 1980/81 crop cycle. This was described as a good year and practically no farmers reported major crop failures, neither did ASBA pay indemnities. In comparison with the previous year, farmers using the traditional technology reported yields that were 24 percent higher, although there were not significant changes in the levels of inputs use. Gross income was higher, but due to increased input prices, net income decreased slightly.

Table No.4.15

STRUCTURE OF THE SAMPLES AMONG INSURED AND NOT INSURED FARMERS

CLASS	TECHNOLOGY	1979/80	1980/81	1981/82	1982/83
NOT INSURED	Traditional	122	48	58	39
	Modern	-	-	7	43
INSURED	Modern	-	38	33	16
TOTAL	-	122	86	98	98

Table 4.16. Melga-Colomi, Resource Use, Yields and Income from Potato Production Among <u>not</u> Insured Farmers Using Traditional Technology, 1979/80 - 1982/83.

Variable / Year	1979/80 (122)		1980/81 (48)		1981/82 (58)		1982/83 (39)	
PRODUCTION COST								
Yunta (DS/yta)	22	2.453	23	3 435	24	3 649	24	11.854
Labor (DS/L)	136	10 296	113	10 640	150	14 087	129	29 672
Seed (cargas)	10	7 322	8	7 402	11	8 321	12	91 069
Organic fert. (cargas)	223	8 406	254	9 744	176	6 779	254	19 821
Chemical fert.		2 835		3 146		3 300		16 779
Insect. and fung.		675		778		1 140		9 018
Other								
TOTAL COST		31 987		35 145		32 276		178 213
INCOME	Kg (%)	$B	Kg (%)	$B	Kg (%)	$B	Kg (%)	$B
1°	3 014 (38.84)	17 481	3 759 (39,11)	18,795	2 453 (36,09)	22 494	1.623 (33.07)	113.610
2°	2 474 (31.88)	11 875	3 097 (32,22)	12,388	2 459 (36.18)	16 254	1.608 (32.76)	90.048
3°	1 875 (24.18)	7 129	2 325 (24.18)	6.975	1 393 (20.49)	6 282	341 (17.14)	17.050
4°	396 (5.10)	396	432 (4.49)	432	492 (7.24)	492	836 (17.03)	16.720
Total	7 760(100.00)		9 613(100,00)		6 797(100.00)		4.908(100.00)	
GROSS INCOME		36 881		38 500		45 522		237.428
NET INCOME BEFORE INDEMNITIES		4 894		3 445		8 246		59 215
INSURANCE INDEMNITIES		n.a		n.a		n,a		n,a
NET INCOME		4 894		3 445		8 246		59 215

n.a.=not applicable

The 'new'technology ws typified fundamentally by an increased amount of seed of improved quality, slightly less organic fertilizer and more chemical fertilizer, insecticides and fungicides. An important component of production costs was the interest costs of credit and the insurance premium. The impact of the technology on yields was dramatic as these were of 14.680 kg/ha compared with 9.613 kg/hg obtained by farmers using the traditional technology. Net income was, therefore, more than four times that received by farmers using the traditional technology. An important determinant of this larger income was the increased proportion of grade 1 potatoes, sold at a higher price (Table No.4.17).

Up to this point the benefits of the program (in a good year) were unquestionable and they can all be attributed to the performance called that prices were to a great extend quaranteed by the rapid move of ASBA's staff to contact truckers who purchased the excess production. This allowed to sell marketable surpluses without delay and at a fair price. As shown in Table No.4.17, however, the potato prices in 1981 were lower than in the previous year.

The 1981/82 crop cycle was a fair one. ASBA insured 56 producers (in Melga) and received premiumsfor B/103.056. In comparison with 1980/81, when no indemnities were paid, in 1981/82 ASBA's indemnities totaled B/215.719, hence the lost ratio was of 2.09. Yield of potatoes of non-insured farmers using the traditional technology declined by 29.3 percent but that of insured producers using the modern technology declined by 44.1 percent. This provides additional evidence that modern technologies perform more poorly than traditional ones under less than optimal weather conditions.

ble 4.17. Melga-Colomi, Resource Use, Yields and Income from Potato Production Among Insured Farmers Using Recommended Technology, 1980/81 - 1982/83.

Year / riable	1979/80	1980/81 (38)		1981/82 (33)		1982/83 (16)	
ODUCTION COST							
Yunta (DS/yta)		25	3 795	27	3 992	22	10 672
Labor (DS/L)		142	13 282	144	13 501	109	25 040
Seed (cargas)		12	9 211	14	10 775	14	106 732
Organic fert. (cargas)		207	7 856	211	8 128	280	25 289
Chemical fertilizer			4 600		3 721		16 931
Insect. and fung.			2 790		1 997		8 527
Other (premium)					5 847		5 398
TAL COST			41 534		47 961		198 589
COME		kg (%)	$B	kg (%)	$B	kg (%)	$B
1°		6 588 (44.88)	32 940	2 980 (36.35)	27 327	1 513 (30.14)	105 910
2°		4 386 (29.88)	17 544	2 856 (34.84)	18 875	1 380 (27.50)	77 280
3°		4 726 (18.57)	8 178	1 364 (16.64)	6 152	910 (18.13)	45 500
4°		980 (6.67)	980	998 (12.17)	998	1 216 (24.23)	12 160
otal		16 680(100.00)		8 198(100.00)		5 019(100.00)	
ROSS INCOME			59 642		53 353		240 850
ET INCOME BEFORE NDEMNITIES			15 052		5 392		36 697
NSURANCE INDEMNITIES			0		3 920		15 522
ET INCOME			15 052		9 312		52 219

The significant drop in yields was apparently compensated for by a large increase in market prices evidencing the nature of negative correlations between yields and prices. In real terms the prices in 1981/82 were significantly larger than in 1980/81, as shown in Table No.4.18. Interestingly, the net income (before indemnities) of non-insured producers increased with respect to the previous year, while that of insured producers declined. But indemnities allowed the net income of insured producers to increase by almost 60 percent, thus providing them with net income after indemnity payment of B/9.312 compared to B/5.392 before indemnities.

In 1982/83 crop cycle was a poor one, ASBA insured 16 producers in Melga and received premiums for $b133.488. ASBA's indemnities added to $b369.074 hence showing a lost ratio of 2.8 which is the highest in the three years that ASBA is offering crop creedit insurance.

A group of producers that in 1980/81 participated in the program, decided to invest their own resources for the 1981/82 crop year, hence they did insured investment and did not borrow from BAB, therefore saving around b/5.800 on interest and insurance premium (the amount paid by insured farmers in that year). In comparison with insured farmers, the independent group reported smaller amount of all inputs except for chemical fertilizers. This could be indicative of a learning process through which they identified a larger marginal productivity of chemical fertilizer than of other inputs. These farmers apparently saved on all inputs, but their main reduction in cost was from not paying interest on borrowed funds, insurance premium and less amount of labor, as shown in Table No. 4.19.

This group reported 81 percent of their produce of grades no. 1 and 2 compared with 71 percent of insured farmers and also produced a very small amount of grade No. 4 potatoes. Their total yield was

TABLE No.4.18

CONSUMER PRICE INDEX, PER MONTH AND YEAR
(BASE 1966 = 100): LA PAZ - BOLIVIA

YEAR MONTH	1979	1980	1981	1982	1983
January	431.01	633.15	866.92	989.21	3.848.40
February	440.08	635.54	883.49	1.148.09	4.242.96
March	438.10	646.09	881.03	1.241.70	4.744.27
April	434.81	651.70	881.92	1.398.84	
May	445.78	671.36	901.41	1.454.52	
June	453.72	708.49	902.62	1.528.00	
July	467.41	718.90	915.62	1.851.68	
August	476.50	742.88	970.46	2.182.81	
September	482.25	725.55	965.70	2.607.75	
October	490.25	735.20	972.44	2.989.36	
November	511.72	743.62	971.08	3.550.10	
December	622.12	771.03	964.74	3.825.64	
Mean	474.48	698.63	923.12	2.063.52	
Mean Agr. Year	561.82	796.70	1.074.59	3.137.10	
June-July	100	141.81	191.27	558.38	

SOURCE: Indice de precios al consumidor - Boletines mensuales 1-12-1982, 1-3, 1983 y anuario 1981, Instituto Nacional de Estadísticas, La Paz, Bolivia.

able 4.19. Melga-Colomi, Resource Use, Yields and Income from Potato Production Among Not Insured Farmers Using Recommended Technology (farmers were insured at least one year).

Year / ariable	1979/80	1980/81	1981/82 (7)[1/]		1982/83 (13)[2/]	
RODUCTION COST						
Yunta (DS/yta)			18	2 748	23	11 286
Labor (DS/L)			99	9 317	144	33 120
Seed (cargas)			13	10 176	14	101 875
Organic fert. (cargas)			151	5 613	319	27 839
Chemical fertilizer				4 143		21 065
Insect. and fung.				1 570		9 311
Other						
TOTAL COST				33 567		204 496
INCOME			kg (%)	$B	kg (%)	$B
1°			2 942 (40.57)	26 978	1 339 (30.74)	93 730
2°			2 967 (40.91)	19 612	1 185 (27.20)	66 360
3°			1 117 (15.40)	5 038	886 (19.88	43 300
4°			226 (3.12)	226	996 (22.18)	19.320
Total			7 252(100.00)		4 356(100.00)	
GROSS INCOME				51 854		222 710
NET INCOME BEFORE INDEMNITIES				18 287		18 214
INSURANCE INDEMNITIES				n.a.		n.a.
NET INCOME				18 287		18 214

n.a. = not applicable

1/ Insured in 1980/81 but non insured in 198 /8

2/ Insured in 1980/81 or 1981/82 but non insured in 1982/83

7.252 kg/ha, while insured farmers produced 8.198 kg/ha. The total gross income obtained by independent producers was slightly less than the one of insured farmers, but because of the important reduction in costs, their net income was four times that of the insured producers. A tentative conclusion from this analysis is that the availability of insured credit to farmers may induce excess use of inputs because the risk of expected income is reduced through insurance.

In the crop cycle of 1982/83 a group of 43 farmers previously insured decided to invest their own resources, these producers were insured in 1979/80 or 1980/81 but not in 1982/83. This group had a similar yield (5,000 kg/ha) to insured and non insured producers. The net real income of previously insured farmers that invested their own resources were higher and their costs lower compared to the insured producers.

A summary of the main economic indicators for all groups of farmers over time is given in Table No. 4.20. Also table 4.21 provides the mean and standard deviation of yields, real costs and real net returns for insured and non-insured producers. It can be concluded that on the average the yield of insured farmers was about 28 percent larger but the variability over time was much more significant. In fact the coefficient of variation of yield of insured farmers was 53 percent compared with 27 percent for non insured farmers. In general, in the worst years the yield of both groups was almost equal, but in the good years the insured farmers performed much better.

There are no significant differences on income before indemnities nor in their total variability measured by the standard deviation. However average income after indemnities increases considerably while the standard deviation is below the one for income before indemnities.

Table 4.20 Melga-Colomi; Yield, Seed, Costs and Income from Potato Production Among Insured and not Insured Farmers, 1979/80 - 1982/83

Year	1979/80	1980/81		1981/82		1982/83[1/]	
A. TRADITIONAL TECHNOLOGY (non insured farmers)			%		%		%
Yield (kg/ha)	7 760	9 613		6 793		4 908	
Seed (cargas)	10	8		11		12	
Cost organic fert. $B	7 322	9 744	(71.2)	6 779	(60.4)	19 821	(43.4)
Cost chemical fert. $B	8 406	3 146	(23.0)	3 300	(29.4)	16 779	(36.8)
Cost insect. and fung. $B	675	778	(5.6)	1 140	(10.2)	9 018	(19.8)
Total cost	31 987	35 145		37 276		178 213	
Gross income	36 881	38 500		45 522		237 428	
Net income	4 894	3 445		8 246		59 215	
B. RECOMMENDED TECHNOLOGY (insured farmers)							
Yield (kg/ha)		14 680		8 198		5 019	
Seed (cargas)		12		14		14	
Cost organic fert. $B		7 856	(51.5)	8 128	(58.7)	25 289	(49 8)
Cost chemical fert. $B		4 600	(30 2)	3 721	(26.9)	16 931	(33.4)
Cost insect. and fung. $B		2 790	(19.3)	1 997	(14.4)	9 527	(16.8)
Total cost		4 459		47 961		198 589	
Gross income		59 642		53 353		240 850	
Net income before indemn.		15 052		5 392		36 697	
Net income after indemn.				9 312		52 219	
C. VOLUNTARY ADOPTION OF TECHNOLOGY (previous year insured)							
Yield (kg/ha)				7 252		4 356	
Seed (cargas)				13		14	
Cost organic fert. $B				5 613	(49.6)	27 839	(47.8)
Cost chemical fert. $B				4 143	(36.6)	21 065	(36.2)
Cost insect. and fung. $B				1 570	(13.8)	9 311	(16.0)
Total cost				33 567		204 496	
Gross income				51 854		222 710	
Net income				18 287		18 214	

Table 4.21. Mean and Standard Deviation over Time of Price, Yield and Income; Among Insured and non-Insured Farmers: Per Hectare, Melga-Cochabamba.

Year	Non Insured Farmers			Insured Farmers			
	Yield	Real total cost	Net Real income	Yield	Real total cost	Net Real before indemn.	Net real income after indemnities
1979/80	7 760	31 987	4 894	-	-	-	-
1980/81	9 613	24 783	2 429	14 680	31 351	10 614	10 614
1981/82 1/	6 797	19 489	4 311	8 198	25 075	2 819	4 869
1982/83	4 908	32 878	12 623	5 019	36 562	6 572	9 352
Mean	7 269.5	27 284.25	6 064.25	9 299	30 996	6 668.33	8 278.23
Standard deviation	1 960.6	6 335.82	4 497.24	4 923.7	5 752	3 898.39	3 019.24

1/ Insurance indemnities were paid to insured farmers.

G. Insurance Demand under Guaranteed prices and High Financial Risk[15]

a. Introduction.

The nature of yield and price risks and their correlation has been taken as a departure point to evaluate potential benefits of insurance (Roumassett, 1979, Hazell Bassoco and Arcia, 1983, Cartas and Norton, 1983). In the simpliest case of monoculture farms or when most of the income is generated by the production of one crop, the expected revenue and variance of revenue without insurance is given by:

$$E\ (R) = E\ (P) \times E\ (Q) \qquad (1)$$

$$E\ (R) = E\ (P2)\ V\ (Q) + 2E\ (P)\ E\ (Q)\ cov\ (P.Q) \qquad (2)$$

The benefits of insurance are perceived in two forms: By stabilizing income over time (hence reducing V (R) and by helping to ensure that the farm family has the necessary income each year to repay debts and meet escencial living costs. To evaluate more precisely the benefits on insurance, one can expand the income and variance of income measured by and indemnity component, therefore, when insurance is available:

$$E'\ (R) = E\ (R) + E(I) \qquad (3)$$

$$V'\ (R) = V\ (R) + V(I) + cov\ (I.R) \qquad (4)$$

Therefore subsidized insurance increases expected income by the amount of the expected net indemnity.[16] If insurance is actuarially fair, in the long run E(I) is zero, but in practice, because insurance has always been subsidized, E (I) 0. The larger the amount of the subsidy, the larger E(I) and therefore, the largest its contribution towards expected income.[17]

Insurance reduces the variance of income overtime by increasing income (by the amount of the indemnity) in those years when a disaster occurs, and by decreasing income (by the amount of the premium) in those years when disasters do not occur. But insurance does not reduce variance of income by affecting V (Q) or cov(P,Q). In fact if insurance induces technological change, these variances could actually increase the variance of income before indemnities. As the amount of the governments subsidy on premiums increases, so does the expected value of income, but care must be exercised for this not to be a motive to demand insurance. When this occurs insurance becomes a source of income and not a way to decrease the variance of income.

In contrast with yield insurance, the benefit of a guaranteed price is known in advance and there is certainty that all the production will be sold at that price. In terms of equation (2) a guaranteed price cancels the second element on the right hand side and affects positively or negatively the third term). Hence, to the extent that the price is guaranteed it means that there is not price risk and this could reduce the variance of income. However, if the price is not larger than in the previous years it does not necessarily increase expected income.[18] Only higher prices lead to higher expected income and hence more willingness to bear risk, but also, they lead into higher investments on inputs, therefore, a larger financial risk which will increase the demand for insurance.

If we limit the analysis to monoculture farms, one can expect that the demand for insurance increases with risk of the insured crop. In such case, the larger variance of production income resulting from specialization on one crop, can be compensated by insurance and move the farmer to a higher utility function, given the expected indemnity.

b. Production of Industrial Tomatoes in Panama

Industrial tomatoes are produced in Panama under contracts between the Nestlé Company and individual producers. Under assumptions about expected yield the contract specifies the acreage to be planted and the price to be paid, and it provides technical assistance and it guarantees the supply of inputs. Finance is provided through short term loans of the BDA. The production is done during the off-season and it needs from irrigation. The water is usually pumped from neighboring canals, hence requiring investments on irrigation equipment, usually a diesel or gasoline pump. On the average the area planted is of 2 hectares and production costs are on the border of 2.500 $/ha, about 5 times those of rice, corn and sorghum.

Tomato producers have enjoyed subsidized credit from the BDA and the loan recovery rate has been, on the average larger than for other crops. However, this recovery rate had been declining until 1978, hence the BDA demanded credit insurance to obtain loans. Insurance is provided for 80 percent of the loan at a premium of 6 percent. In contrast with farmers producing other crops, tomato producers have accepted the insurance conditions although it increased the cost of credit by about 4.8 percent. Total revenue from tomato production is, however, quite above the costs and it leaves a net margin of about 1.000 $/ha compared to $100 to $150 for grains.

c. Effects of Insurance on Farm Income and Credit Recovery

Tomatoes were insured by ISA for the first time in 1979/80, and approximately 62 percent of theBDA borrowers were insured at that time. Beginning in 1980/81, practically over 95 percent of borrowers were insured. The small number that did not insure their crops were exempted by the BDA, because it was considered that they

had an extremely good record (or else they may have been quite influential to go without insurance!). Tomato insurance represents a burden of administrative costs to ISA because of the large number of producers (over 450 as an average in the last three years). The number of policies represents 18 percent of the total crop policies and even though, the coverage per hectare is rather large (three times that of maize) the total coverage accounts for only 10 percent of ISA's crop coverage (figures for 1980/81 - 1982/83). Although the crop is irrigated, farmers face the risk of severe drought, excess humidity and diseases. But the reason for high demand for insurance seems to be largely explained by the financial risk to which the farmer is exposed, because high value loans from the BDA for production costs and amortization of equipment. This would support the hypothesis that the higher the financial risk, the larger the demand for insurance, hence implying that insurance may be more desirable for capitalized farmers. Furthermore, it also shown that when price risk is removed, insurance has more to offer and hence it becomes more attractive, otherwise the farmers would just gamble on price and yield risks.

Given the guaranteed price scheme, high technology and operating costs, the case of tomato producers was examined more closely to find net benefits of insurance when 'ideal' conditions are given. Table No. 4.22 shows the main economic indicators of tomato production in the two areas in Panama, were this crop is grown. The survey was taken among insured and non insured farmeres in 1979/80.[17]

Producers in Cocle plant smaller acreage and in 1979/80 they were affected by disasters in most of the area. But the intensity of the disaster was rather small and hence final indemnities per hectare average $163. Seventy-six percent of the farmers received indemnities. In Los Santos insured farmers planted about the same

Table 4.22. Panama, Economic Indicators of Tomate Production 1979/80.

Variables	Cocle				Los Santos			
	Insured		Not-Insured		Insured		Not-Insured	
	N°	Average	N°	Average	N°	Average	N°	Average
DATA PER FARM								
Gross income	21	4 087	11	4 192	86	5 783	17	6 545
Area planted	21	1.82	11	1.75	86	1.83	17	2.44
Production harvested	21	669	11	666		788		
Indemnities	16	296	-	-	7	732	17	753
Gross income after indemnity	21	4 382	-	4 192	86	6 611	17	6 545
DATA PER HECTARE								
Yield	-	372	-	384	-	447	-	407
Gross income	-	2 242	-	2 395	-	3 160	-	2 682
Indemnity	-	163	-	-	-	400	-	-
Gross income after indemnity	-	2 498	-	2 395	-	3 560	-	2 682

acreage in Cocle, but their yields per hectare are significantly larger on the average. But 7 of the 86 producers lost a major portion of their crop and indemnities averaged $400 per hectare.

The data in Table No. 4.22 reveal that in a single year the benefits of insurance were of very different type in each region. In Cocle the income before indemnities was larger among non-insured farmers, and indemnities allowed a change in conditions as insured farmers had a income per hectare that was only 4 percent larger than the one of non-insured farmers. In Los Santos, income per hectare even before indemnities was much largerfor insured farmers and it increased substantially by the amount of the indemnity. But the insurance benefits were shared by only 8 percent of the insured farmers.

The results of the first year of operations, the continuing support from Nestle and the invariant BDA and ISA credit and insurance conditions had important implications for the demand for insurance in the following years. As it is observed in Table No. 4.24 practically all clients from the BDA now insure their tomato crop. In 1981/82 when ISA could not insure all credit for tomato production (the reasons were not identified), the net result on the bank's recovery rate were quite noticeable.

This simple research piece has shown the importance of insurance for farmers facing large financial risks and low prices risks. The most important implications is that given the wide variety of risks that farmers face (especially price risk) and given their poor state of capitalization, there is not reason to expect a 'natural' demand for insurance. Therefore, unless other risks, besides production risks, are diminished and until farmers are more capitalized it may be better not to insist with all-risk crop insurance.

Table 4.23. **Financing and Insuring of the Tomato Production in Panama, 1974/75 - 1982/83**

Credit	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
Number of borrowings	439	274	420	310	504	512	498	726	410
Financed areas (has)	991	624	813	855	1,087	684	876	733	711
Amount borrowed (B/.)	884,191	490,078	793,886	950,955	984,290	923,428	1,454,264	913,663	1,230,587
Amount recovery (B/.)	789,875	423,655	571,260	755,257	800,669	839,539	1,315,827	786,663	1,127,941
Balance (B/.)	85,315	66,423	222,626	195,698	183,621	83,899	138,437	127,000	102,646
Net recovery	0.903	0.863	0.71	0.794	0.813	0.909	0.905	0.861	0.917
Insurance									
Number of insurers 2/	-	-	-	-	-	320	470	384	438
Insured area (has) 2/	-	-	-	-	-	540	860	428	694
Coverage (B/.) 3/	-	-	-	-	-	543,500	1,290,255	689,079	1,144,766
Premium (B/.)	-	-	-	-	-	39,386	77,855	41,345	69,007
Amount indemnity (B/.)	-	-	-	-	-	17,053	75,993	85,131	40,561
Sinister area (has)	-	-	-	-	-	34	55	115	72
Coverage per hectare (B/./ha)	-	-	-	-	-	1,000	1,500	1,630	1,650
Indemnity per hectare (B/.ha)	-	-	-	-	-	53	88	19,9	58

Sources: 1 Banco de Desarrollo Agropecuario; Evaluaciones del cultivo de tomate industrial varios años y estadística.

1 Instituto de Seguro Agropecuario, Informe Anual, 1979/80 y 1982/83.

1/ It refers to the real amount disbursed by the ADB

2/ Include areas of autofinanced producers with the financing of the cooperative production and from the NBP.

3/ It is in function of the insured area according to the coverage and include producers with own financing, from the NBP and cooperatives. The coverage for these groups ascend to B/89,925.

4/ Notice that it is measuring effective recuperations.

H. Conclusions and Policy Recommendations

In relation to the demand for crop insurance by farmers, the following are the most important conclusions and recommendations:

a. An analysis of the nature of yield variability over time is a point of departure to determine the insurability of a crop. Systematically low and unestable yields which reflect low productivity should not be insured. However, if technical assistance and economic incentives are available, crop insurance could be offered initially to help in the introduction of new technology. Yields that fluctuate signficantly over time should not be insured, because this will require very large premiums. In this case investments in infrastructure for risk preventions, like irrigation will help to increase and stabilize yields. Crop insurance should be offered only for those cases when yields fall very low or to zero levels because of disasters of climatic origin which do not occurr more frequently than every 6 to 8 years.

b. Farmers have a their reach several traditional methods of risk managment, but such methods proof effective only when there are not major disaster or catastrophies, which affect the whole farm and produce destruction of farm resources. The results of the analysis in Bolivia, support previous findings from several authors for other countries, about how most farmers diversify effectively by crops planting dates, technologies, ecological floors, when risks are moderate.

c. Farmers demand for insurance at a particular point in time is a function of the level of premiums, the expected net income from production and the occurrence of disasters in the most recent past. However, the stability of the demand for insurance over time at a given premium, is strongly influenced by the farmers understanding of insurance. The antropological studies in Panama and the surveys

in Ecuador demonstrate that farmers did not view insurance as a long term financial instrument, in part because the insurers had not explained this point to farmers. Therefore, to create a natural demand for insurance, the technicians from insurers should first understand themselves how insurance works and then explain this to farmers.

d. Also in relation to the demand for insurance, when it is compulsory and tied to the use of credit, it is rejected by farmers, because they view procurement costs and premiums as an additional cost of credit. Given current practices and strenght of development banks, farmers can not explain themselves why such institutions could not just continue their procedures of rescheduling debt or issuing areas. Therefore, given the farmers aversion to new institutions and additional bureaucracy, an option could be not to create the insurer, but just to raise the interest rate by the amount of a risk premium, and let the lending institution manage its risks.

e. The studies in Panama also shows that farmers who do not receive indemnities after the second or third year leave the programs, leading the insurer to confront the problem of adverse selection. This was also found in Ecuador, where many farmers left the program. Therefore, before creating insurers, it is important, besides the understanding of insurance, to analyze the farmers' planning horizon and if it is not long enough, insurance should not be promoted.

f. The analysis of farmers' behaviour and their attitudes towards risk using a farm model in Panama, allowed to conclude that the availability of insurance for individual crops will lead farmers to purchase insurance only for the riskier ones. Farmers will grow these riskier crops under the expectations of higher net returns, and the elimination of yield risk. To the extent that this results

in an increase in production due to increases in areas planted, farmers will sacrifice areas of less risky crops, hence making aggregate supply more unstable. Therefore, insurance should be promoted with the intent of increasing levels of input use through technology adoption, rather than substitution among the areas planted of the various crops. In other words insurance and diversification should be complementary.

g. The results of the analysis with a farm model in Guarare district in Panama were encouraging for insurance. There was a very high return to farmers from ISA's maize insurance, sufficiently high by fact that the scheme should be viable without any subsidies. Insurance for sorghum, however, proved to be much less remunerative. It should be remembered however, that Guarare district is one of the riskiest agroclimatic zones in Panama, and the finding can not be generalized to Panama as a whole. Another study of insurance in Bugaba using also a farm model indicated that the typical farmer in this district would not be significantly affected positively by the presence of compulsory insurance under present conditions. In addition, such farmer would not have purchased insurance on a voluntary basis. These findings support the notion that insurance is demanded when risk exposure is larger and therefore insurance should be offered only against major disasters.

h. It was shown in the case of Bolivia that the input intensive technology used by farmers increased potato yields in highland rain-fed agriculture in relatively good years such as 1980-81. In poor years, however, (1982-83), the yields of farmers with and without modern technology are quite similar (low for all the groups studied). The adoption of the improved technology in this area was greatly facilitated by the existence of the credit-technology - insurance package. Once the new technology was introduced thanks to the availability of insurance, farmers show a willingness to

continue utilizing most of the technology, but preferred not to use the official credit and insurance, perhaps because enough savings were available. Therefore, it wouls appear that by eliminating yield uncertainty insurance facilitates the introduction of modern technologies. Therefore, the use of crop insurance is a promising field to strengthen the extension service in developing countries.

i. The studies in Bolivia showed that insurance reduces the standard deviation of the net income, hence this is more predictable under insurance than without it. One would consequently expect that in an actuarially fair insurance scheme, insured farmers would enjoy higher net incomes in bad years (due to indemnity payments) although non-insured farmers would receive larger net incomes in good years. The choice then for the farmer is to decide between income fluctuations by not insuring or, alternatively, opt for a steady income stream by using insurance to transfer some of the profits the farmers would have realized in good years to bad years.

j. It was also evidenced from the Bolivian and Panama cases that CCI is only one of the financial services needed by farmers to effective marketing and price policies, CCI may have only a marginal impact on the stability of farm incomes. The greatest utility can be realized when CCI is part of an integrated income stabilization policy which addresses the interrelated problems of yield variability, price risk, and marketing margins.

k. From the studies in Bolivia it was also shown that insurance induced technical adoption, but that at the farm level the net benefits were largely due to the degree of yield and price correlation for all crops grown. Hence in farms with enough possibilities for diversification by crops and by planting dates,

insurance has a much more limited role unless major disasters were to affect severely all crops, but this was not the case in Bolivia. In contrast with this last finding, the study of tomato producers in Panama reveals that insurance is most attractive for monoculture farms, when the price risk is eliminated and when indebtness is larger per unit of area.

The farm level studies have shown important information for the design of insurance programs. The main conclusion is that for insurance to be viable, there must be a demand for it. This demand exists in different degrees, given the nature of risks and the farmers capacity to manage them, but it is strongly influenced possitively by the farmers understandingof insurance and by the magnitude of financial risks. It is also concluded that given other risk management instruments available, crop insurance should be offered only for catastrophic losses when other means are not effective.

FOOTNOTES

1/ This section uses a methodology proposed by Jean Paul Lhomme, which is discussed in greater detail in Chapter 4 (The Supply of Agricultural Insurance) of this report, and it is based on the work of Andia y Ccama (1983).

2/ According to John Murra in his book "Formaciones Económicas y Políticas del Mundo Andino", the ability of the Andean people to own land and to farm in several ecological zones simultaneously is not new.

3/ Based on the work of Heckadon (1981).

4/ The lands are owned by small income groups which abandoned agriculture because of extreme risk aversion consistent with their age and inability to farm. The richer land owners in the area do not in general rent out their lands.

5/ Given the persistent drought condition, alfalfa was providing yields that were less than 50 percent of those under ideal conditions, but the variability of it from cut to cut was minimal, hence farmers adjusted by lowering the number of head per hectare and providing supplementary concentrate. As a result net incomes were lower but stable, especially since the price of milk was guaranteed.

6/ This is consistent with ISA's experience, which indicates that the lowest loss ratio was on fattening cattle (0.73) compared with sementals (1.04) and cows (0.93).

7/ Based on the work of Avalos and Dousdebes (1983).

8/ A group of farmers that did not purchase insurance indicated that the reason was that they did not have enough information (76 percent) while others indicated that the price was too high (14 percent).

9/ CONASA reported much lower loss ratio because this was calculate using total premium income, part of which is contributed by the government.

10/ Data until December of 1982.

11/ Based on the work of Hazell and Arcia (1982), revised in 1983.

12/ An ideal insurance scheme is not feasible in practice because of its excessive cost.

13/ Based on thw work of Ccama, Gudger and Pomareda (1982) and Ccama (1983).

14/ Uncertainty in yields is understandably a limitation for technology adoption. It is well demonstrated that under uncertainty, economically optimum use of improved seeds and fertilizers could well be at zero levels; hence the justified use of traditional technologies. In yield uncertainty was managed through a well understood crop insurance program, farmers would be more willing to adopt. Yet, farmers, as conservative and as suspicious as they are of government programs, may still hesitate before taking insurance, even when this is offered at a very low (subsidized) premium.

15/ Based on the work of Fuentes and Pomareda (1982) and more recent data gathered by Danaik García.

16/ Net indemnity equals the amount received in indemnities minus the premium paid by the farmer.

17/ Plantings are done between November and January, and harvest usually extends between March and May.

V. AGRICULTURAL CREDIT AND THE EFFECTS OF INSURANCE ON BANK PERFORMANCE

V. AGRICULTURAL CREDIT AND THE EFFECTS OF INSURANCE ON BANK PERFORMANCE

A. The Political Economy of Agricultural Credit: Setting the Hypothesis

B. Insurable Risks and the Expected Benefits of Insurance

C. The Direct Benefits of Insurance and Loan Recovery

D. The Impact of Insurance on Bank Growth.

E. Higher Interest Rates as Alternative to Credit Insurance

F. Conclusions and Policy Recommendations

V. AGRICULTURAL CREDIT AND THE EFFECTS OF INSURANCE ON BANK PERFORMANCE[1]

A. The Political Economy of Agricultural Credit. Setting the Hypothesis

The debate on the financing of agriculture in developing countries has long centered aroun two basic issues. One relates to the organization and quality of service provided by the development finance institutions. The other relates to the financial policies themselves.

Institutional design has made most agricultural development banks (ADBs) a class of rather specialized farm credit agencies. As such, they provide loans for agricultural production and few other financial services. Also, they rely mostly on international soft loans and government contributions all of which contributes to their limited capacity to act as financial intermediaries.

Financial policies toward agriculture depart from the basic philosophy that low interest rates are a necessary condition for technical substitution and increased income in rural areas. There is, however, much controversy on the validity of these policies. They are in part responsible for a series of distortions in the capital markets, and the inability of the development banks to grow by generating their own resources.

ADBs have reduced earnings because of interest rate policies and limited financial intermediation capacity. This is one of the major reasons for ADBs to provide a low quality service. But, also in order to fulfill development goals, ADBs must serve a large number of small farmers, which implies high operating costs for the banks.

Considering that the instability of farmers income due to crop failures is an important reason for low loan repayment, credit insurance is being considered among the components of a new strategy to increase a supply of credit. How effective this policy can be, has been up to now a theoretical issue, and it was hypothesized that credit insurance increases loan recovery rates. Even when this was the case, the question still remains as to how credit insurance changes the bank's growth of credit supply in comparison with alternative changes in policies and management, and how cost effective is credit insurance.

The remaining of this Chapter analyzes the points outlined above, i.e., the institutional design of ADBs and their financial policies, the risks in agriculture and their effect on income stability and loan repayment, and the effects of credit insurance on the later.

Development banks are financial institutions which integrate the system necessary to support economic development. As such they have particular ways of fulfilling their functions and also, if publicly owned, they are highly exposed to government intervention.

Development banking emerged in the post-World War II period to meet a need to supply low price capital for economic growth. These bansk are intended to provide a complete package of services, including capital and management for development purposes (Basu, 1974). Most development banks were created with the purpose of serving a particular sector (industry or agriculture), and hence specific types of development projects. The latter are supposed to have high social rates or return, but they also need low cost capital to be financially viable.

Given this characteristic of development projects, banks face a conflict of purposes. Kane (1975) explains that the conflict

emerges because, as a development institution, the bank should deal with those projects with the highest ranking on the development impact scale. As a banking institution, it should finance those projects with the highest ranking in the financial (interest rate) scale.

In deciding which development projects to finance, the development banks are influenced by government goals and policies and by financial criteria. Governments exercise pressure on the banks to finance particular projects expected to benefit target groups. Once this is decided, the banks must seek funds to implement such projects. However, the lower the expected monetary return of the project, the more difficult it is to get the funds to finance it. To the extent that the government wishes to reach certain political targets and groups, it will increase the level of subsidy, and/or the pressure to get external-low cost funds. While fulfilling these functions, a development bank becomes a mer conduit for funds and less of a financial intermediary.

The above functioning of development banks has been criticized, especially in the case of public development banks. To the extent that the bank leans more towards private ownership, profit and hence monetary return on projects, becomes a more important criteria in a project financing. In this regard Kane (1975) concludes that public development banks therefore, make a more significant contribution to economic development than private banks. This assertion is questionable in the long run, when banks with low earnings have a slower growth as a function of their financial performance, and hence the need for continuous subsidies.

This discussion is indicative that development banks intend to operate as banks within the limits imposed by political constraints and institutional design. They are concerned about earnings while fulfilling development goals, hence at the difference of commercial banks, profits per se is not the motive in development banking.

In a political context, ADBs are an instrument of government policy for agriculture. As such they should serve particular groups of producers, usually the farmers. ADBs supply credit for crops that have high priority, either as part of food supply programs or for those that provide the basic foreign exchange earnings. They are characterized by very large operating costs, because of the type of clientele they serve. Finally, as a general rule, they have poor loan collection performance, which reduces even further the earnings margin or makes it negative, hence the permanent need for government subsidies.

Many agricultural development banks are very specialized institutions. Von Pischke, Hefferman, and Adams (1981) refer to them as "specialized farm credit institutions". The great majority of them are publicly owned banks, limited to offering farmers low interest rate loans, but not other financial services. They do not accept checking and savings deposits, provide money, transfer services, store valuables for safekeeping or serve as fiduciaries. The limited sources of funds for these institutions inhibits them from acting as financial intermediaries. Von Pischke (1981) suggests that the limited capacity to access market funds results in alienation of the institution, because it can not intermediate between rural savers and borrowers, and it limits itself to serve as a link between the government and the rural sector. On the other hand, this institutional design and the high operating costs do not allow the bank to offer good quality credit, hence the farmers' preference for rural private lenders (Ladman, 1981).

In a recent analysis of the portfolio composition of 97 development banks in Latin America, Pomareda (1982,b) found very peculiar characteristics of those banks serving primarily or exclusively the agricultural sector. Banks with over 90 percent of their resources allocated to agriculture were exclusively public

banks, they were smaller than the other banks and they depended fundamentally on internal resources. The most significant contribution to the latter was public borrowings. The proportion of public deposits in the portfolio was around 3 percent compared with 40 percent for other banks.

The discussion presented here suggests that the ADBs have much to gain from acting more as financial intermediaries. This is to say that the bank can restructure the composition of their assets and liabilities, but still specialize in lending to agriculture. A bank could even charge low rates on certain agricultural loans, if it can earn more in its role as financial intermediary by issuing checking and savings accounts and investing on securities.

As part of the same philosophy of finance for development, interest rates for agriculture are below market rates. Most developing countries provide subsidized interest rates to agriculture, with the main purpose of inducing the adoption of capital intensive technologies that would result in increased productivity. Low interest rates have been visualized as a necessary condition for agricultural development, yet much controversy exists on the subject. Besides the criterion of "low interest rates to induce technology adoption", several other arguments are offered to justify this policy. Some of these arguments are discussed below.

Low interest credit is offered as an alternative to high cost funds supplied by informal lenders in the rural markets. These groups are believed to exercise monopoly power, and hence, to receive returns above their costs. Nevertheless, informal lenders usually offer to farmers other services like input supply and a guarantee of purchasing the harvest (Barton, 1977, Bouman, 1979), hence justifying a higher cost of capital. On the other hand, the high cost of informal credit, usually delivered at the farm, may not

be higher than the real cost the farmer faces when using official credit. This includes the farmer's time until the credit is obtained and during the loan supervision period (Adams, 1981). In many cases, however, these intermediaries do exploit the opportunities in the rural sector and exercise monopoly power, particularly among the less fortunate farmers who do not qualify as credit worthy according to the ADB criteria.

Perhaps, the strongest argument for low interest credit has its roots in the historical time when development policies were originally designed. The development philosophy gained strength in the 30's, when the world recession implied negative real rates of interest, the rate on the loan should include at least the cost of inflation, hence higher rates. Failure to do so will result in decapitalization of the banks.

When inflation was not so severe and when international financial agencies had a stronger position, they could lend at very low rates. It was believed therefore, that domestic development banks should provide farm credit at the same rates. That, however, ignores the administrative costs of credit because of the rather large number of small loans. If ADBs act as banks, they may have the right to transfer those costs to the borrowers. But also, if they act as instruments of government policy, then they can expect government subsidies.

The higher the cost of capital, the lower the expected profitability of the financed enterprise and hence, a smaller margin to the farmer. Profit is a determinant of loan bearing capacity, therefore it is believed that lower rates increase profit margins, and hence loan repayment ability. Low rates, however, induce misuse of credit obtained for agriculture, but invested in alternative projects. As a result, a farmer could be an excellent payer to the

bank because of higher returns of the borrowed money put in other uses, but not because of a larger profit margin in agriculture.

One of the strongest and most debated arguments for low cost credit to agriculture is the income distribution effects, expected to benefit the rural poor. This, however, assumes larger benefits to be distributed among a large number of small producers (Gonzâlez-Vega, 1977, 1981). In practice, however, even though ADBs show a large number of loans, the number of beneficiaries is much smaller. The reason for this is that loans are provided on a crop-site basis. Hence, a large commercial farmer, with several properties and growing various crops, may receive each year five or more of the largest loans, while small farmers receive one or, at the most, two small loans.

While subsidized interest rates may not be justified from a financial point of view, there are other reasons why at a particular point in time agricultural interest rates may need to be low. If that is the case, the banks should then be prepared to supervise agricultural credit, for farmers to use it in the desired investments and not outside agriculture. However, this increases the banks' operating costs. In this case, the ADBs should be prepared to generate financial resources from other activities, in order to allow themselves to fulfill their development goals.

Nevertheless, if it was agreed to increase interest rates, an issue of relevance is the responsiveness of farmers to higher interest rates. It is argued that the elasticity of demand for public credit is rather insensitive to changes of the nominal interest rate, because the later is only a small portion of the total cost of credit the farmer faces (Adams, 1981). Furthermore, this sensitivity could decrease if better quality loan services are provided, and larger volumes of credit made available.

An interesting paradox exists on interest rate policies and agricultural risks. Low interest rates to agriculture have been justified from the farmers' point of view, because of high risk-low profit of agricultural enterprises. Low interest is therefore, expected to compensate for the cost of risk. However, from the bank's point of view, as financial institution, it should charge a higher interest rate on loans to the rieskier enterprises, i.e., a higher rate for agricultural loans. This paradox and the naturally expected high default on agricultural development bank loans, is an important reason for the ADBs limited growth when they depend on their own resources. Further discussion on this issue is contained in the following section.

The reasons for limited expansion of credit to small farmers were documented above. The strongest arguments, from the bank's point of view, are too high administration costs for the bank, too low productivity and management of farms, and high exposure to risks, which contribute to low repayment. Under these arguments, there are specific actions that could be taken to expand credit to small farmers in order to move them out of their marginality, nevertheless there are also some potential benefits from insurance. Hence the hypothesis on this regard are the following,

a. Agricultural production risks, that can be covered by insurance, are only one of the reasons for poor loan recovery, therefore public price policy and better credit management could provide substantial improvement in the performance of loan recovery records of agricultural lending institutions.

b. Credit insurance could be an efficient mechanism to assist in the expansion of credit to small farmers. Insuring the credit allows the bank to solve at least part of their problem, that of

recovering their investment in the event that because of severe natural risk, farmers loss their harvest and are unable to pay back the loan. Insured credit could therefore bring benefits for the bank to the extend that it improves loan recovery.

c. Credit insurance reduces the cost of credit administration and the net costs of running credit and insurance programs (including the costs paid by farmers) are smaller than the costs of credit alone. The benefits of the credit insurance package are distributed among larger number of smaller farmers as insurance is a control mechanism to prevent the diversion of credit outside agriculture.

These hypothesis are tested for the case of the Agricultural Development Bank of Panama. The analysis that follows uses a sample of production loans and it uses a mathematical programming model of bank growth.

B. Insurable Risks and the Expected Benefits of Insurance

Chapter IV provided a detailed analysis of agricultural risks. They are revised here in the context of their effect on loan recovery.

Risk in agriculture stems from various sources. First, uncertain input supplies and prices make production costs a random variable. Second, uncertain yields and product prices imply risk on gross returns. There are also risks because of storage and marketing loses that the farmer often has to sustain. In order to manage risks, farmers adopt different strategies, including crop and technology diversification, reluctance to use modern inputs and credit, and the use of agricultural insurance.

Uncertain input prices are not widely recognized in the literature a primary source of risk. However, experience shows that to avoid crop damage from unexpected diseases or pests, farmers will rush to purchase insecticides and fungicides. It is usual for prices to rise to very high levels because of short term inelasticity of supply.

The use of insecticides and pesticides can reduce risks, however, Just and Pope (1979) have demostrated that a risk averse farmer will tend to overinvest in such inputs, and this can be just as socially inefficient as underinvesting in inputs which increase risks (as fertilizers). There is also often the case than in spite of the farmers' willingness to use certain inputs as part of a modern technology, these can not be obtained. In fact, the success of some change and development projects has been guaranteed thanks to the provision in kind of those inputs. Such situations have been reported by Scobie and Franklin (1977) in Guatemala and by Ccama and Pastor (1982) in the highlands of Bolivia.

Yield variability is a common source of risk and it is as significant in the arid environments as it is in the humid and subhumid tropics. It is usually associated with hail, frost, drought, fire, dust storms, hurricanes and river floods. Also, diseases and inappropriate use of technologies can result in loss. Yield variability associated with climatic factors is widely documented in the agronomy and agricultural economics literature, as shown for example by Anderson, Dillon, and Hardaker (1977). Yield variability associated with higher levels of input use is also evidenced in the works of de Janvry (1972) and Moscardi and de Janvry (1977). Yield variability is an important reason for low rates of technology adoption as explained by Berry (1977), Green (1978), and Binswanger (1973). The risks of agricultural production emerging out of yield variability have provided the rationale for crop insurance.

Price risk has been given greater attention in the literature, particularly in developed countries. In the U.S. agriculture price programs are an indication of the importance of the issue. The income stabilization effect of price support programs in U.S. agricultural was recently examined by Baker and Dunn (1979) and Gardner (1979), concluding that such programs affect positively the financial viability of farms.

Much of the research on price variability has been with regard to its effects on consumers welfare, as reported in the works of Waugh (1944), Subotnik and Houck (1976), Maell (1969), Just et. al. (1977), among others. On the producers side, the desirability of price stabilization has been demonstrated by Hazell and Scandizzo (1975), among others. Agricultural price stabilization programs in national and international schemes have been widely advocated. However, few of these have operated effectively because of their large costs and lack of political feasibility (Hazell and Pomareda, 1981).

This analysis suggests that there are several sources of risk in agricultural production and similarly several ad-hoc ways of handling them. Clearly, agricultural insurance is only one way of contributing towards the stabilization of farmers' income when yield failure occurs. Furthermore, the effectiveness of agricultural insurance as an income stabilizing policy would be affected by the correlation between yield and price variability.

The allocation of financial and physical resources at the farm level can be examined with references to Figure 5.1. Following the principle of money fungibility, the different money sources are aggregated into a capital input, which is in turn assigned to various production processes according to the farmer's decision criteria.

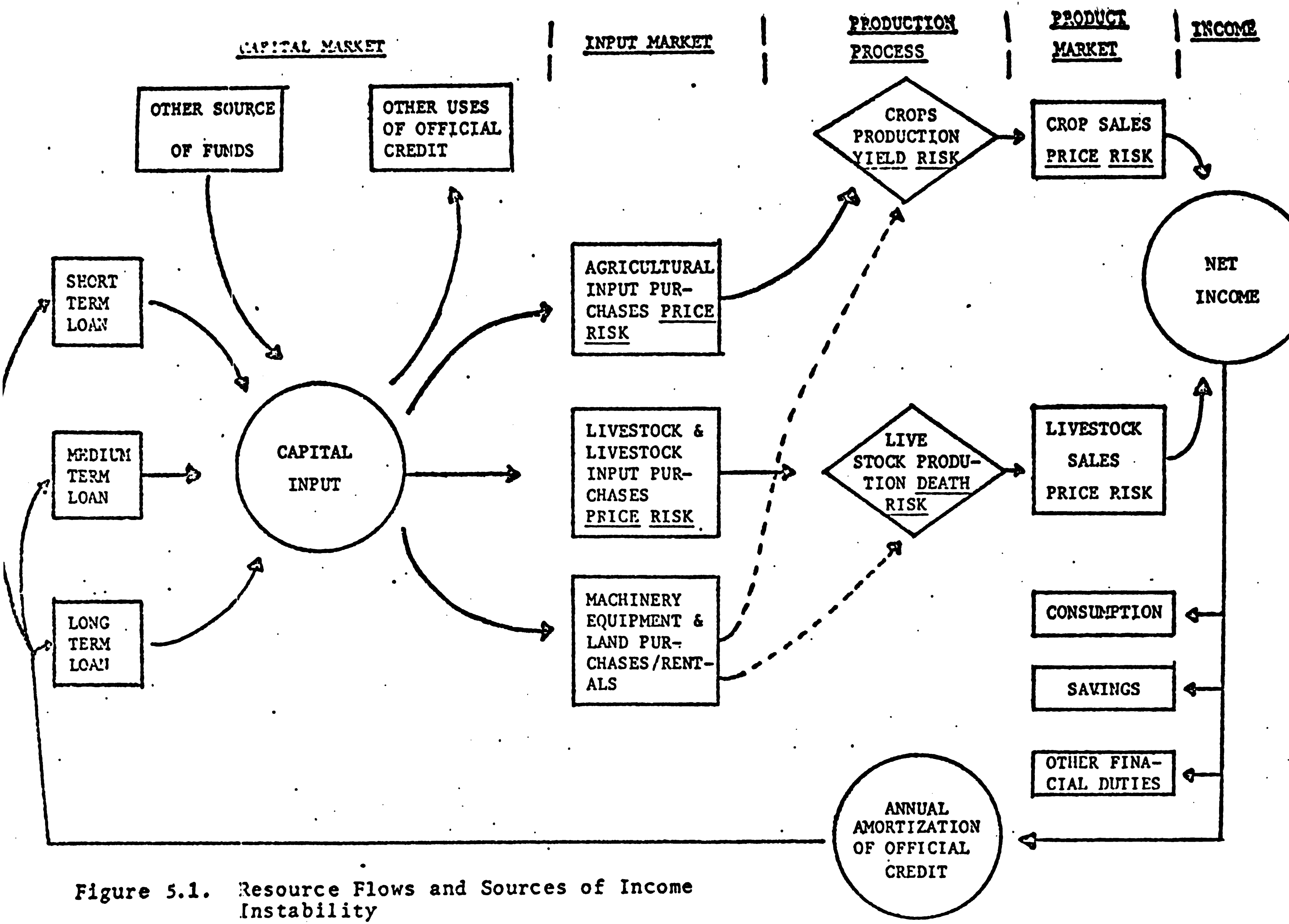

Figure 5.1. Resource Flows and Sources of Income Instability

Farmers, especially those that are smaller in terms of income, usually combine the earnings from several activities in one account, and use those resources for the most pressing needs. The latter, of course, include present consumption and uses outside agriculture, both favored by the low interest rates at which official agricultural credit is obtained.

Money is used to purchase agricultural inputs, and as discussed before, here is the first origin of risk. In addition, it is important that inputs are used at the optimal time, because this affects vulnerability of crop yield to the variabilities of climate. Climate induced yield variability can produce a total crop loss in all or part of the total area grown, or it can be partial loss in the total area. The last source of risk in the cycle is market risk, reflected in the instability of prices.

With reference to Figure 5.1., it is clear that net income (at the far right of the diagram) is a random variable. More over, beyond this point are additional elements that determine the available funds to repay the bank loans. Farmers allocate net income into planned consumption, savings and payment of outstanding debts. It is common to find that farmers would engage in luxury consumption even before paying outstanding debts, or else that present consumption is given greater importance than future consumption (savings). In any event, there are only exceptional cases when the banks intervene in product sales to guarantee recovery of the loans. This could be the case when the products are commercialized through a government owned marketing agency.

This process of the allocation of capital, plus the risks faced by the farmers at each stage of the process, explain why farmers may be unable or unwilling to repay their loans. The banks' awareness

of this process for each individual borrower would provide the basis for loan provisions. However, the bank can not do much to improve the position of those not qualifying for loans. The bank can, however, request government action to supply inputs at the opportune time and to provide support to input and product prices or the provision of agricultural insurance. All of the above would contribute towards a higher and more stable income.

This simplified analysis of income variability at the farm level provides the rationale for income stabilization policies of different kinds. However, a point worth emphasizing is that farm income can be stabilized and that should increase the farmer's debt bearing capacity. Yet, the removal of all income variability by itself does not guarantee loan recovery, because possible moral risk.

Given these conditions, credit insurance has been suggested as a way to increase loan recovery. Credit insurance is slightly different than agricultural insurance, as it protects only the value of the investment and not the total value of the harvest. By purchasing a credit insurance policy, the farmer protects his loan or a portion thereof. If the harvest (or part of it) is lost, or if the animal dies the insurance agency paus the bank the amount due by the farmer, thus allowing him to return to production with out seriously decapitalizing his resources.

On theoretical grounds, one can discuss the benefits of credit insurance from various points of view. Credit insurance pays the farmer's debt in the event of yield loses. By doing so, it stabilizes the farmer's income and increases his debt bearing capacity. By paying his bank debt, it allows the farmer to return to the bank in the following year and request a new loan and continue investing.

Other advantages of credit insurance to the lending institution could be the reduction of costs of "farmer hunting" to collect the delinquent loans, and the additional supervision for the most optimal use of credit. The insurance supervision program helps the bank to separate those farmers that do not want to pay from those that cannot pay. For the latter group the insurance agency will pay the bank the amount due by the farmer. However, since credit insurance provides coverage only for yield losses, its protection is only partial, because farmers can still have reduced incomes because of excessive costs of production or low product prices. Credit insurance would therefore, provide the largest benefits for the bank when lack of loan repayment is due mostly to yield failure.

It should be pointed out that although credit insurance allows the bank to show a healthier loan portfolio, it could be interpreted as a cover up for the bank's low capacity to recover its loaned funds. In this sense credit insurance does not offer an incentive for the bank to improve its loan selection procedures and inspection practices to increase loan recovery. However, it is a way of improving loan recovery and it should allow the bank to grow at a faster rate. Its desirability is clearly high for the bank, yet its justification is to be based on cost effectiveness; i.e. whether the overall costs to the bank and the insurer do not exceed the benefits.

An issue for debate still remains: Subsidized interest rates are requested, because among other reasons, agricultural production is too risky. If credit insurance compensates for losses in agricultural production, and therefore stabilizes farm incomes, then there should be no reason anymore for such subsidized interest rates. With credit insurance therefore, agricultural development banks could charge higher interest rates to farmers; but insurance premiums are a way to raise interest rates without increasing interest rates.

From the viewpoint of the farmer, who is used to paying a low price for credit, it is unlikely that he would be very willing to pay the total ost of insurance. On the other hand, if credit insurance provides direct immediate benefits for the bank, it may be reasonable to think that this institution should help to pay for the cost of insurance. This is an issue for further research, but to estimate the maximum benefits of insurance for the bank it is assumed in this work that the bank does not pay any of the insurance cost.

C. The Direct Benefits of Insurance on the Loan Recovery

The benefits of insurance for a lending institution were analyzed for the BDA, the Panama government owned bank specialized in lending to agriculture. Its financial structure is representative of many specialized agricultural lending institutions in the developing world. In the asset side it specializes in lending. In the liability side it includes only direct government subsidies, borrowings from IFAs and from CBs. The latter is possible by government subsidies. A major proportion of the loan portfolio is production credit with less than 20 percent for investment purposes. From the production loans, approximately 80 percent have an expected maturity of less than a year.

Through its history the bank has experienced severe problems of loan recovery. The BDA authorities recognize that production risks are the main source of poor loan performance (BDA, Memoria Anual - Various issues). In response to this situation the government created in 1975 the Agricultural Insurance Institute (ISA). ISA is a public institution expected to work in partnership with the BDA. Its rapid growth was made possible in part by a government subsidy and a grant from USAID.

The most directly observable benefit of ISA on the bank is the payment of indemnities. In Table No.5.1 shows the total indemnities paid by ISA, and from these approximately 90 percent were paid to the BDA; hence, his was the contribution to loan recovery in a particular year. These contributions were quite significant in all years but certainly more in 1981/82, when serious drought and floods in different regions caused major losses. The amount that the bank would have recovered without ISA's program can not be determined at this stage. Neither could it be known what would have been the re-scheduling conditions issued by the bank. But in any event it is clear that the BDA received indemnity income from ISA and this increased its average recovery.

The effects of insurance on individual loan classes are observable from the data on Table No. 5.2 for loan classes.[2] The main conclusions derived from a comparative analysis of insured and non-insured loans are the following:

i. Insured loans on the average have slightly larger average net returns than non-insured loans. However, the actual rate of interest is never equal to the agreed rate at issuance time (in nominal terms), because insured farmers not affected by disasters, or those not receiving indemnities, even if partially affected by disasters, could always delete payment without additional interest charges. This is a case of unanticipated late rapayment.

ii. Insured loans show a smaller coefficient of variation of returns than non-insured loans. But, their coefficient of variation of returns is not very large hence suggesting that low average recovery rather than variability of recovery is the dominant feature.

Table 5.1. Relationship Between ADB Loans and Insurance Coverage Provided by ISA, 1977/78 to 1981/82 (US$ Thousands)

Variable	1977/78	1978/79	1979/80	1980/81	1981/82
CREDIT FROM BDA					
Rice	7 177	7 632	12 962	13 522	n.a
Corn and sorghum	2 477	2 432	3 457	4 622	n.a
Industrial tomatoes	1 038	1 068	1 063	1 806	n.a
Vegetables	1 053	1 399	2 047	2 959	n.a
Cattle	6 261	8 254	11 249	15 446	n.a
Other[1/]	1 689	4 005	8 584	9 349	n.a
Total	19 695	24 790	39 362	47 704	52 372[2/]
COVERAGE PROVIDED BY ISA					
Rice	-	911	2 438	3 338	5 080
Corn and sorghum	1 129	975	1 492	2 148	2 653
Industrial tomatoes	-	-	544	1 290	689
Cattle	1 129	2 272	6 987	13 099	13 500
Other	-	-	103	31	533
Total	1 129	2 272	6 987	13 099	13 500
INDEMNITIES PAID BY ISA					
Rice	-	5	38	68	184
Corn and sorghum	18	89	57	147	379
Industrial tomatoes	-	-	22	74	85
Cattle	-	8	64	112	214
Other	-	-	13	-	107
Total	18	102	194	401	969
ISA's loss ratio	0.30	0.90	0.59	0.74	1.27

1/ It includes crops, other livestock, and investment loans, none of which are insured.

2/ Preliminary.

Table 5.2. ADBP, Characteristics of the Loan Portfolio

	Variable	Rice			Corn		Industrial tomatoes		Vegetables		Coffee		Livestock		Other Loans		Assoc. Credit
	Class	1	2	3	1	2	1	2	1	2	1	2	1	2	1	2	3
Not insured loans	Amount disbursed ($)	449.	5013.	21638	440.	1366	433.	1619	505.	2376	490.	2447.	611.	3988.	513	2456	36256.
	Nominal rate of interest (%)	9.25	9.61	9.69	8.88	8.84	8.69	9.00	8.75	9.37	8.59	9.13	9.17	9.60	8.97	9.26	8.44
	Amount collected ($)	475.	5257.	22520	473.	1473	457	1704	530	2500	524	2594	704	4574	540	2635	37367.
	Net Interest ($)	27.	235.	882.	33.	106.	36.	86.	24.	153.	33.	147.	93	586.	28.	179	1611
	Actual rate of interest (%)	6.41	5.33	5.36	7.57	6.73	5.64	7.08	5.72	6.80	6.46	6.40	6.95	6.73	6.58	6.60	4.69
	Expected duration (months)	7.85	7.60	8.43	8.57	8.38	4.55	5.91	6.22	6.00	10.81	10.51	31.33	37.36	15.57	11.36	14.10
	Actual duration (months)	13.20	11.74	12.06	12.81	13.5	14.17	12.80	11.70	9.96	12.58	12.51	28.33	33.24	15.24	13.39	13.79
Insured loans	Amount disbursed ($)	589	4722	22275	748	2286	394	1597	-	-	-	-	-	5034	693	3703	-
	Nominal rate of interest (%)	10.10	10.36	11.6	9.5	9.96	9.17	10.83	-	-	-	-	-	12.08	9.67	10.07	-
	Amount collected ($)	606	4836	23299	799	2387	403	1658	-	-	-	-	-	5633	718	3878	-
	Net interest ($)	17.0	164.	1023	51.	101	11.3	61.	-	-	-	-	-	599	25.	174	-
	Actual rate of interest (%)	8.67	5.86	6.78	9.24	8.75	8.86	9.95	-	-	-	-	-	9.42	6.58	6.49	-
	Expected duration (months)	5.83	7.69	8.01	6.50	6.79	5.06	5.67	-	-	-	-	-	23.66	5.08	5.24	-
	Actual duration (months)	4.00	7.19	8.33	8.58	8.29	4.50	4.83	-	-	-	-	-	15.08	6.67	8.85	-

iii. Insured loans have actual duration equal to the expected duration and in almost all cases the actual duration for insured loans in significantly smaller than for non-insured loan.[3] This means that insurance allows the bank to lower its costs of bookeeping and prosecution of overdue loans.

These results support three of the arguments offered in the previous section in favcor of credit insurance. They imply direct short term benefits for the bank. However, it is a matter for discussion the extent to which insurance incentivates the bank for less careful loan analysis and supervision.

This analysis made in static framework abstracts from long term effects of insurance on bank growth. Measuring this impact on growth is necessary for the BDA. As a financial institution the BDA has growth goals since it wants to provide the largest amount of credit to agriculture.[4]

D. The Impact of Insurance on Bank Growth

Decision makers in general show varying degrees of risk aversion in the sense that they have different preferences for return relative to the variance of return. Bankers are not exception, although the type of bank ownership will influence the attitude toward risk. It is assumed that public institutions are less concerned with risk management, as any significant losses can be recovered through government allocations. In addition, public institutions have been able to reduce financial risks by obtaining low-cost long-maturity funds from international financial agencies. Private lenders are likely to be more concerned with risks because they do not have access to free government funds and because they borrow almost exclusively in the commercial capital market.

The purpose of this section is to illustrate how credit insurance benefits a bank serving the agricultural sector, even when there is a neutral attitude towards risk. To start, we should recall that credit insurance has three effects: First it improves average loan recovery, second it reduces risk of returns, and third it diminishes administrative costs. These direct benefits filter into the bank and have long term effects that influence growth. The analysis is made through a multiperiod linear programming model of bank growth (see Pomareda, 1984).

The first two columns in Table No. 5.3. show the growth of transfer of funds (net loan recovery), lending and borrowing, when the number of insurable loans is assumed to grow at an annual rate of 5 percent per year. Column 1 shows the results when the bank is neutral risk (Ø = 0) and column 2 shows the results when the bank is extremely risk averse (Ø = -3.15). The expected growth paths for a bank operating under a risk neutral (Ø = 0) or an extreme risk averse (Ø = -3.15) type of management were found to be very similar. However, when the bank acted under a risk averse manner, the path of growth was slightly more stable but with a small total tutility over the planning horizon.

The above suggests that the variance of returns in the loan portfolio is rather small, and hence there would not be a significant change in the allocation of funds as the degree of risk aversion increases. This condition is turn implies that average recovery is the determinant factor for choosing among various types of loans. It is interesting that in spite of this situation, the model shows important benefits to the ADBP from insurance. Even without risk aversion (column 3 in Table No. 5.3) the absence of this insurance program would have implied a much slower growth for the bank.

Table 5.3. ADBP Model, Growth with and without Insurance (million [illegible])

Variable	Year	Situation: With insurance, risk neutral	Situation: With insurance, risk averse	Situation: Without insurance, risk neutral	Situation: Without insurance, risk averse
Objective Function	10 years	226 117	214 215	196 424	181 919
Transfer of Funds	01-02	51 014	51 014	51 161	51 169
	02-03	34 078	37 777	22 353	33 930
	03-04	41 348	42 904	38 725	43 591
	04-05	58 192	57 402	53 107	50 633
	05-06	59 332	58 567	53 308	50 913
	06-07	63 051	62 309	56 031	53 708
	07-08	67 146	66 434	58 986	56 758
	08-09	69 828	69 022	61 698	59 190
	09-10	95 091	90 801	66 334	63 557
Total Lending	01	49 792	49 792	49 603	49 629
	02	48 937	50 407	37 941	42 541
	03	30 956	32 135	36 510	40 199
	04	45 318	47 183	32 904	38 773
	05	56 201	55 461	51 175	48 873
	06	59 695	58 981	53 789	51 559
	07	63 530	52 857	56 628	54 488
	08	66 198	65 247	59 233	56 824
	09	87 259	85 966	63 686	60 902
	10	40 742	40 067	35 702	34 221
Borrowings from Commercial Banks	01	21 400	21 400	21 400	21 400
	02	9 904	11 710	0 413	6 065
	03	16 065	15 524	23 1[illegible]	21 420
	04	22 379	22 050	20 498	19 468
	05	23 867	23 548	21 630	20 633
	06	26 680	26 370	24 066	23 099
	07	28 544	28 252	25 460	24 544
	08	28 894	28 500	26 510	25 287
	09	50 993	48 351	29 476	28 089
Standard deviation of Returns		3 101	2 988	4 264	3 924

When insurance is not available, loan recovery declines, therefore, given the bank's leverage requirements, borrowings from commercial banks also decline but not as much. The net effect is a decline in lending activity as the net transfer of funds between periods also diminishesas it is illustrated in Figure 5.1. For the risk neutral case with an with and without insurance.

There is a clear indication that insurance has a net positive effect on bank growth. This net effect is however, the result of a number of forces. The availability of insurance, even when it is only for a portion of the total loan portfolio, allows for a larger number of medium size loans, which are also of shorter actual maturity than large loans. Hence money is turned around more rapidly. In addition as shown in Table No. 5.4., the expenditures on loan supervision and collection, as a proportion of total expenditures, is reduced considerable, therefore, leaving a large availability of loanable funds. It should be recognized that even when the total volume of loans issued declines when insurance is not available, the collection costs increase considerable as the number of overdue loans grows.

The opportunity cost of a restriction of the number of insurance policies declines over time because of the assumed growth rate of ISA's program (see Table No. 5.5). In spite of this latter assumption, all shadow prices suggest that it would pay to supply ISA with additional operating resources to issue a larger number of policies. For example one additional insurance policy in year two would increase the utility of the risk neutral bank by US$5.190 over the 10 year horizon.

The ADBP model results in Table No. 5.6 show a definite bank preference for insuring loans for rice and livestock. Arcia (1982) reports that these two item are the ones in which ISA portfolio as described in Arcia's model. It is surprising, however, that the

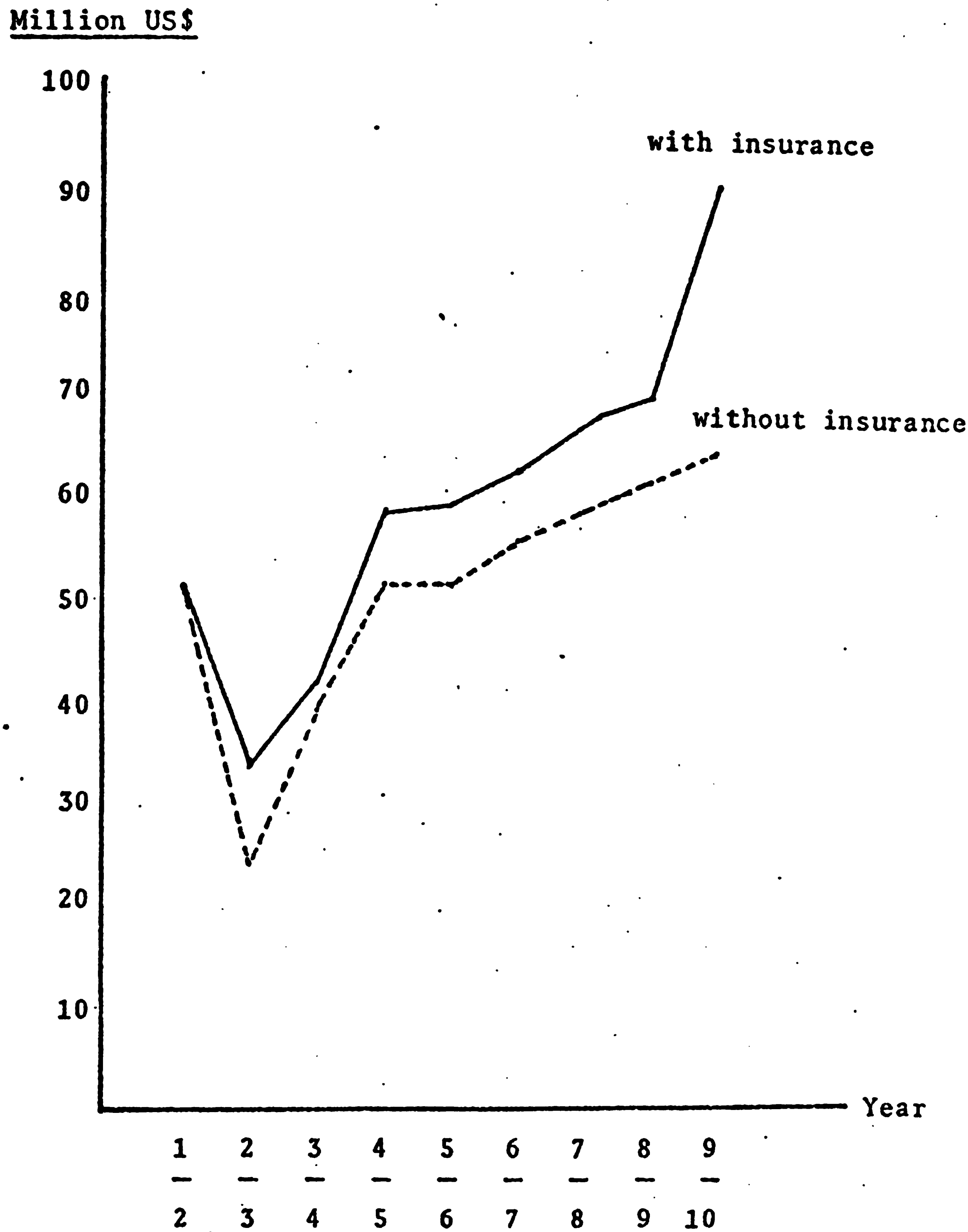

Figure 5.2. ADBP Model, Transfer of Funds Between Periods, Risk Neutral Case.

Table 5.4. ADBP Model, Personnel Costs with and without Insurance (10 years)[1/]

Variable	Risk Neutral Situation	
	with insurance	without insurance
TOTAL COSTS (million US$)		
Loan officer time	51.34	43.29
Collection officer time	10.96	15.71
Total	62.30	59.00
TOTAL NUMBER OF LOANS	65.150	51.962
TOTAL COST PER LOAN (US$/Loan)	956.24	1,135.45
Loan officer time	788.00	833.11
Collection officer time	168.24	302.34

[1/] Does not include all other fixed costs.

Table 5.5. ADBP Model, Total Number of Loans Issued and Opportunity Costs of Insurance (10 years).

Variable	With Insurance		Without Insurance	
	risk neutral	risk averse	risk neutral	risk averse
BY SIZE				
Small[1/]	25 156	25 156	25 156	25 156
Medium	18 663	22 878	4 683	8 966
Large	18 331	18 161	19 127	26 063
Total[2/]	62 150	66 195	48 962	60 185
INSURED LOANS	33 566	33 566	0	0
SHADOW PRICES OF THE NUMBER OF INSURANCE POLICIES (1 000 US$ policy)				
1	0 000	0 000	-	-
2	5 190	4 748	-	-
3	0 000	0 000	-	-
4	0 316	0 291	-	-
5	0 273	0 240	-	-
6	0 233	0 202	-	-
7	0 194	0 166	-	-
8	0 155	0 130	-	-
9	0 118	0 133	-	-
10	0 000	0 000	-	-

1/ The number of small loans was always equal to the minimum requirement i.e. 2 000 loans in the first year and a growth rate of 5 percent per year.

2/ It does not include the 3,000 loans outstanding in year 1.

Table 5.6. Comparison of the ADBP and ISA Insurance Preferences.

Variable	Total	Rice	Corn Sorghum	Industrial Tomatoes	Livestock	Other
Actual ISA's[a] coverage (million US$)	13 118	3 340	2 116	1 289	6 329	0 044
ISA's administrative[a] cost as a percentage of coverage	-	2 54	8 96	11 59	3 70	11 68
ISA's coverage in[a] Arcia's Model (%)	13 118 100 0	3 725 28 4	-1 574 12 0	1 181 9 0	6 559 50 0	0 079 0 6
ISA's coverage in[b] the ADBP Model ($)	14 133	6 849	-	-	7 284	-
Basic solution for[b] year 2 (%)	100.0	48 5	-	[illegible]	51 5	-

Sources: [a]Arcia, (1982)

[b]Results from the ADBP model

bank model does not show a preference for insuring loans for corn and sorghum, the items in which ISA has had the largest losses. The reason is that, besides being very risky, loans for corn and sorghum are unprofitable for the bank in terms of average recovery. Similarly, loans for industrial tomatoes appear more attractive because of large returns, but these loans tend to be rather small and therefore, from a resource use point of view, loans for tomato production are not appealing to the bank.

E. Higher Interest Rates as an Alternative to Insurance

Insurance shows as a rewarding alternative to the bank, however, insurance is costly to administer. Until now th government (plus donnors money) has absorved the full administrative cost of the insurance program in Panama. Table No. 5.7 shows the average administration costs per loan and per policy for the BDA and for IDA respectively. The BDA shows a declining average cost while ISA does not show any evidence of decreasing costs per policy.

From the data of the BDA and ISA there is no concluding evidence that the total administration costs of insured credit are small than the cost of non-insured credit. In fact, they may be larger. Although the insurer could reduce the cost to the bank, its own adminitration costs are larger than the reduction experienced by the bank. However, the net benefit for the bank includes also that of higher loan recovery and as it was indicated earlier, insurance improves loan recovery. In the case of Panama, it could be concluded that the net benefits of the insurance program are not yet positive by there is a high likelihood that this could be achieved if ISA and the bank lower further their administration costs. There is always of course the danger that to prevent moral hazard and to cover the full portfolio of the BDA, the ISA may need to incur in higher administration costs per policy issued.

Table 5.7. ADBP and ISA, Total and Average Administration Costs, 1976/77 - 1982/83.

	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
BDA							
Total cost (mill US$)	n.a	n.a	4.236	4.405	5.304	n.a	n.a
N° of loans issued	-	-	5,473	5,556	8,020	n.a	n.a
N° of loans outstanding[a]	-	-	1,350	1,642	1,667	n.a.	n.a
Total no. of loans	-	-	6,823	7,198	9,687	n.a	n.a
Average cost per loan ($/loan)	-	-	621	612	547	n.a	n.a
ISA							
Total cost (mill US$)	0.123	0.188	0.218	0.318	0.463	0.682	0.714
No. of policies issued[b]	9	351	809	2,114	2,722	3,486	4,140
Average cost per policy ($)	c/	c/	c/	151	167	196	173

a. Estimated as 30 percent of loans issued in the previous year

b. Includes crop policies and livestock policies. In the second case it includes outstanding policies issued in the previous year.

c. Pilot years of the insurance program.

Source: ISA, Memoria Anual, various issues
BDA, Informe Anual, various issues

<u>Note</u>: When calculating the average cost is would seem unfair to use all the costs of the BDA and those of ISA, and dividing them by the number of loans and insurance policies respectively. However, the bank does not fulfill any other function than lending and ISA does not do anything else but insurance. Hence all the expenditures of each institution are made towards that end. Of course, somebody less severe could use, if it wished a percentage of the total cost for the calculations of average cost per loan and per policy.

It is well known that, according to the theory of finance, a higher expected return would induce on investors the willingness to bear higher risks. Taking this from the point of view of the bank it could then raise interest rates so that in the long run the higher average return compensates for the losses due to risk of return. This assumes that the average loan recovery rate does not change when interest rates are increased. The assumption would be valid for small changes in interest rates and for those cases where low loan recovery is explained mainly by production risks.

The model for the BDA was used to evaluate the required increase in interest rates that would bring the bank growth effects comparable to those of insurance. It was found that a two points (like from 9 to 11 percent) in the annual interest rate would provide the bank similar benefits to those provided by insurance on the riskiest portion of its portfolio (approximately 30 percent of total credit). The results are shown in Tables Nos.5.8 and 5.9.

The aggregate portfolio composition of the bank is similar with insurance (on the riskiest portfolio) than with a two point increase in the interest rate. However, there are additional points that deserve further discussion. With higher interest rates the bank will be exposed to a larger risk a suggested by the standard deviation of return. Second, the bank will be more conscious in its costs considerations and will opt for a smaller number of loans, and mainly the larger ones. And third, the average recovery as a percentage of issued credit will be smaller, nevertheless profit margin to the bank will be larger.

Table 5.8. BDA Model, Sources and Uses of Funds under Insurance and Interest Rate Policies in an Average Year under Neutral Risk Aversion[1/]

Variable	Without insurance	With insurance	With two percent increase in interest rates
		Sources of Funds	
INTERNAL RESOURCES			
Loan recovery and interest earnings	52.64	58.86	58.91
Government subsidy	2.99	2.99	2.99
Other resources	0.24	0.24	0.24
Sub-total	55.87	62.09	62.14
EXTERNAL RESOURCES			
Borrowings from Commercial banks	19.26	22.87	22.52
Borrowings from IFA's	1.79	1.79	1.79
Sub-Total	21.05	24.66	24.31
TOTAL	76.92	86.75	86.45
		Uses of Funds	
OPERATING COSTS			
Salaries	5.73	6.10	6.23
Other costs	0.17	0.13	0.12
Sub-total	5.90	6.23	6.35
FINANCIAL COSTS			
Amortization of Borrowings	20.84	24.29	24.14
Interest payments	2.76	3.16	3.14
Sub-total	23.60	27.45	27.28
LOAN ISSUANCE	47.40	53.10	52.78
TOTAL	76.90	86.78	86.41

[1/] This average year was calculated by dividing the total values in the model by ten years in the planning horizon.

TABLE 5.9. Other economic indicators of the effects of alternative policies on the BDA, BDA model, Panama.

	Without Insurance	With Insurance	With a two percent increase in interest rates
		(US$ Millions)	
Objective Function (Discounted Value of Expected Utility)	196.420	226.177	224.843
Standard Deviation of Returns (Discounted Sum)	4.264	3.100	4.547
Number of Loans Issued			
Small[a]	25.156	25.156	25.156
Medium	4.683	18.665	3.995
Large	19.123	18.330	21.704
Total	51.962	65.151	53.855
Average Size of Loans (US$)	10,858	7,674	10,369
Average Administration Cost per Loan (US$)[b]	1,135	956	1,179
Ratio of Loan Recovery[c] to Loan Issuance	1.10	1.11	1.12

a The model had a requirement for a minimum number of small loans and this was always binding.

b The average costs are higher than in Table 7 because fewer small loans are issued.

c Including interest earnings.

It is important to recognize that this option implies a much smaller cost to the farmers. They will pay only 2 percent increase in interest rates and not the 5-6 percent on insurance premiums. But of course, these longer term benefits of not having to pay for insurance should be compared against those short term benefits of insurance indemnities whem crops are severely damaged. If the bank reschedules debt repayment when such disaster occur, farmers may feel relieved, but in any event it should be expected that the bank makes a more careful loan appraisal and supervision of its clients.

F. Conclusions and Policy Recommendations

About the demand for insurance for agricultural development banks, the major conclusions and recommendations are as follows:

a. The institutional design of ADBs and the interest rate policies for agriculture would limit the financial intermediation capacity of these specialized lending agencies. There are diverse views about the justification of interest rate policies, but it is well recognized that they introduce distortions in the rural capital markets. Also, because of the clientele ADBs serve, they face high operation costs. Therefore, low interest earnings and high costs determine low net returns to the bank and poor quality of service.

b. A generalized characteristic of ADBs is their poor loan collection performance; which is due only in part to agricultural risks. Agricultural insurance and credit insurance should be considered as a means for stabilizing farm income and increasing debt repayment capacity; but the effectiveness of insurance in stabilizing farm income increasing debt repayment, depends on the origin of risk. Furthermore, even when income would be fully guaranteed, there could still be low loan repayment because of moral risk.

c. An analysis of bank growth made with a multiperiod LP model for the case of Panama's ADB shows that increased risk aversion provides a more stable growth of the bank, because although total utility decreases, it can be expected with more certainty. Therefore, increased risk aversion would become more important as financial support from the government and soft international loans diminish, and it is advisable that this criteria be used by banks in the management of their loan portfolios.

d. Agricultural credit insurance provides benefits for ADBs through higher average recovery, decreased variations of recovery over time and reduced administration and collection costs but the net cost of credit plus all risk crop insurance administration outweights the net benefits over time. Yet, net benefits increase as production risk becomes a more important factor in loan recovery. Credit insurance provided the largest net benefits when issuing large loans in the case of the ADB of Panama, but this can not be generalized to other banks.

e. Higher interest rates on loans should be considered as an alternative to the bank to increase its returns and offset the risk of farmers' default. This alternative does not lower bank administration costs neither it favors small producers, who are the clientele ADBs wish to reach. The alternative of increasing interest rates should be considered while product prices are high enough for farmers to cover the cost of credit.

f. Credit insurance allows for repayment of farm debt, hence farmers can return to production in the following year without decapitalization, but even when insurance is available the production is still lost. In such case food shortages would have to be imported or else product prices will rise with the consequent

loss to consumers and gains to those producers whose harvest was not lost. Foreign exchange expenditures on food imports will add to government expenditures for the subsidy to premiums and administration costs. Therefore, it is more desirable that the banks reallocate funds, for investments that increase and stabilize yields as irrigation, land leveling, drainage.

g. If, as it was shown for Panama, credit insurance provides, in first instance, benefits to the bank, and given that similar benefits can be achieved by increased interest rates, this could be preferred to creating a new institution. An advantage of this will be a reduction in administration costs, but a disvantage is the limited options for diversifying the portfolio to include other items besides those for which the bank lends. In any event, the recommendation is that before creating an agricultural insurer, the countries explore the possibilities of managing lending risk through more professional bank management and interest rates that include a risk premium. To complement this insurance should be offered only the catastrophic losses when neither farmers nor banks could afford the excessive losses.

A government decision to provide crop insurance must consider the aggregate benefits and costs and their distribution. The analysis in Chapter VI reveals important sector level effects of insurance.

a. There is need to consider an income stabilization policy such as insurance long with investments which reduce the instability of production and allow to increase it at a faster rate. Certainly that a combination of both options is the most desirable, along the lines suggested in the document i.e. to offer crop insurance against catastrophe and to promote irrigation and other farm investments.

b. Of major significance have resulted the findings using the sector model in Mexico where insurance increases the instability of supply for a particular crop, while at the same time it may induce production of riskier crops. Hence, insurance should be beared in mind while designing a food security strategy as it would appear its benefits could be greater to producers than to consumers. On the other hand, however, it could be argued that more unstable but increased production resulting from a more intensive use of hybrid seeds and larger amounts of food for a hungry urban population. As it was pointed out here, in such case, stronger consideration should be given to the management of food reserves. In other words, the country should be more prepared to trade surpluses or deficits, whichever may occur.

c. As far as the benefits of insurance on rural employment and foreign exchange balance, again in the case of Mexico, the effects are specific depending on the resource requirements to produce the insured crops. For labor intensive crops which have higher production risks insurance could lead to higher levels of labor use for production activities, however, if the harvest is lost, labor will not be required for this purpose. Farmers will receive indemnity income but rural workers will be worst off.

d. One of the major conclusions which arises from the sector level analysis is that the net social benefits to compulsory all risk crop insurance that allows indemnities for partial loses are distributed quite unevenly and may even be negative, when "social benefits" are defined in the traditional way in terms of producer and consumer surplus. A related point is that the effects of crop insurance are quite complex since multiple price and output changes are engendered. The initial conditions, including the point of departure for the insurance program, strongly influence the pattern of consequences of crop insurance. Although there some consistent characteristics of these consequences, in some cases even their sign

proves impossible to predict. At least in the case of Mexico farmers have received positive benefits from the insurance programs, and the poorer producers have benefited proportionately more than the better-off producers.

The feasibility of crop insurance is to a great extent determined buy its design, strategy and operating practices. Chapter VII of the research report analyzed the main factors determining the financial viability of crop insurers. The main conclusions are the following:

a. The design of crop insurance program it is important to identify the administration costs and the risk cost, both of which can be reduced substantially by the modality used by the insurer. It was found from the studies in Panama and in other countries that in general the cost of indemnity has been the largest share of total cost of all-risk insurance programs and that this has been around 80-90 percent of total cost. About the administration costs, it is concluded that in existing program such costs have been a small proportion, (except in the case of the U.S.), because of limited supervision and poor quality of service.

b. Given that the design of an insurance program determines its costs, it is concluded that the cost/coverage ratio is smaller for programs for specific risks and with larger deductibles. On this basis it is strongly recommended that crop insurance be offered only against specific risks and preferable only for those derived from climatic factors and the indemnities are paid only whn total losses are evidenced. The advantage of this scheme is that requires lower risk premiums that the all-risk option and it allows to lower administration costs because inspections for partial losses are not required.

c. All public sector insurers in existence have relied on government subsidies. Such contributions have represented about 75 percent of the total cost while the other 25 percent comes from farmers' premiums. This dependence from public funding can not only be attributed to the fact that the insurer is public, but also to the fact it is not managed as a financial institution. This observation is important, because for crop insurance to be viable it is not enough to be runned by the private sector, but to be administered as effectively as possible as a financial institution. To the extent of development purposes, it can keep it as a public institution demanding sound financial management.

d. The cost of serving small farmers with crop insurance may be higher in its administrative aspect; yet given that small farmers usually diversify more and are more conscious of their role as farmers, there is no reason to exclude them from a specific risk/total loss programs. Crop insurance is desirable to promote capitalization in the rural sector and it has been previously concluded that if prices are high enough and input costs reasonable, small farmers in high risk areas will demand the type of program proposed here.

e. The use of yield data for an specific risk/total loss program must be complemented by weather, runoff, and flood data, as these factors are the most important reasons for total losses. Such weather data is more readily available; for a wider geographical coverage, for several variables and for long periods of time. It is also useful to determine the insurability of an area and to determine possible structure of the insurance portfolio.

f. Although actuarially fair premiums are the basis for a sound crop insurance program, the financial vaibility of the program is strongly influenced by an adecuate composition of the portfolio --seeking negative correlations among insured items. This will prevent from major disbursements in a particular year. In this

regard it is important to include various crops in various regions, livestock, farm machinery and equipment, and life insurance. It is also important to instruct farmers to diversify by crops, planting dates and technologies, within reasonable limits that do not inhibit efficiency from economies of scale.

g. Investment of premiums receipts by exploiting the seasonability of agriculture and the stochastic demand for indemnity payments, is a key element in the management of cash flow of funds. This should use an intertemporal portfolio management of the insurance and investment portfolios. Using the reserves in hard currency would be best way to protect against current inflationary pressures which could lead to insurer to rapid decapitalization as it has been evidenced in several countries.

h. All the above factors taken into account in the management of the insurers will enhance its possibilities for obtaining commercial reinsurance or to persuade central banks for loans to create reserves. It is recommended that central banks provides initial finance to the insurers in local currency and allow repayment in such currency on favorable terms, but also that they allow to convert the initial loan into hard currency to create a strong reserve.

The conclusions and recommendations of this research report are based on field and experimental work, on extensive reviews of bibliography and on the experience of various countries. They are offered as the result of a sound research effort with the participation of several individuals and they represent a guidance for public action. Yet, a strong recommendation is made for each country to evaluate carefully its own situation.

FOOTNOTES

1/ This Chapter is ased on the work of Pomareda (1982), forthcoming as a book published by Westview Press (1984).

2/ This data corresponds to average indicators of 900 loans issued between 1974/80 which had matured by June 1981. They were randomly sampled from 8 of the BDA agencies where the insurance program was in operation. Some bias is possible, as for non-insured loans the reference period is only 1977 to 1980. This affects the average nominal and actual rates of interest which, as shown, is larger for insured than for non-insured loans. The sampling was done by the author to determine the duration, average return and risk of return of the various items.

3/ The few cases of actual duration smaller than the expected duration for insured loans occurs because, if total crop failure occurred at early stages of growth, the amount so far disbursed by the BDA are paid off by ISA, and hence the loan terminated. In several cases of livestock, loans farmers paid off their loans before maturity.

4/ It is in fact common misconception among DFIs to measure achievements by the amount of credit allocated without consideration of its origin or the bank's actual financial performance.

VI. SECTOR LEVEL OF EFFECTS INSURANCE

VI. SECTOR LEVEL OF EFFECTS INSURANCE

A. Setting the Hypothesis

B. Production for Income Stabilization. The policy Choices

C. A Sector Level Analysis of the Crop Insurance in Mexico

VI. SECTOR LEVEL EFFECTS OF INSURANCE

A. Setting the Hypothesis

The decision to provide public crop insurance is largely a political one. As it will be demonstrated in the following chapter all insurance programs now in existence depend on government subsidies and there is a small chance that crop insurance can be provided without such contribution. However, in making the decision about starting new programs or continuing, the support to existing ones, it is important to know the aggregated benefits of insurance and its distribution.

Crop insurance has been promoted under the basic hypothesis that benefits outweight the costs. Although it is rather simple to evaluate the benefits. Such benefits are direct and indirect. Direct benefits are the indemnities received which, when a program is not subsidized, will equal to premiums paid over a series of past and future years. The benefit, therefore is perceived by farmers by being able to collect at once what was saved (paid in premiums) over various years. From an accounting point of view indemnities are just equal to premiums paid, however, in most cases direct indemnity benefits are above premiums paid because of government subsidies.

The indirect or spillover effects of insurance have been taken as the stronger reason to support insurance. The risk reduction effect of crop insurance is expected to increase aggregate supply, to reduce food imports, to reduce foreign exchange loses, to increse rural employment and all the other traditional benefits of public intervention (see Gudger and Maurice, 1978). However, these indirect benefits of insurance could actually not occurr because of the nature of product and input markets.

One of the points to consider in the evaluation of the benefits of crop insurance, must be the recognition that it only contributes to stabilize income but crop insurance would also lead to make production more unstable. This occurrs because insurance will be purchased to protect riskier crops hence increasing their areas planted but not necessarily the levels of use of inputs which reduce risk. Therefore, a decision about the support to insurance must examine the government preferences for more stable farm income or for higher and more stable production.

The following hypothesis have been tested about the aggregate benefits of insurance:

a. With insurance against risks that can be managed and reduced by other means, the costs to the government in subsidies to premiums, reserve contributions and the eventual import of food deficits could be larger than the benefits to producers and consumers.

b. From the product market point of view, the increase in areas planted induced by the availability insurance may in good years result in excess production, thus a decrease in prices at harvest time, therefore unless guaranteed prices are enforced with the governments absorbing any excess production, farmers would receive returns that are below the ones originally anticipated.

c. If farmers pay the full cost of insurance, the net effect of its provision may be positive for consumers and for intermediaries, yet farmers may lose. However, in bad years farmers would gain as production income is complemented by indemnities.

d. Insurance reduces the risk of return of crops and this will induce a larger number of farmers towards the less risky, but still more unstable crop at the expense of areas of other crops. This will create sectorial disbalance in the product markets and hence the need to import the more stable crops.

B. Production or Income Stabilization, The policy Choices[1]

Production risk is intrinsic to agriculture and farmers have lived always with it. Their impact is pervasive, hence public policy is intended to reduce it, to manage it or to protect against it. As it can be understood, policy alternatives ought to be carefully selected for each type of risk to avoid distortions that in the long run become too costly to society.

Risk of drought, hail, excess humidity and runoff can in some cases be reduced. Investment in irrigation projects, either with superficial or ground water have been largely advocated.[2] In the humid and subhumid tropics and in some cases, in the desert lands, the nature of soils conditions the existence of drainage problems. Also, quite commonly, in arid environment poor draninage leads into salinity conditions. Runoff is usually a severe constraint to agriculture when desertification and bad cultural practices have destroyed soil coverage, yet terraces and furrow irrigation can prevent further agravation of the problem.

Hillside agricultural, typical of the latinoamerican sierras, is usually affected by drought, for which little can be done because of high costs of water diversion projects. Yet, at least in some countries small irrigation projects are being funded in areas of easy access to water supply.

When risk cannot be reduced, then it should be managed by on-farm available means. Diversification can be a powerful tool to manage risks and it should be understood that it is a very broad concept. Monoculture farms can diversify by planting dates, varieties, cropping techniques, proning to retard flowering, etc. Multicrop farms can in addition do intercropping and crop diversification. The effectiveness of diversification increases with the negative correlations of yields among the several alternatives, and it its successful if there are not catastrophic loses. However, in the cases of lasting drought periods, hail storms and floods, little can be gained by diversification.

In the case of small farms, they recurr to off-farm employment as a way to manage income instability from production. This is quite common in most of latinoamerican agriculture, while in some cases the non-farming income is generated from hadcrafts from public rural works, working in neighboring farms or dividing the family in a group that stays on the land while the other work in the cities.

Production risks which cannot be eliminated or reduced or those that cannot be managed, should be insured. The experience of many countries around the world suggest that insurance was created as an ad-hoc policy to manage risks, without a careful analysis of other alternatives. In other cases insurance is being used to compensate farmers for the inefficiencies of pricing policies, the constraint of land ownership and the poor administration of credit, hence insurance has been applied as a subsidy in itself.

Greater emphasis of government policies is given now to increase and stabilize productio, as a necessary food security strategy. If these are the goals, then stabilization of farmers income is not the only interest, but one of several, and with a realtive weight that can change from country to country depending upon the number of rural

and urban families in danger of consumption insecurity. To the extent that insurance stabilizes rural incomes. even when it does not stalizes production, this guarantees rural families the capacity to secure the purchase of foods. But the facts are that at least in Latin American, on the average only 32 of the population now lives in rural, comparad to 60 percent in 1950 (Aguirre and Pomareda, 1980, p.19) which calls for a reconsideration of policies, and hence more weight to food supply increase and stabilization with slightly less concern for rural income stabilization as a goal per se.

Stabilization of farm income may be desirable because it allows farmers to stay in agriculture and to plant again, but to pursue insurance alone as rural development strategy that stabilizes farmers income is not justifiable if it contributes to make production more unstable over time. Yet, it should be recognized that the rural income stabilizing effect of insurance should not be neglected as part of a food security strategy for the rural population which are producers. However it could be said that to the extent that insurance--by reducing the risk of income loss--induces technical adoption and this results, on the average, in higher yields in good years, the overall average production would increase. In the case of India, Hazell (1982) recognized that this larger variability would have to be accepted as a trade off with a faster average growth of production. From the point of view of a food security strategy, then this latter case will require the capacity to handle buffer stocks.

The above discussion leads us into the issue of which policy or policy combination, given financial resource constraints (which is a fact!), should be implemented to increase and stabilize production or only to stabilize farm income. The choice ought to be made in light of government goals. Two options, insurance and irrigation, are considered here to discuss their effects.

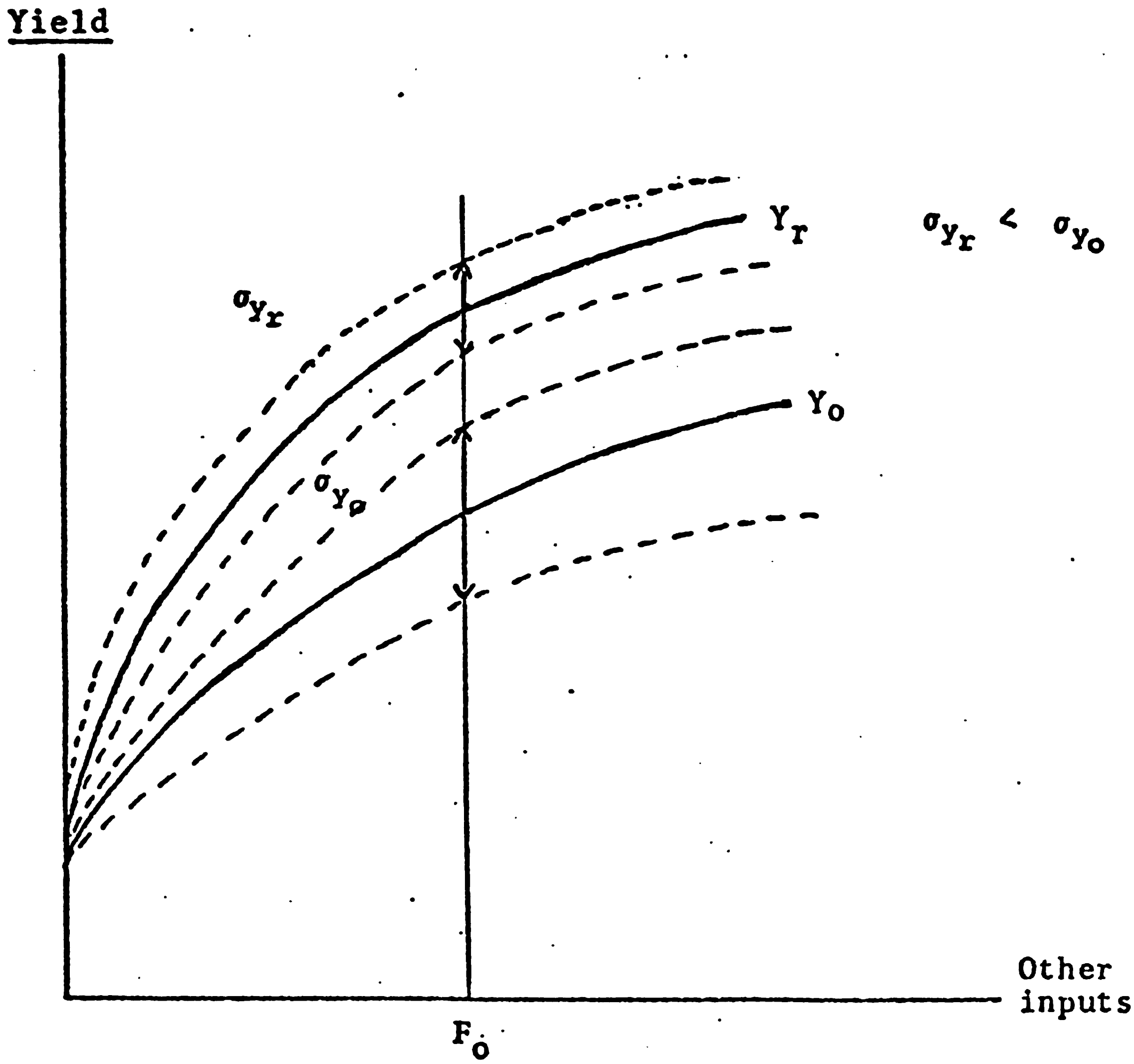

Figure 6.1. Yield response functions with and without irrigation.

Departing from a simple production economics framework, with regard to Figure 1, we can assume yield as a function of other inputs than water supply. The availability of irrigation shifts th production function, and hence, for the same amount of other inputs, a larger yield can be obtained.[3]

Irrigation has another important effect, which is many times ommited in the analysis of investment projects. This effect is risk reduction. When water is available as needed (from a canal, a reservoir or a well) it can be supplied before the plants reach turgidity and are affected by water defficiency. As a result, the yield of irrgated crops varies less over time than when rainfall is the only source of water. However, total income variability will depend on the correlation of yield and prices, as observed later in this chapter for the case of Mexico.

In relation to Figure 6.1. Y_o is the response function to other inputs without irrigation and Y_1 is the response function with irrigation. For a given price of the fertilizer input F, the optimum level of fertilizer application can be determined in each case at the level at which the marginal value product of fertilizer equals the input price, plus a risk premium. Within this framework one can see that the effect of insurance does not produce a shift in the production function but, throught risk reduction, it could motivate an honest farmer to increase the amount of fertilizer input use.

The resulting expected supply functions with an without irrigation are shown in Figure 6.2. Irrigation shifts the actual supply function from S_0 to S_r, and at a given price the quantity produced can be expected with larger probability i.e. Q_r fluctuates between Q_r' and Q_r''. The supply function when irrigation is not available is less elastic,[4] and for a given price the expected quantity varies over a wider range, hence production is riskier.

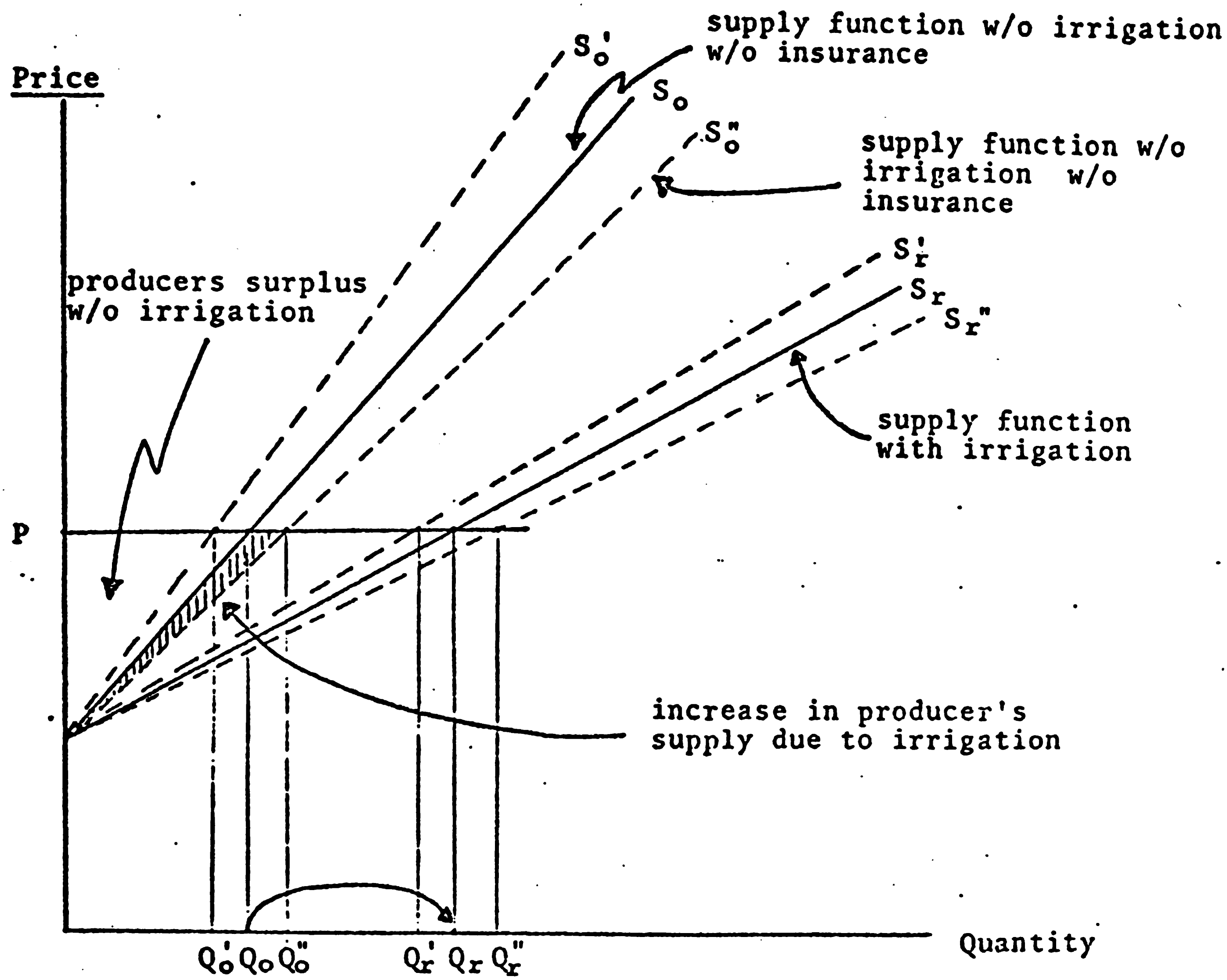

Figure 6.2. Supply functions with and without irrigation and insurance

In a welfare context, irrigation could offer larger gains to producers, because of the more elastic supply. Also these gains can be expected with more certainty. The above has taken implicit account of the cost of irrigation, but as this cost is larger S_r will move towards S_o. Hence lesser benefits can be expected as the cost of irrigation gets larger.

Insurance does not modify the production function, but through its risk reduction effect, it could only incentivate farmers to increase the use of inputs along the same production function or to expand areas planted (see the discussion in chapter 2). But even this expected effect of insurance has been reported only in very special circumstances and not as a continuous process. In any event, the larger use of inputs such as fertilizers, when irrigation is not available, exposes the farmer to a larger production risk. In addition because inputs are purchased with credit, the real financial risk also increases. It would seem therefore that insurance tries to justify itself by increasing production and financial risk.

As a result of the stimulus offered by insurance, the expected supply (but not the actual supply) will shift to the right, to the maximum possible value without irrigation, i.e. S_o'' in Figure 2. A similar effect, with the same risk characteristics could be obtained with a price guarantee program. In this later case however, the benefits to farmers are much smaller in bad years as no indemnities are received when production is lost. Therefore, although on a normal year price guarantees and insurance coverage provide similar benefits, insurance is more rewarding in the years below average, as indemnties are added to the value of product sales.

C.3. A Sector Level Analysis of the Effects of Crop Insurance in Mexico[5]

Official crop insurance in Mexico has a history on only about twenty years, although private agricultural credit insurance has existed for a longer time. The official insurance agency (Aseguradora Nacional Agrícola y Ganadera, S.A. or ANAGSA) now insures more than a dozen annual crops. The area covered by ANAGSA programs has expanded at about 5 percent per year, and more rapidly recently, so that now over eight million hectares are insured (Table 6.1.). This area represents about half the total area in Mexico shown with annual crops.

Maize alone now accounts for about 43% of the insured area, followed by beans with 16 percent of the area, sorghum with 15 percent, wheat with 8 percent, and soybeans, safflower, and cotton, each with 3 percent of the insured area (these Figures are averages for 1981 and 1982). The emphasis on basic food crops has increased sharply in recent years, as witnessed by the following statistics on the percentage of the insured area represented by maize and beans,

1976	1977	1978	1979	1980	1981	1982
45%	42%	40%	41%	56%	60%	57%

This new policy emphasis was part of the program orientation of the Mexican Food System Program (Sistema Alimentario Mexicano or SAM).

Nevertheless, from its inception, Mexico's crop insurance program has contained an important redistribution element in its administration. The beneficiaries of the agrarian reform (ejidatarios)play much lower premiums that private farmers do. These variations in premiums do not, and are not intented to reflect

Table 6.1. Cropping Area Insured by ANAGSA, 1976 - 1982 (thousand hectares)

Crop	1976	1977	1978	1979	1980	1981	1982
Sesame	55	65	84	118	145	69	135
Alfalfa			4	*		10	19
Cotton	146	232	199	205	212	225	240
Rice	47	69	42	68	94	136	172
Safflower	105	123	158	164	155	275	198
Barley						69	65
Soybeans	74	140	100		69	204	254
Beans	471	331	248	269	767	1163	1307
Maize	1028	1160	1017	924	2107	3259	3459
Maize-beans[a/]				20	4		
Potato			4	5	2		3
Sorghum	564	514	517	495	830	1062	1229
Wheat	348	348	318	206	294	512	675
Others	477	541	455	504	486	435	570
Total	3315	3523	3146	2973	5165	7418	8327

[a/] Maize and beans intercropped

* Less than 500 has

Source: ANAGSA

Note: Totals may not add due to rounding; lack of entry means zero area insured.

differences in average levels of compensation. On the other hand, increased production efficiency also is one of the motivations of the ANAGSA program.

This comments indicate that, from the viewpoint of the Mexican government, the crop insurance program should not be evaluate in terms of any single social goal, but rather it has to be reviewed in light of multiple policy preferences. This is consistent with Mexico's agricultural policy formation in general, for at least the past two presidential administrations (Ministry of the Presidency, 1973, Sistema Alimentario Mexicano, 1979).

Until recently, the agricultural insurance scheme which has been operated in Mexico has had the following principles of operation,

a. Indemnify the producer for all his cultivation costs when these are totally or partially lost because of drought, frost, hail, storms, hurricane-force winds, fire, crop disease and infestations, or excessive rainfall or floods.

b. The insurance coverage is calculated per hectare and should not exceed the total costs incurred through the harvest stage, nor should it exceed 70 percent of the value of the anticipated harvest.

c. The insurance coverage begins from the day that the crop germinates or takes root after transplanting.

In 1980, several important changes were made in these provisions and other modes of operation of the insurance program. The insurable cost ceiling was raised from 70 percent to 80 percent, and changes were made in the types of risks covered. Risks now covered included exceptionally hot and cold spells in the climate, failure

of the plant to germinate, low fertility of the seeds, inhability of the farmer to carry out planting for reasons of nature, and other problems beyond the control of the farmer. The insurance protection now is in effect from the date of land preparation to the end of the harvest. This last provision represents a signficant change with respect to the previous law, under which protection came into force from the date that the plants germinated.

In addition to the new regular insurance program of ANAGSA, some farmers now receive more extensive coverage under the program of shared risk (riego compartido). This program was spelled out in the new Law of Agricultural Insurance and Peasant Livelihood, enacted on December 29, 1980. This Law provides for indemnification of the farmer for one hundred percent of his cultivation costs when they are totally or partially lost owing to risks adumbrated in the legislation. The new definition of cultivation costs, for purposes of insurance coverage, now includes labor costs, interest due on agricultural credit, and the insurance premium itself, as long as total costs do not exceed the total anticipated value of the harvest. The shared risk program represents an important departure from previous practices, in that it insures participating farmers against variations in income, and not just against variations in yields. Howeverm to date this program has remained quite small relative to the regular insurance program (Table 6.2.). ANAGSA now subsidizes most of the insurance premiums. The total subsidy outlays rose sharply in 1980 and 1981, to a level of about 15 billion pesos (Table 6.3). The above discussion has shown how does the Mexican crop insurance program works. Its effects are clearly quite complex, but with some simplifications they were measured using a sector level model.[6] The model used here (CHAC) was developed several years ago, but it is now the first time a sector model is used for an analysis of insurance benefits at the sector level.

Table 6.2. Insurance Coverage under the Shared Risk Program (thousand hectares insured)

Crop	1980	1981	1982
Beans	13	30	2
Maize	6	43	19
Maize-beans[a]	*		
Wheat	2	5	1
Total	21	78	22

[a]Maize and beans intercropped

* Less than 500 has

Source: ANAGSA

Table 6.3. Subsidy Content of Crop Insurance Premiums (million pesos)

1970	129.3
1971	161.8
1972	172.2
1973	233.0
1974	493.8
1975	783.0
1976	899.4
1977	627.9
1978	877.7
1979	1,295.9
1980	5,224.8
1981	15,188.5
1982*	17,305.4

*The figure for 1982 refers to planned operations

Source: ANAGSA

The effects are measured in a multivariate way, including changes in producer's income, sector income, employment, consumer surplus, the agricultural income distribution, and other variables. The analysis is carried out via parametric solutions of the Mexican agricultural model CHAC, with varying assumptions about the riskiness of production decisions and the degree of insurance coverage extended to farmers.[7] Existing input subsidies (including the implicit subsidy on irrigation water) are incorporated in the input cost coefficients, so that the model simulations are conducted in as realistic manner as possible. Also, the tendency of subsistence farmers to rely on home retentions of basic foods is refleted in the model structure via basic food consumption constraints (for some farm groups) plus parameters which charge the wholesale-retailprice differentials which are associated with use of the market rather than home retentions to meet these constraints. Finally, the technological dualism of agriculture is reflected in the much narrower range of production choices, and lower yields, faced by subsistence farmers, as opposed to commercial farmers.

Risk considerations for producers are specified in two components: i) a set of matrices which generate, as part of the solution, measures of the income variability for farmers which is associated with the endogenous cropping patterns, and ii) a set of risk aversion parameters in the objective function. The latter are based on local linearizations of (E,V) utility functions (Baumol, 1963; Markowitz, 1959), so that they are expressed in terms of expected income and its standard deviation. The procedure for developing and endogenous measure of income variability (i.e., its standard deviations) was developed by Hazell (1971), and it has been adapted to th sector-wide context by Hazell and Scandizzo (1974). This kind of model is used in a comparative statics manner. That is, it does not give information regarding the time path of the variables, but rather it simulates a new equilibrum, conditional on

changes in parameter values or resource endowments. This kind of analysis is similar to that performed with the farm model in Chapter No.2.

In this kind of model, the role of crop insurance can be reflected in two ways: in terms of effects on attitudes toward risk (risk preferences) or in terms of the objective variability of farm incomes. It was chosen to employ both methods and hence to generate two sets of numerical insurance experiments. The first set of experiments computes estimates of the effects of a "perfect" insurance program which totally eliminates risk considerations from the farmer's decision function. The second set of experiments attempts to simulate as closely as possible the consequences of recent alternative formulations of the ANAGSA insurance program.

To implement the initial set of experiments, parametric variations were conducted on the model parameter which reflects farmers' risk aversion. Clearly it is not possible to associate intermediate values of ϕ ($0 < \phi < \phi^*$, where ϕ^* is the base value) with degrees of effectiveness of the insurance programs. However, it is possible to say that $\phi = 0$ corresponds to the case in which risk concerns are totally absent, i.e., the insurance program is perfect in the sense that it fully guarantees income. It should also be noted that this case carries the implicit assumption that the premiums are fully subsidized.

For the second set of experiments, two kinds of crop insurance programs are simulated. The first program attemtps to simulate the ANAGSA program which has prevailed until very recently: farmers are compensated if their yields fall below 80 percent of the "normal" for each crop and region, taking into account the production technology used. The model is solved under two different assumptions about the subsidy content of the premiums. The other insurance program analyzed is the shared risk program, under farmers are compensated for variations in gross revenue, not just yields.

In this program, farmers are being insured against market price variations as well as yield variations. Here the net outcome for farmers is influenced by the covariance between prices and yields as well as the variances of each concept. The experiment of fairly hypothetical in that it is assumed that the shared risk program is applied to the entire sector. Again, the model is solved under two different assumptions about the subsidy element in premiums.

For these last experiments, the objective risk parameters of the model were modified as described in Hazell (1981). In words, the time series of past values of gross revenues by crop and district was modified as if the stated insurance program had been operative in those years. This corresponds to a new evaluation on the part of farmers of how the revised insurance program would affects income fluctuations over time, assuming that their perceptions of the insurance program are correct.

Before reviewing the model solutions, it is useful to examine the degree of variability of crop return in Mexico. Tables 6.4. and 6.5 present a measure of the variability in farming incomes, based on a ten-year time series on yields and prices in locality. Table 6.4 illustrates the two facts that farm incomes in Mexico are unstable and that the degree of their instability varies over crops and locations. The coefficient of variations[8] ranges from 0.12 (maize in Rio Yaui) to 1.38 (oats in the nort central irrigated districts). Of course, some of these coefficients are based on relatively small numbers of observations, and they would differ for a different ten-year period. Nevertheless, the ranges of values probably are reasonably representative.

The coefficient of variations of income usually is greater than each of the component coefficients of variations of prices and yields. Interestingly, prices tend to be more unstable than yields. Since some of the cropped areas are quite small, and

Table 6.4. Coefficients of Variations and Changes in Cropping Patterns under Risk Elimination, Principal Crops

District	Crop	Coefficient of variation of prices	Coefficient of variation of Yields	Coefficient of variation of income	Production Base (ϕ=1)	Production ϕ=1 in all areas
A. Irrigated Areas						
Río Colorado	Cotton	.64	.22	.79	276.7	42 7
	Alfalfa	.40	.17	.46	1052.0*	1052.0*
	Wheat	.31	.16	.48	0	437.1
Hermosillo	Wheat	.38	.11	.49	485.0	480.4
	Beans	.44	.22	.35	8.2	0
	Sorghum	.45	.17	.65	0	33.6
Río Yaqui	Safflower	.41	.24	.50	7.7	0
	Flaxseed	.50	.13	.55	14.2	14.2
	Soybeans	.41	.13	.47	178.2	0
	Wheat	.39	.18	.56	1002.8	765.8
	Maize	.37	.12	.12	0	73.4
	Watermelon	.40	.79	.63	0	418.6
Culiacán-Humaya	Rice	.56	.21	.70	257.3	261.6
	Chile	.48	.36	.67	42.2	0
	Tomato	.30	.37	.53	383.9	649.9
	Melon	1.07	.31	1.19	202.3	277.2
	Soybeans	.42	.18	.49	35.1	0
	Wheat	.34	.19	.48	40.3	0
El Fuerte	Alfalfa*	.32	.18	.46	68.0	68.0
	Rice	.57	.18	.58	58.6	64.8
	Chile	.52	.53	.78	2.5	64.8
	Chickpeas	.47	.23	.53	0.2	0
	Tomato	.51	.36	.43	65.4	17.3
	Potatoes	.52	.21	.65	25.8	0
	Wheat	.35	.17	.54	960.1	982.35
El Bajío	Garlic	.38	.17	.42	24.3	0
	Alfalfa*	.67	.37	.55	244.0	244.0
	Peanuts	.42	.29	.46	53.0	10.2
	Onions	.30	.21	.50	18.4	0
	Barley	.28	.12	.31	15.7	18.4
	Beans	.49	.31	.58	30.4	89.8
	Chickpeas	.38	.23	.43	52.4	16.8
	Sorghum	.44	.15	.54	206.9	34.6
	Cucumber	.69	.11	.66	0	106.2

Table 6.4.(continued)

District	Crop	Coefficient of variation of prices	Coefficient of variation of yields	Coefficient of variation of income	Production: Base (ϕ=1)	Production: ϕ=1 in all areas
Northwest (remainder)	Rice	.67	.16	.78	142.8	61.6
	Beans	.51	.27	.52	119.5	210.2
	Cucumber	.45	.32	.81	40.4	0.9
	Watermelon	.33	.22	.45	55.2	0
	Wheat	.38	.19	.54	823.4	751.0
	Alfalfa	.39	.27	.61	514.0	514.0
	Tomato	.34	.17	.39	0	63.5
	Sorghum	.45	.15	.38	0	84.4
Northeast	Alfalfa	.52	.35	.24	771.0	771.0
	Cotton	.73	.29	.84	248.9	385.3
	Safflower	.42	.19	.57	167.2	45.5
	Maize	.40	.21	.48	369.6	531.0
	Sorghum	.32	.15	.29	89.4	0
North Central	Cotton	.66	.22	.61	383.9	264.5
	Alfalfa	.33	.06	.34	687.0	687.0
	Safflower	.42	.19	.57	59.8	0
	Onions	.39	.53	.81	14.3	312.1
	Oats	1.03	.41	1.38	0	52.5
	Peanuts	1.02	.24	.58	0	6.78
Center (remainder)	Alfalfa	.26	.50	.45	10624.2	10642.2
	Sugarcane	.41	.14	.55	8747.5	6252.3
	Barley	.33	.09	.40	586.1	583.4
	Chile	.54	.32	.48	76.9	226.5
	Strawberries	.42	.28	.53	96.3	96.3
	Beans	.43	.18	.54	390.9	300.3
	Lima beans	.60	.47	.65	19.5	0
	Tomato	.42	.21	.51	348.4	0
	Maize	.33	.12	.45	736.5	1261.9
	Sorghum	.40	.21	.47	205.1	0
	Wheat	.35	.28	.50	94.3	0
	Garlic	.46	.28	.43	0	24.1
	Chickpeas	.39	.27	.46	0	28.9
	Safflower	.38	.33	.54	0	179.4
South	Chile	.24	.27	.34	214.3	119.8
	Beans	.54	.13	.52	124.4	147.2
	Watermelon	.38	.25	.59	43.5	52.1

Table 6.4. (continued)

District		Crop	Coefficient of variation of prices	Coefficient of variation of yields	Coefficient of variation of income	Production Base (ϕ=1)	Production ϕ=1 in all areas
B. Rainfed Areas							
Northwest	B	Sesame	.44	.78	1,17	.4	6.1
		Maize*	.40	.39	.42	4.4	12.4
	C	Safflower	.42	.31	.31	9.2	0
		Beans	.53	.29	.37	1.5	0
		Sesame	.44	.22	.44	2.3	0
		Maize*	.36	.29	.27	73.1	104.3
		Sorghum	.44	.74	.98	16.9	0
	F	Safflower	.42	.32	.30	8.2	0
		Beans	.54	.31	.36	10.1	0
		Maize*	.36	.31	.29	37.4	68.4
		Sorghum	.44	.78	1,03	28,0	0
North	G	Safflower	.49	.34	.59	4.6	31.8
		Maize	.38	.25	.53	244.9	244.9
	5	Beans	.54	.69	.51	58.1	49.5
		Maize*	.39	.50	.52	348.5	420.5
		Soybeans	.45	.15	.45	87.1	0
		Sorghum	.45	.22	.54	0	6.8
	6	Maize*	.38	.13	.39	39.2	39.2
	7	Oats	.74	.32	1,03	.4	0
		Maize*	.40	.36	.49	3.2	9.2
		Wheat	.31	.68	.56	.7	26.6
Center	8	Cotton	.49	.17	.49	45.8	324.8
		Maize*	.39	.14	.48	601.6	380.2
	9	Sesame	.33	.09	.34	92.6	89.3
		Maize*	.38	.11	.38	12.9	12.9
		Sorghum	.32	.16	.35	0	86.9
		Wheat	.32	.25	.39	0	16.7
	10	Chickpeas	.36	.34	.52	136.5	143.1
		Maize*	.38	.10	.39	2256.2	2246.2
		Tomato	.41	.36	.72	0	95.8
	11	Onions	.37	.13	.47	271.0	0
		Maize*	.39	.15	.43	41.9	41.9
		Sorghum	.28	.12	.33	818.1	2614.0
		Soybeans	.42	.16	.51	96.8	0
	12	Oats	.74	.33	1,04	49.8	
		Maize*	.40	.17	.50	1104.0	1720.1
		Sorghum	.41	.19	.52	1705.8	394.8

Table 6.4. (continued)

District		Crop	Coefficient of variation of prices	Coefficient of variation of yields	Coefficient of variation of income	Production Base (ϕ=1)	Production ϕ=0 in all areas
South	13	Sugarcane	.43	.06	.41	2353.8	26025.9
		Maize*	.40	.18	.40	2148.1	1680.8
		Potatoes	.25	.29	.52	607.9	679.1
		Sorghum	.39	.15	.43	1344.7	893.4
		Soybeans	.45	.14	.58	297.1	756.4
		Tobacco	.33	.11	.28	31.8	8.6
		Peanuts	.59	.16	.67	0	38.1
	14	Maize*	.40	.09	.36	7.3	7.3
	15	Rice	.43	.10	.49	20.8	91.5
		Beans	.53	.15	.55	20.4	0
		Lima beans	.73	.47	.38	23.7	46.8
		Maize*	.39	.27	.43	158.6	140.2
		Potatoes	.30	.25	.59	14.0	0

Note: An asterisk indicates the crop's production level was at a bound--usually representing home retention requirements.

Table 6.5. Coefficients of Variations of Income for Selected Crops

Crop	Irrigated Areas	Rainfed Areas
Maize	.46	.42
Wheat	.54	.56
Sorghum	.47	.45
Barley	.40	n.a.
Oats	1.38[a/]	1.04
Alfalfa	.44	n.a.
Cotton	.73	.49
Rice	.71	.49
Safflower	.57	.36
Soybeans	.47	.54
Sesame	n.a.	.35
Beans	.53	.50
Chile	.42	n.a.
Onions	.64	.47
Garlic	.42	n.a.
Tomatoes	.51	.72[a/]
Cucumber	.81	n.a.
Lima beans	.65	.38
Chickpeas	.43	.52
Strawberries	.53	n.a.
Watermelon	.51	n.a.
Peanuts	.46	.67[a/]
Melon	1.19	n.a.
Sugarcane	.55	.41
Tobacco	n.a.	.28

[a/] Based on weights in the $\phi = 1$ solution; see table 4.2.

n.a.= not available

therefore, the corresponding coefficient of variations are not very representative, Table 6.5 represents aggregations over localities of the coefficients, using as weights the production levels in the base solution (Ø = 1). With these aggregations, clearer patterns begin to emerge. First, the coefficient generally do not differ by more than a factor of two across crops, although at the extreme the coefficient for irrigated barley. Second, the conventional wisdom that vegetables are more risky than grains does not appear to hold up. Under irrigation. leaving aside the extreme cases of oats (c.v = 1.38), melon (c.v. = 1.19), and cucumber (c.v. = 0.81), the range of values for the coefficient of variation is 0.40 - 0.71) for maize, wheat, sorghum, barley and rice, while it is 0.42 - 0.65 for beans, chile, onions, garlic, tomatoes, lima beans, chickpeas, strawberries, and watermelon. A similar holds in rainfed areas, although fewer vegetable are grown there. Third, irrigated and rainfed areas appear to be comparable in relative riskiness, as measured by the coefficient of variation.

However, this last fact if offset by the consideration that rainfed incomes are much lower than irrigated incomes on the average, so the absolute riskiness of farming, as measured by the standard deviation (or variance) of income is much higher in irrigated areas (Table 6.7). Bassoco and Norton (1983, p.165) report that for the sector as a whole income per hectare is over four times as high in irrigated areas as it is in non-irrigated areas.

Turning to the solutions of CHAC, Table 6.6 shows the basic result that complete risk elimination would have clearly positive effects on net social welfaer, as measured by the sum of producer and consumer surplus. However, consumers are the beneficiaries, and price responses, producers are the losers. Shifts in demand schedules over time would mitigate these effects, but nevertheless

Table 6.6. Welfare Effects of Risk Elimination

Concept	Base $\phi=1$	$\phi=0$ in irrigated areas	$\phi=0$ in rainfed areas	$\phi=0$ in all areas
Objective function (10 million pesos)	17962,18	18549,71	18484.68	18951.67
Producer surplus (10 million pesos)	2798.82	2598.91	2333.96	2215.92
Consumer surplus (10 million pesos)	15163,36	15950,80	16150.72	16735.75
Sector income (10 million pesos)	3674.96	3526,93	3330.98	3179.81
Gini coefficient (index)	.3386	.35574	.23948	.29659
Employment (thousand man/years)	1561.92	1589.21	1758.34	1704.29
Quantum index of production (index)	100.00	101.20	102.53	105.07
Maize production (thousand tons)	8180	8179	8372	8995
Imports (10 million pesos)	182.03	178.16	142.39	22.86

Table 6.7. Standard Deviation of Income per Hectare by District

District	Base solution (ϕ=1)	ϕ=0 in irrigation areas	ϕ=0 in rainfed areas	ϕ=0 in all areas
A. Irrigated				
Río Colorado (1)	0.70	0.54	0.56	0.52
Hermosillo (1)	0.14	0.16	0.15	0.16
Río Yaqui (1)	0.16	0.30	0.13	0.29
Culiacán-Humaya (1)	0.58	0.84	0.33	0.74
El Fuerte (1)	0.09	0.13	0.09	0.12
El Bajío (3)	0.17	0.27	0.17	0.28
Northwest (1)	0.14	0.19	0.13	0.22
Northeast (2)	0.24	0.33	0.07	0.28
North (2)	0.28	0.38	0.30	0.39
Center (3)	0.12	0.13	0.11	0.13
South (4)	0.10	0.10	0.11	0.11
A. Rainfed				
B (1)	0.08	0.08	0.09	0.08
C (1)	0.01	0.01	0.03	0.03
E (1)	0.02	0.01	0.02	0.03
G (2)	0.04	0.04	0.05	0.05
5 (2)	0.06	0.06	0.06	0.06
6 (2)	0.02	0.02	0.02	0.02
7 (2)	0.03	0.04	0.09	0.06
8 (3)	0.06	0.04	0.69	0.31
9 (3)	0.03	0.03	0.04	0.04
10 (3)	0.04	0.03	0.05	0.04
11 (3)	0.06	0.06	0.08	0.08
12 (3)	0.04	0.04	0.04	0.04
13 (4)	0.04	0.04	0.06	0.06
14 (4)	0.01	0.02	0.02	0.02
15 (4)	0.03	0.03	0.04	0.03

Note: Figures in parentheses indicate the region. The rainfed districts are defined in the appendix.

the static consequences for producers are negative. Landless workers, on the other hand, are beneficiaries of this hypothetical change because employment rises significantly. This leads to an increase in net income for this group, and so the decline in sector income is less than the decline income of farmers. Maize production would be proportionately more responsibe than total production to an elimination of the risk factor.

Table 6.7 shows the expected result that risk elimination increases the variability of farm income, although there are a few exceptions on spatial basis. From a policy planning viewpoint, this result implies that insurance programs may well decrease the level of national food security in some years, because of the greater variance of production caused by the shift toward riskier crops. Of course, the variance of production is likely to be less than the variance of income (see Table 6.4.), but an increase in the latter is likely to mean an increase in the former. It leads to higher expected production levels and improves the rural income distribution, but it leads to greater instability of national food supplies. Hence a crop insurance program may have to be accompanied either by greater investments in storage facilities or by a policy of holding higher levels of foreign exchange reserves.

The actual Mexican crop insurance programs have effects which are rather different from those associated with the hypothetical case of risk elimination. One of the differences is that actual programs do not eliminate risks. Another difference is that farmers pay insurance premiums. As noted above, in order to simulate the effects of the actual programs, the risk time series (time series of gross revenues by crop) have been modified to reflect insurance operations. This procedure effectively alters the basis on which

the farmers form their perceptions of the riskiness of crops and crop combinations. One important departure of the model experiments from reality is that in the experiments the program are assumed to apply to the entire sector, that is, to be the entire area in annual crops.

Table 6.8 presents the aggregative results of the insurance program simulations. The salient features of these simulations are the following:

1. Unlike the case of risk elimination, the actual insurance programs have a slightly negative effect on aggregate social welfare, measuring welfare as the sum of producer and consumer surplus. This consequence occurs because the insurance premiums constitute a component of the farmers' cost of production, and hence there tends to be a leftward shift in the aggregate supply function. Crop composition changes are occurring as well, but the aggregates consequence is a reduction in social welfare. Given the generally inelastic nature of the demand for agricultural products, there also occurs an increse in producer revenue and a corresponding decrease in consumer surplus.

2. Conversely, increasing the subsidy content of the insurance program stimulates output (under both types of programs) and therefore reduces producer surplus. However, not counting the cost of the subsidy itself, there is a net social gain from the subsidization. The income distribution improves with the insurance programs, given the actual pattern of premiums and of crops insured, but it worsens under higher subsidy, as commercial farmers receive greater increases in benefits. The employment responses to increased subsidization are ambiguous, the output increase gives rise to positive changes in employment, but crop substitution effect cause negative changes in employment. The insured crops are by-and-large not the more labor-intensivce crops, i.e., they are not the fruits and vegetables.

Table 6.8. Welfare Effects of Changes in the Mexican Crop Insurance and Risk Sharing Programs

	Yields insurance		Income insurance	
	Without subsidy	With Subsidy	Without subsidy	with subsidy
Objective function (10 million pesos)	17179.4	17597.0	17253.7	17661.7
Producer surplus (10 million pesos)	3251.2	2965.7	3196.4	2949.2
Consumer surplus (10 million pesos)	13928.2	14631.3	14057.3	14712.4
Sector income (10 million pesos)	4147.4	3888.7	4095.3	3837.4
Gini coefficient (index)	.31232	.31879	.29941	.32426
Employment (thousand man-years)	1592.8	1613.6	1611.5	1595.7
Quantum index of production (index)	98.2	100.0	98.4	99.5
Maize production (thousand tons)	7948	8179	7948	8179
Imports (10 million pesos)	183.5	182.5	182.5	182.5

Note: These experiments were conducted without taking into account the average insurance reimbursement to farmers, by crop and by locality (see text).

3. Another comparison which may be made in Table 6.8 involves comparing the first and third column of numbers, or the second and fourth. In other words, we may assess th effects of changing the insurance concept from one of insuring yields (at 80 percent of normal). This shift in concept also increases social welfare, and in this case the deleterious impact on producers is ot included in the measures of producers surplus and sector income, and not doubt its inclusion would make the change in producer surplus positive under the shift from yield insurance to income insurance.

4. Because of crop composition changes, the consequences for the income distribution of the change in insurance concept are uncertain. Under the unsubsidized vèrsion of both concepts, the change in concept improves the income distribution. Under the subsidized version, the change causes it ot deteriorate slightly. Similarly ambiguous results are obtained for employment, and the level of maize production is not affected at all by the change in concept.

In comparing the two types of programs, it should be borne in mind that the income insurance program, as designed in Mexico, is considerably more expensive than the yield insurance program. In the forceable future, it it unlikely that income insurance will be extended to a very significant portion of the sector.

Subsequently to the work reported in the tables of this section, some experiments were conducted taking into account the average insurance compensation paid to producers. Apart form raising producer incomes in all cases, this change did not alter the basis results reported above. In particular, the insurance programs still lead to a slight reduction in overall production, a decrease in

aggregate social welfare and an increase in producer incomes. This occurs because the compensation occurs ex-post and can not be anticipated by the farmer at planting time, and therefore, it does not offset the left-ward shift in the supply function which is caused by the premium.

On the average, farmers benefit significantly from Mexico's crop insurance, basically in two ways:

a. On the average indemnities more than offset the portion paid of premiums, and

b. The tendency for reduced supplies improves producer returns.

Also, the rural income distribution tends to become less unequal. The chief social costs of the programs are a reduction in consumer surplus and greater instability of national foods supplies. If it is desired to avoid production decreases, then the case for subsidized premiums becomes strong.

Perhaps it is useful to ask if policy makers were aware of these trade-offs when the programs were designed. In particular, did they anticipate that one of the main mechanisms of increased farm incomes would be a reduction in national production? We suspect the answers to both questions are negative.

APPENDIX

Table A. Mexican Crop Insurance Premiums (as of 1981, in pesos per hectare).

I. Irrigation Districts	Premium without subsidy	Premium with subsidy
Río Colorado		
cotton	915	346
sorghum	692	278
Hermosillo		
wheat	374	185
Río Yaqui		
safflower	418	227
maize	365	195
soybeans	382	165
wheat	374	185
Culiacán		
soybeans	584	251
wheat	412	167
El Fuerte		
rice	429	163
beans	387	119
soybeans	584	251
wheat	412	167
El Bajío		
barley	272	105
beans	506	207
maize	600	239
Other northwest districts		
cotton	660	339
rice	429	173
cucumber	750	363
sorghum	308	156
wheat	412	167

Table (continued)

	Premium without subsidy	Premium with subsidy
I. Irrigation Districts		
Northeast districts*		
cotton	693	274
safflower	389	163
maize	368	152
North central districts**		
cotton	693	274
safflower	158	146
wheat	415	188
Other central plateau districts		
barley	377	130
beans	566	283
chickpeas	150	67
Southern districts		
green chile	470	223
beans	302	97
watermelon	917	416
II. Rainfed Areas* **		
Northwest		
B sorghum	178	80
C safflower	414	164
maize	316	121
E safflower	414	164
maize	316	121
sorghum	260	114
North central and northeast		
G safflower	145	62
maize	157	62
sorghum	191	72
5 maize	157	62
sorghum	191	72
6 maize	400	154
7 maize	400	154
wheat	299	100

*Including La Laguna

**Chihuahua and Durango

***See appendix table B for a definition of the rainfed areas

Table (continued)

II. Rainfed Areas	Premium without subsidy	Premium with subsidy
Central plateau		
8 maize	396	147
9 maize	129	45
sesame	283	108
sorghum	182	73
10 maize	532	177
11 maize	398	96
12 maize	450	163
South		
13 rice	546	241
maize	511	224
sorghum	448	187
14 soybeans	470	197
maize	446	125
15 sesame	316	132
maize	511	224

Note: These premiums were aggregated to the CHAC spatial definitions on the basis of data supplied by ANAGSA

Classification of Rainfed Districts in CHAC According to Altitude, Precipitation and Region

Altitude in meters	Annual precipitation in millimeters					
	0-200	200-400	400-600	600-800	800-1000	More than 1000
0 - 500		B	G	5,C	E	13
500 - 1000				9		8
1000 - 1500					10	
1500 - 2000			6,11,13	12		
More than 2000				7		15

Regions

Northwest	Districts	B, C, E
North central and northeast	Districts	G, 5, 6, 7
Central plateau	Districts	8, 9, 10, 11, 12
South	Districts	13, 14, 15

Note: Each district is a set of not necessarily contiguous agricultural counties (municipios) which are characterized by their region of location and their altitude and rainfall. For example, district 6 is located in the northern part of the country at altitudes of 1500-2000 meters with rainfall of 400-600 mm. District 11 has the same altitude and rainfall characteristics but is located in a different region, the central plateau. Empty cells in the table either do not exist in Mexico or do not have agricultural activity.

VII. THE SUPPLY OF AGRICULTURAL INSURANCE

VII. THE SUPPLY OF AGRICULTURAL INSURANCE

A. Introduction, Setting the Hypothesis

B. The Cost of Agricultural Insurance

C. The Finance of Agricultural Insurance

D. Premium Rate making with Yield Data

E. Insuring Against Climatic Risk and the Use of Weather Data to Asses Insurability

F. The Problems of Portfolio Concentration

G. The Usefulness of an Insurance Portfolio Management Model

H. Seasonality of Agriculture and Management of the Insurance and Investment Portfolios

I. The Reinsurance of Agricultural Insurers

VII. THE SUPPLY OF AGRICULTURAL INSURANCE

A. Introduction, Setting of the Hipothesis

The farmer's demand for insurance is affected by the expected profitability and risk of an agricultural enterprise, the farmer's attitudes towards risk and the availability of other risk management alternatives. The works of Johda and Walker (1983) and Hazell, Bassoco and Arcia (1983) and the results of the farm model presented earlier in this report, demonstrate the importance and interrelation among such factors. One can expect therefore, that from the farmer's point of view it is most desirable to access insurance at the lowest price, hence insurers should be interested in providing insurance in those conditions.

Although much of our interest was on the benefits of insurance, a great deal of concern was the cost of insurance. A recommendation on how to go about crop insurance, has to be based on benefit-cost considerations. Hence several hypothesis were tested about the cost and finance issues relating to crop insurance.

a.- The cost of insurance has two components. The administration cost and the risk cost. The cost of risk is determined by the expected magnitude of loss. This is in fact quite cumbersome to explain but the idea is that if we define for example that "insurance will be provided only against hail and that indemnities are paid only in the event of total loss", then the risk premium will be smaller than the one required to finance "a program that covers against hail, drought and flood and indemnities to be paid if yields fall below 70 percent of the average". Insurance in the past has been provided in most cases as all-risk insurance and allowance has been made for indemnity payments for partial losses.

The hypothesis that emerges out of this is that premium rates for all risk insurance are larger than for specific risk insurance, and allowance for indemnities under partial loses requires higher premium rates and much larger administration costs.

b.- Because all-risk crop insurance is costly, it has required strong government subsidies. The hypothesis presented is that without government subsidies all-risk crop insurance is not possible, therefore for insurance to be self financed by farmers premiums, it must be for specific risks and only total loses.

c.- There has been a major effort in the development of methods to calculate risk premia using crop yield data. The hypothesis is that, the validity of this approach is limited because of the insufficient information about the causes of yield fluctuation.

d.- The use of weather data is not extended in the calculation of risk premia. It is hypothesized that the use of weather data is a very permissing area in the future work of crop insurance for climatic risks.

e.- Unless disease and pests are totally unexpected in a particular year, and only as the first time, insurance should not be provided against such events. Its availability will induce less care from the part of the farmer to prevent and control pests and diseases. Such prevention and diseases are a problem for technical assistance and not for insurance.

f.- Although actuarially fair premiums are the basis for a sound insurance program, the financial sucess of the insurer depends on the structure of the insurance portfolio. The hypothesis are that

no item should dominate the portfolio and that correlation of expected loses should be small or negative. This will help to prevent total indemnity payments in a particular year, being above total premium income, yet indemnities for a particular crop in that year might in fact be much larger than premiums collected.

g.- Significant gains for the financial stability of the insurer can be obtained from proper management of the insurance premiums collected. Income to the insurer (either to be capitalized or used for administration costs or to be distributed) should be generated from investments of premiums collections in capital market instruments, in a way that the insurer exploits at maximum the seasonal inflow of cash and the stochastic demand for indemnities.

h.- Reinsurance is a necessary condition because of the catastrophic nature of agricultural risks. The hypothesis is however, that for all-risk insurance, administered by public institutions, reinsurance can be provided only by government reserves, because reinsurers will demand too high reinsurance premiums.

It should be stated here with honesty, that insufficient knowledge about insurance management did not allow to formulate these hypothesis at the earliest stages of the research program. These hypothesis emerged as time passed and we gained more and more information from two primary sources. The first was the insurers' own experience and the second was the literature on general insurance principles and the one on agricultural risk.

B. The Cost of Agricultural Insurance[1]

The long run cost of insurance is determined by the cost of risk protection (the indemnities paid) and the administration cost. Regardless of how this cost is financed, the insurer should be

interested in providing insurance at low prices.[2] When these prices became too low thanks to government subsidies they induced abuse of insurance and hence becoming a source of income, rather than an income stabilization policy.

The experience throughout the world reveals that, for all-risk crop insurance, indemnities have been around 15 percent of coverage (See Table 7.1). This would suggest that pure insurance premiums (cost of risk) should have been at least that high. This aggregate figure however, has a wide variation by country and crop. For some annual crops and livestock it is as low as 2 percent and for other crops it is as high as 26 percent. For the case of tree crops in Israel, this ratio is rather low. In this case, for citrus for example, insurance is only for the specific risks of hail and frost, and indemnities are paid on the difference between 90 percent of average yield, or the lowest yield in the last 5 year period--whichever is lowest, and the actual recorded yield (IFNRA, 1977).

An examination of the data in Table 7.1. for various insurance programs in existence for many years (thanks to government subsidies), reveals that indemnities account for as much as 94 percent of the total cost of the programs, as in the case of Brazil and Costa Rica, and 88 percent in Mexico. In the case of U.S., indemnities have been a much smaller proportion of the total cost of the programs.

All-risk insurance program which also pay indemnities for partial loses could have high administration costs. The administration cost would in such case include the costs of issuing the policy, preliminary inspection, disaster(s) inspection(s) and harvest inspection, depending on the number of disasters reported or whether there was partial or total damage (see Velásquez, 1983). In

Table 7.1. Ratio of Indemnities to coverage for some crops in various insurance programs

Country	Program	Crop	Period	Indem-nities as a % of Coverage	Indemnities as a % of Total Cost
Mexico	ANAGSA	Total	1963-79	10.84	86.36
Costa Rica	INS	Total	1970-81	16.54	93.22
		Rice	1970-81	16.24	-
		Corn	1970-81	26.20	-
Panama	ISA	Total	1977-82	7.18	-
		Crops		8.46	-
		Livestock		4.67	-
USA	FCIC	Total	1948-78	5.28	
		Peaches	1963-78	18.85	-
		Apples	1963-78	13.17	-
		Potatoes	1962-78	12.92	-
		Rice	1960-78	1.52	-
		Wheat	1948-78	6.15	-
Israel	IFNRA	Total	1967-77	1.77	93.62
		Citrus	1967-77	2.47	-
		Flowers	1961-77	19.20	-

Sources: ANAGSA, 1980
Arauz, G., 1983
Arcia, G., 1983
Velasquez, V., 1983
FCIC, 1980
IFNRA, 1978

addition there are the fixed costs of handling, processing and retrieving information. The costs of administration and the indemnities for the case of Panama in 1981/82 are given in Table 7.2 and they show a significant variation between crops and regions.

Administration costs could vary depending on the approach used for assesment of loses and payment of indemnities. A way to lower the administration cost is to use the area approach, instead of the individual approach. In this case indemnities are paid to all farmers in an area affected by disaster at a rate consistent with a sample estimate of loses (Dandekar, 1977).

Total administration costs of most programs have been in most cases rather small. This was so even in the case of Mexico, where such a large number of farmers was given insurance. It was recognize however, that the supervision and evaluation at harvest time were minimal in the case of Mexico (Aubey and Hogan, 1979, and Hogan, 1981). In the case of Costa Rica, the administration costs are low because the program is concentrated in a small number of large farmers and the program has very little supervision. However, inspections may have been made with more intensity in the last years (Arauz, 1983). In the U.S. the administration cost is very large in relation to the total cost of the program and about 65 percent of it is due personnel costs.

The insurance program in Panama (ISA) is probably the one that has the largest average administration cost per policy issued.[3] ISA has a rather intensitive supervision program, and as a result moral hazard in minimal. Furthermore, in spite of good planning, a mixed clientele of small a medium size policies and a new computarized data management system, has not shown yet a significant reduction in administration costs. The data in Table 7.2 indicates that in 1981/82 the administrative and total costs for different

Table 7.2. Panama-ISA, Administration Costs/Total Cost[1/] as a Percentage of Coverage, 1981/82.

	Province					
	Chiriqui	Los Santos	Herrera	Cocle	Veraguas	Panama
CROPS						
Rice	.0213/.0324	.0099/.1333	-	.0021/.0927	.0190/.0777	.0205/.0395
Corn	.0630/.1027	.0263/.0530	.0197/.0874	.0233/.1133	.1070/.6990	.0451/.0451
Sorghum	.0244/.1123	.0115/.3000	.0162/.3628	.0155/.1514	.0754/.2750	.0634/.6089
Beans	.1110/.3742	-	-	-	-	-
Tomatoes	-	.0472/.1853	.0561/.1420	.0410/.1275	.1385/.1385	-
Onions	-	.0026/.2773	.0419/.4937	.0369/.1810	-	-
LIVESTOCK						
Fattening	.0400/.0489	.0430/.0475	.0402/.0574	.0570/.1605	.0470/.0607	.0527/.0830
Bulls	.0112/.0392	.0121/.0389	.0222/.0585	.0116/.0116	.0056/.0446	.0117/.0591
Cows	.0269/.0414	.0282/.0369	.0257/.0404	.0293/.0532	.0268/.0406	.0276/.0597

1/ Includes indemnity and administration cost as a percentage of total coverage.

crops and livestock explotations. Variations among items are explained by the average size of policy (in terms of coverage), the distances to the farms (which affect the cost of fuel and the number of inspections that an officer can make), the number of times that disasters are reported, etc.

From this analysis it is concluded that the total premiums needed for an actuarially fair all-risk crop insurance, program, which allows indemnities for partial loses and which also covers administration costs, should be on the border of 20 percent. Clearly, this total cost of agricultural insurance is high compared to other types of insurance. Given profit margins in agriculture for most cereal crops, an insurance premium of this magnitude would imply a small demand for insurance. Aggresive marketing strategies would have to be put on by the part of the insurers, unless government subsidies on premiums are allowed.

This explains in part why private companies have not entered the all risk agricultural insurance business. On the other hand, no attempt has been made to establish fully self-financed insurers, perhaps because it is recognized that if the farmers had to pay the total cost of insurance protection, other risk management mechanisms would prove to be more cost effective, given the farmers' attitude towards risk and their planning horizon.

C. The Finance of Agricultural Insurance

The preceding section explained the nature of costs and the likely premium levels for all-risk insurance programs to be self-financed. The degree of government participation varies among programs, but all subsisting ones owe it to government support.

Much debate has already been presented about the justification for government support to insurance, but in financial terms, all risk-crop insurance cannot be justified, hence it cannot be admitted as a profile enterprise.

Government contributions have taken the forms of subsidies to premiums, allowances for administration costs and reinsurance when catastrophic disasters occurred, or when for political reasons income flows into agriculture may have been considered necessary, taken advantage of the occurrence of a disaster. This reinsurance mechanism has been the largest contribution of governments, as premiums have not been sufficient to pay for losses.

In the earlier years (1963/64 - 1967/68) of the mexican program, the government contribution to premiums was 40 percent. Between 1967/68 and 1972/73 it was 55 percent. From then on, until 1966/77, the subsidy to premiums averaged 64 percent, but it began declining after that year and now it is around 50 percent (calculated with data from ANAGSA, Departamento de Operaciones Agrícolas, Sección Programación). It should be recalled here that the proportion of the total cost beared by the government is larger as it also finances the administration costs of ANAGSA, but these figures are not known.

The Costa Rican rice insurance program (over 70 percent of the portfolio is on rice) has been very heavily subsidized. Over the last 12 years the government has financed around 77 percent of the program. In this heavy subsidy to rice plus low interest credit has allowed rice production to increase, in spite of rather stable (in real terms) guaranteed prices (Vogel and Larson, 1981). The benefits of the program have accrued to a reduced number of farmers in the area of Guanacaste (Gudger, 1983).

The U.S. program operated by the FCIC is a voluntary all risk insurance program that has enjoyed signficant amount of government subsidies. The government provides appropriations for administrative expense, and in 1978 and 1979 this contribution was equal to 12 million US$. An important source of income in 1977 was the iisuance of capital stock for 50 million US$. This allowed FCIC to finance its devastating loses which added up to record high of 148 million US$.

The most heavily subsidized program over 40 years of existence, has been the one in Japan. Between 1939 and 1980 the japanese government has financed over 90 percent of the cost of the insurance program (see the works of Yamauchi and Tsujii in Hazell, Pomareda and Valdes). Part of this cost was subsidy to premiums, with heavier weights in areas with more frequent damage. In these latter case the portion of premium paid by the treasury was up to 80 percent; and on the average the treasury paid 60 percent.

This analysis reveals that the feasibility of self-financed all-risk crop insurance is questionable. Premiums would have to be much larger for them to cover the overall long term cost of the program.

D. Premium Rate Making with Yield Data

There is wide recognition that one of the limitation to implement crop insurance is the lack of adequate data to estimate premiums (see Ray, 1982, and Rustagi, 1983). The available methods to calculate premiums are in principle two. The first uses actuarial experience of the insurer and it allows to adjust premiums as information on indemnities becomes available each year. This approach could eventually permit the insurer to use individualized premiums according to each farmer's experience. The second approach (with some variation in methods and definitions) uses yield data to evaluate the premium needed to manage a variance of yield.

If we assume that in the long run an insurance program is self-financed and that no profits are distributed, the amounts collected as premia plus interests earned on temporary surplus funds must equal the payment of indemnities plus administration costs. The discussion here centers in the calculation of pure premiums for all-risk crop insurance that allow for indmnities when partial loses occur. This analysis is based on the valuable contributions of Halcrow (1949), Botts and Boles (1958), Dandekar (1977), Togawa and Kada (1979), and Rustagi, Lee and Price (1983).

From actuarial principles, those farmers experiencing the largest variability of yields should pay the largest premiums, but calculating premiums for each farmer is not possible for practical reasons. If an average premium is calculated for a group of farmers so that everybody pays the same rate, those farmers with the less than average variability will be subsidizing the others. They may soon realize this abandon the program unless of course, it is made compulsory. As compulsory insurance with the same rate for a group of farmers may not lead to lasting political stability of the insurer, alternative approaches are needed.

Dandekar (1977) proposed the homogeneous area approach. Under this scheme, in a given year, depending upon the actual average yield over the area in comparison with the normal yield, indemnities are paid at a uniform rate to all insured farmers in the area, irrespectively of the actual yields of the crop in their respective farm. The area uniform premium should then be calculated on the basis of the year to year variations of yields for the area. Therefore, the premium would be higher in areas where the year to year variability is larger. It is suggested also that such area average annual yields be estimated through crop cutting surveys, which are done anyway for purpose of agricultural statistics.

The general advantage for the area approach seems to be cost reduction. Hence, it would be most desirable when inspection costs are high.[4] An interesting point to be made for it is that it only is necessary that a farmer pays a premium for a number of hectares, not being necessary that the farmer actually plants them.[5] If the area average yield is below this normal yield, the farmer will receive indemnities for what he paid premiums and nobody will actually know whether he planted or not. This is based in an independent chance system, and the whole practically validity of the approach is that those who insure do not have the capacity to interfere with the chance system, i.e., the chance of influence the calculation of the area average yield. This may not be an easy task to guarantee.

The homogeneous area approach sounds appealing, but in practice the homogeneity condition is questionable. Small variations in leveling can make a difference for the impact of excess of humidity. Very few days of difference in planting date can make a difference for the effects of drought or flood. In highland farming, few meters of altitude and wind direction can make a difference for the effects of frost and hail, etc. Therefore, it is quite likely that in some cases an homogeneous area may not exist beyond the farmer's plot. Under those conditions the likelihood of high positive correlation of yields within an area may be rather small. Dandekar, of course, argues for the existence of positive yield correlations (p.7)[6].

It is possible that, even if the area approach was used for the calculation of premiums, the payment of indemnities could be made on the basis of effects of disasters on individual plots. This would not only allow the use of existing yield information, but it would also be more appealing to farmers. If premiums are for example 8 or 9 percent of coverage, the attitude of different farmers towards whether this premium is fair or not will depend on whether they were

or not affected by a disaster. Those who lose their harvest will expect indemnities, hence their attitude towards the insurer will be different from farmers who did not lose their harvest.

The use of yield data has been recommended as the best alternative when previous actuarial information is not available. However, even statistically 'pure', yield data is not without its problems for premium rate making. The major limitation is that the variability of yield may be due to several factors. For example instability in government policies, from year to year, incentive or desincentivate use of inputs as fertilizers which result in yield variability. Also, the scarcity or the high price of insecticides may limit their use for controllable diseases.

As it was mentiones earlier, the relation between yield and price risks that determine income instability are of concern to farmers. As price and yield expectations vary among individuals, an innovative idea is the one introduced by FCIC, when a farmer can choose from among alternative yield and prices for the calculation of expected indemnities. As the probability of obtaining a larger yield and larger price diminishes, the premium as a percentage of total coverage gets larger. For an expected yield the farmer could choose from three levels of coverage, let's say 50, 60 and 75 percent and three prices levels (see FCIC, 1980).

E. Insuring Against Climatic Risk and the Use of Weather data to asses Insurability[6.a]

Insurance should be provided for those events that human activity can not control. In agriculture, crop insurance should therefore, be provided to protect the farmers against the catastrophic impact of weather, for example. We make explicit that this protection should be provided because when weather conditions are abnormal but not catastrophic, their impact could vary among

crops, technologies and the stage of the production cycle. Hence, the impact of abnormal but not catastrophic weather is manageable by the farmer, especially if the farm has a good infraestructure of irrigation, drainage, runoff control, wind erosin, control, etc.

Although insurance should be provided against catastrophic risk, a caveat is important about the frecuency of occurrence of a disaster. If for example, a region is exposed to constant drought, which inhibits any normal plant growth, this should not be interpreted as a frequent occurrence of a disaster, but rather as the case of water defficient area were agriculture could not be practiced, unless irrigation is available. This is the case of the Northeast Brazil for example, where if insurance was established, it would not be but a subsidy to low yields. In another case, and area may be highly exposed against frost or hail. Let's say for example that there is a 70 percent probability that in July the temperature will be near freeze for a period of hours long enough to cause crop damage. Here, a case could be made for insurance if the ecological conditions impose a cropping pattern that implies that crops will be standing in July, and hence farmers have no alternative, as in the highlands of Bolivia.

Using weather data to assess insurability in developing countries, offers some advantages, over using crop yield data, for various reasons. First, the data is available for several climatic indicators including minimim and maximum temperatures, precipitation, luminosity, hail, etc. Second the data is available usually more widespread than offices of the agricultural extension and statistics services that collect yield data. Fourth, the data is available for longer time series and it has not been manipulated or distorted for political reasons, which could, in some cases, occur with yield and production data.

However the use of weather data could be applicable only to small areas. In the case of Bolivia for example, given the conditions of topography, microclimates are well defined. This limits the validity of studies with a geographic coverage based on data from few meteorological station. Nevertheless, if ones defines the area for which the data for a station is valid, important information for insurance can be obtained. With this caveat a study in Bolivia was performed to evaluate the single and joint probabilities of occurrence of drought and frost, and the probability of occurrence of hail.[7]

The study in Bolivia used daily information and this was grouped in 36 periods of 10 days (a decade) during each year.[8] For each of these decades we calculated ETP and ETP/2, considering that this latter value would represent the lower limit for a crop to produce before serious damage. Similarly for the case of frost, we calculated the likelihood of at least one day of frost ($0^{o}C$)occurring within a decade, but no information was available to estimate its duration. A similar approach was used to estimate the occurrence of hail, without knowledge of its duration and intensity. It as also assumed in the analysis that the probability of drought P(S), frost P(H) and hail P(G), were independent. Then we calculate the probabilities of occurrence of least one of these events as:

$$P\ (S\ u\ H\ u\ G) = P(S) + P(H) + P(G)$$

$$+ P(S)\ .\ P(H) + P(G)$$

$$- P(S)\ .\ P(H) - P(H)\ .\ P(G) - P(S)\ .\ P(G)$$

The estimated probabilities were graphed for 36 observations using a Fourier series approach. The graphs are shown for the

station of La Paz at 3.632 msl. (Figure No.7.1.) and Peñas at 3.986 msl (Figure 7.2.).[9] From the graph one can observe that the likelihood of at least one of these disasters is very high and hence it leaves little chance to farmers, but to adjust to loses. Agriculture in the highlands of Bolivia is not well diversified by crops since potatoes and barley are among the few alternatives. This analysis would therefore indicate that farmers recur to other means of adjustment to disasters and this is primarily 'sacrifice'.

In the two cases shown, any insurance program would have to be very costly if all risk protection was provided. under these conditions, insurance for small, decapitalized, high risk exposure farmers carries a social benefit. Then to lower the cost to achieve these benefits insurance would be designed only to compensate for the dramatic effects of weather on farm production and income and hence in their food security condition. In such case, there should be coverage with a deductible that does not make of insurance a source of income but a minimum income guarantee to assure subsistence. Of course, this could well be called simply an income subsidy program but not insurance.

In Costa Rica, data of monthly precipitation for 46 years was used to estimate rain distribution throughout theyear in the Dry Pacific region where insured-rice is produced. As it s shown in Table 7.3. and Figure 7.3 the rainfall distribution shows the typical pattern of the dry tropics[10], with two peaks, one in June and the other one between September and October. Total annual rainfall is 1.640 mm, but 28 percent of its falls between May and June and 40 percent falls between September and October. The average dailt temperature does not vary much throughout the year and the minimum annual average is ^{o}C22.0, while the maximum annual average is ^{o}C32.6.

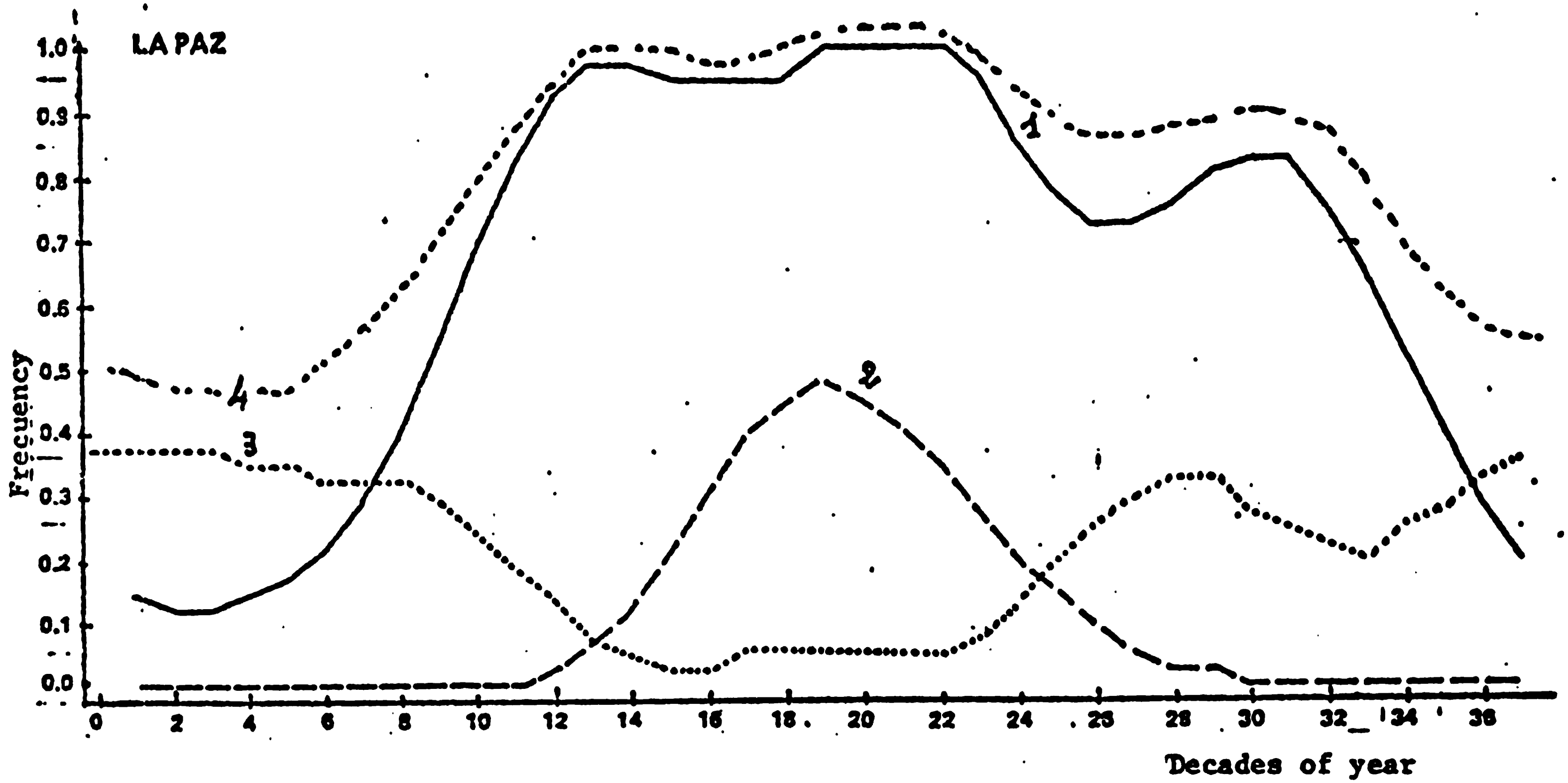

Figure 7.1. Evolution through the year of the drought frecuency (1), frost (2) and hail (3), and at least one of the three (4) with an elemental period of analysis of ten days.

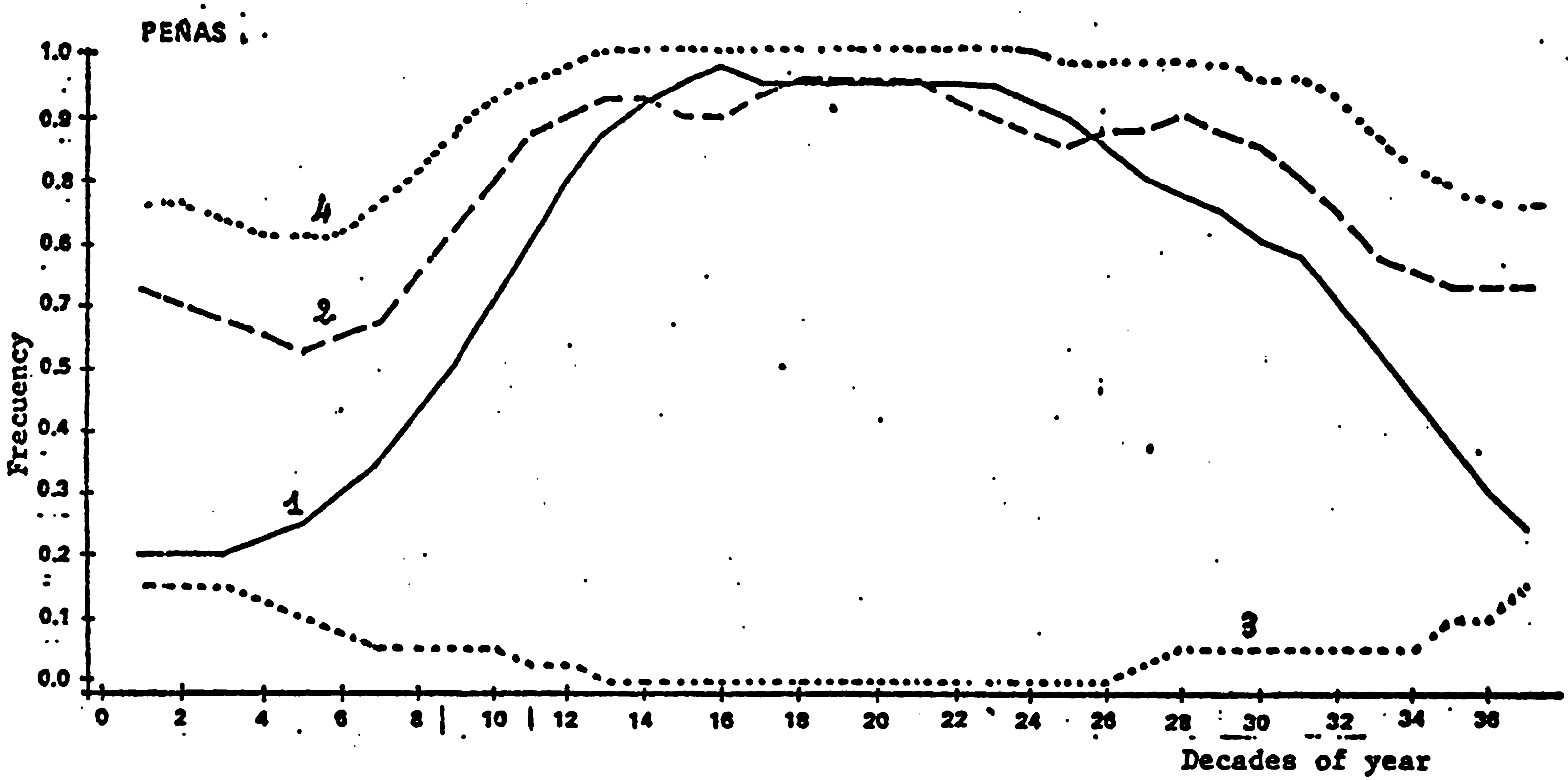

Figure 7.2. Evolution through the year of the drought frecuency (1), frost (2) and hail (3), and at least one of the three (4) with an elemental period of analysis of ten years.

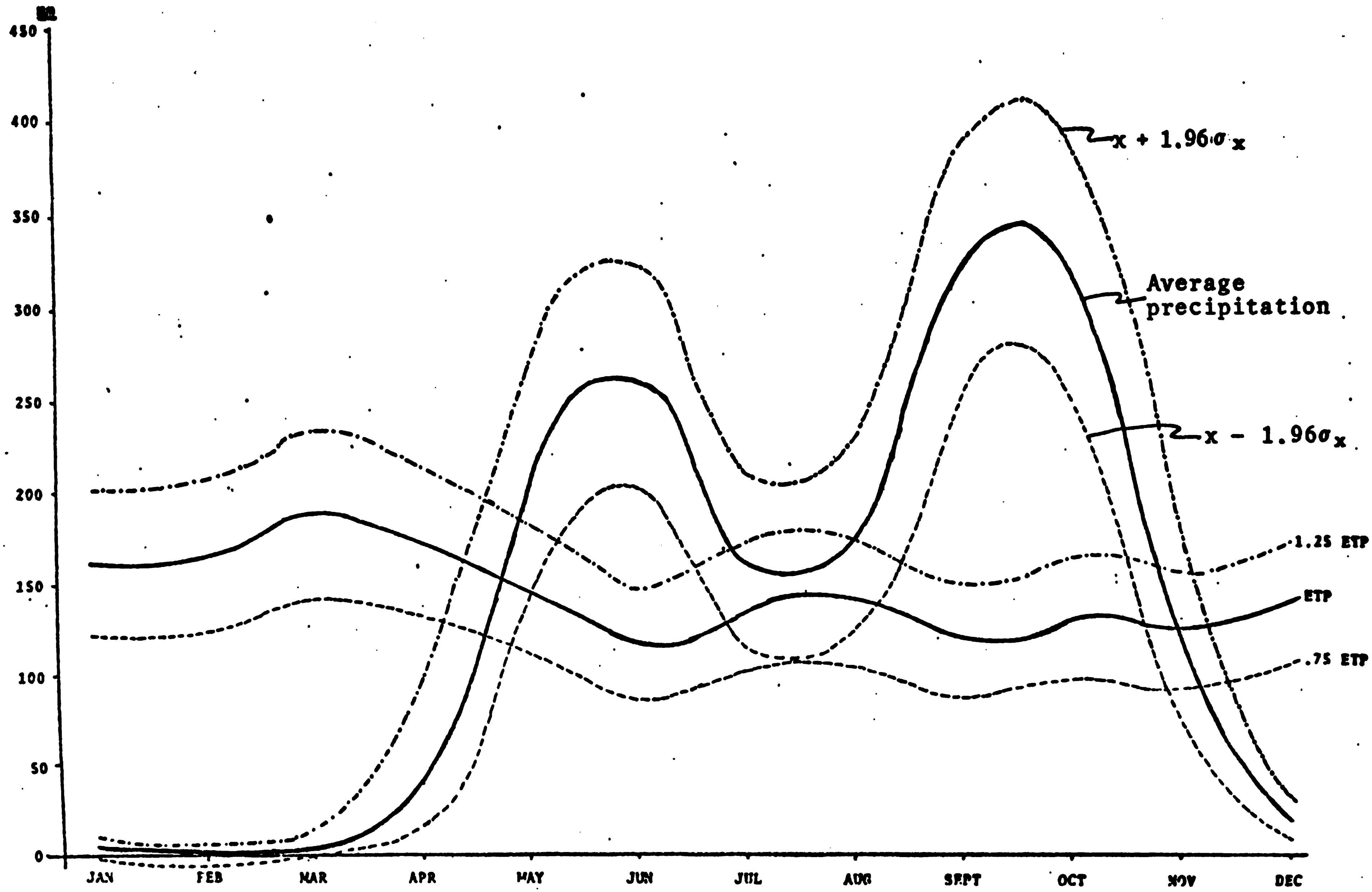

Figure 7.3. Liberia, Costa Rica. Distribution of Precipitation, Average. 1935 - 1982 (mm).

TABLE 7.3. Liberia Station, Costa Rica; Monthly Precipitation 1937 - 1982 (mm)

-------------------------- STATION=LIBERIA LATITUDE=10 37 LONGITUDE=85 26 ALTITUDE=144 --------------------------

OBS	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	TOTAL	AVERAGE
1	1937	0.0	0.0	0.0	0.0	314.0	259.0	234.0	109.0	698.0	646.0	144.0	44.0	2448.0	204.0
2	1938	0.0	0.0	0.0	5.0	278.5	280.0	91.0	453.0	623.0	629.0	390.0	0.0	2749.5	229.1
3	1939	0.0	0.0	0.0	0.0	102.0	239.0	2.0	4.0	165.0	250.0	208.0	30.0	1000.0	83.3
4	1940	12.0	0.0	6.0	0.0	145.0	229.9	27.9	48.3	405.6	441.4	50.0	0.0	1366.1	113.8
5	1941	4.6	0.0	0.0	34.2	144.8	179.8	286.0	65.3	258.9	151.8	193.0	27.7	1346.1	112.2
6	1942	1.0	0.8	20.5	4.6	201.8	182.5	145.0	205.5	332.5	365.9	76.6	63.7	1604.6	133.7
7	1943	8.6	0.0	13.1	82.4	220.7	318.2	111.3	295.2	510.9	358.6	302.3	46.8	2268.1	189.0
8	1944	10.4	6.4	6.5	42.8	258.9	395.8	373.6	413.4	388.9	240.8	258.0	82.6	2518.1	209.9
9	1945	0.0	0.0	0.0	15.4	365.4	163.3	138.5	247.4	285.7	191.2	79.9	15.1	1501.9	125.2
10	1946	0.6	0.0	0.0	0.0	158.7	130.9	154.1	321.8	242.4	293.4	151.6	68.0	1526.5	127.2
11	1947	0.0	0.0	45.8	16.4	70.8	314.8	163.8	107.1	240.6	241.4	180.6	66.3	1453.6	121.1
12	1948	16.6	1.4	2.7	0.0	112.6	199.5	171.2	92.0	189.6	265.8	157.9	0.3	1249.6	104.1
13	1949	0.0	0.0	0.0	0.0	69.3	305.3	164.6	245.1	361.2	505.5	262.4	35.8	1949.2	162.4
14	1950	2.4	0.0	1.2	1.0	181.7	262.6	100.1	179.2	715.0	491.2	85.7	49.0	2073.1	172.8
15	1951	0.0	0.0	0.3	34.3	15.6	184.6	275.6	181.6	420.1	168.7	127.3	0.0	1408.1	117.3
16	1952	0.0	0.0	0.0	25.5	256.8	297.4	148.3	109.0	151.9	152.2	11.2	0.0	1157.3	96.4
17	1953	0.0	0.0	0.0	78.2	700.6	154.9	143.5	62.4	291.2	141.0	45.5	35.9	1653.2	137.8
18	1954	1.7	1.8	0.0	38.9	287.0	659.1	110.2	117.3	497.1	566.7	23.1	0.2	2303.1	191.9
19	1955	0.0	0.0	0.0	1.3	101.6	373.2	543.6	381.7	531.8	817.5	93.7	20.1	2864.5	238.7
20	1956	0.0	0.0	0.0	0.0	247.4	51.6	68.6	171.4	343.0	267.5	119.4	0.0	1268.9	105.7
21	1957	0.0	0.0	20.3	0.0	386.5	189.7	123.7	40.2	353.6	215.8	16.0	4.6	1350.4	112.5
22	1958	6.9	0.0	0.5	0.0	173.4	373.3	105.4	102.9	381.3	138.0	31.7	1.8	1315.2	109.6
23	1959	0.0	0.0	0.0	0.0	63.2	212.1	188.7	145.8	409.4	122.1	61.9	12.4	1215.6	101.3
24	1960	1.9	34.9	22.2	76.7	305.7	183.3	225.9	160.5	218.8	347.2	112.3	13.8	1700.2	141.7
25	1961	0.0	0.0	0.0	0.0	73.7	165.8	293.8	83.3	386.4	287.8	514.2	28.3	1833.3	152.8
26	1962	0.0	0.0	0.0	31.8	271.6	474.5	97.8	178.6	272.9	146.0	28.1	0.0	1501.3	125.1
27	1963	0.0	0.0	0.0	81.4	22.1	259.9	163.3	81.8	390.1	345.2	167.9	0.0	1511.7	126.0
28	1964	0.0	0.0	0.0	25.2	62.2	375.9	333.2	224.5	237.6	377.7	86.1	41.4	1763.8	147.0
29	1965	0.0	0.0	0.0	0.0	235.3	140.5	16.1	31.1	516.0	154.0	9.1	0.0	1102.1	91.8
30	1966	0.0	0.0	0.0	0.0	146.2	283.6	371.3	213.7	329.0	457.6	78.9	0.0	1880.3	156.7
31	1967	0.0	0.0	0.0	63.5	7.5	93.0	184.0	153.9	309.0	203.6	46.7	31.6	1092.8	91.1
32	1968	5.6	2.8	0.0	0.0	184.1	393.4	18.3	25.9	88.6	261.3	102.8	2.3	1085.1	90.4
33	1969	6.3	0.0	0.2	53.3	243.5	295.9	134.6	392.1	296.4	640.6	64.0	14.3	2141.2	178.4
34	1970	0.0	0.0	0.0	67.2	91.3	116.4	237.7	170.8	270.3	192.5	124.3	3.9	1274.4	106.2
35	1971	68.9	3.0	0.0	46.0	182.4	124.4	165.5	204.8	441.9	257.5	70.0	18.8	1583.2	131.9
36	1972	38.7	1.0	1.5	1.2	144.5	174.8	64.8	31.3	91.2	107.3	79.1	32.7	768.1	64.0
37	1973	1.2	0.0	10.4	1.5	94.4	198.2	227.5	279.3	291.6	471.6	88.9	6.5	1671.1	139.3
38	1974	4.4	1.2	5.2	1.3	245.0	343.0	13.8	73.0	338.6	340.8	172.1	9.4	1547.8	128.9
39	1975	0.0	0.0	0.0	3.2	127.3	65.7	147.8	299.3	531.3	210.1	255.3	2.9	1642.9	136.9
40	1976	0.0	0.0	0.0	5.1	73.7	358.6	105.5	53.7	68.6	251.5	126.7	0.0	1043.4	87.0
41	1977	0.0	0.0	0.0	3.1	65.6	238.6	17.7	149.5	313.8	123.4	222.6	6.5	1140.8	95.1
42	1978	0.0	0.0	1.2	0.0	383.4	118.6	310.6	322.3	232.3	216.2	42.2	61.4	1688.2	140.7
43	1979	0.0	0.0	0.8	122.3	154.7	761.2	176.7	225.2	640.1	294.5	74.1	17.9	2468.5	205.7
44	1980	0.7	0.0	65.5	10.2	202.6	231.7	143.8	204.2	272.3	276.0	171.6	3.2	1585.8	132.2
45	1981	0.0	0.0	0.0	47.0	401.0	555.6	109.5	527.7	304.3	376.1	86.9	44.2	2452.3	204.4
46	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Given the relatively high temperature, potential evapotranspiration is also relatively high, nevertheless if the lenght of the growing cycle was short, two crops highly demanding in water could be obtained, during the first and second rainy periods. Few crops, however, meet this requirement being rice one the best opportunities. The problem with rice is that the lenght of the growing cycle of th most precocious varieties is about 120 days hence there is always the risk of not having enough water at planting data or at flowering. This is suggested by the area of safety that is defined by the 95 percent probability of rain and the 0.75 ETP and 1.25 ETP.

The above information would reveal that the potential for two short cycle rice crops in the area is rather limited and that farmers could, to protect against wather hazard, move towards the largest cycle varieties, so that flowering occurs when enough precipitation is available. Alternatively, and this would seem the best agronomic recommendation, suplementary irrigation should be made available to plant the first crop very early and to guarantee enough humidity at flowering. The second crop could be planted, also with suplementary irrigation in August. The above is not however, the risk minimizing strategy that Costa Rica has followed for rice production. Rather, rice has been insured at high costs to the government (see Gudger, 1983), and the reasons for loses are clearly explained by the prevailing weather conditions in the area.

The climatic data analysis would also provide valuable information for portfolio diversification. It would allow to know the likelihood that poor weather conditions (joint probability of all causes) will take place simultaneously in the various regions of a country. This line of work should be extended to use weather data in the calculation of premia and other analysis useful in the management of the insurers.

F. The Problems of Portfolio Concentration[11]

Agricultural insurers are financial institutions and should be managed as such, but the experience of several cases, show that the agricultural insurance programs in existence have not depended on their financial management, but on their bargaining capacity to obtain government funds. Many of them, as agricultural development banks, have not exploited portfolio management principles nor have they been professionally interested in the generation of financial resources. This section addresses some considerations to allow insurers the generation of financial resources, portfolio protection and efficient of use of physical and financial capacity.

The occurrence of catastrophic losses in one single year can destroy the insurer. Protection towards this can be achieved through structure of the portfolio, reserves and reinsurance. The insurance portfolio is composed of alternatives, each one of them with an expected net return and variance of return, and with a given share in the portfolio. Each of the above elements, return, variance of return and share in the portfolio, are of importance in structuring a well balanced portfolio. Because of the nature of the insurance business however, the shares of each item (X_i's) and their correlation is most relevant. Given an expected loss ratio, the greater the danger of catastrophic loss to the insurer and hence the need to use up reserves and/or reinsurance.

We can define the portfolio of the agricultural insurer as composed by n items. Its expected return and variance of return can be defined as:

$$E(R) = \sum_{i=1}^{n} X_i R_i \qquad (1)$$

$$V(R) = \sum_i \sum_j X_i X_j \sigma_{ij} \qquad (2)$$

where:

E(R) = expected return

V(R) = variance of return

X_i = the proportion of the i^{th} insured item, therefore

$\Sigma X_i = 1$

R_i = the return of the i^{th} insured item

σ_{ij} = variance-covariance matrix of returns.

A brief additional explanation about the variance of the portfolio would suffice for an understanding of the principles: The variance of return of the portfolio can be written as:

$$V(R) = \sum_i V(Ri) + \sum_{i \neq j} \sum_i \text{cov}\ (Ri,\ Rj) \qquad (3)$$

In matrix rotation the variance of return is:

$$V(R) = X_1\ X_2 \ldots X_n \begin{bmatrix} \sigma_{11} & \sigma_{12} & \cdots & \sigma_{1n} \\ \sigma_{21} & \sigma_{22} & \cdots & \sigma_{2n} \\ \cdot & \cdot & & \\ \cdot & \cdot & & \\ \cdot & \cdot & & \\ \sigma_{n1} & \sigma_{n2} & & \sigma_{nn} \end{bmatrix} \begin{bmatrix} X_2 \\ X_2 \\ \cdot \\ \cdot \\ \cdot \\ X_n \end{bmatrix} \qquad (4)$$

Thus, the larger the negative correlation of returns among items i.e. the absolute value of a negative covariance, the smaller the variance of return of the portfolio. In addition, as equation (2) shows, the variance of the portfolio is a function of the proportion of each item in the portfolio. Therefore, the larger X_1 the more weight than item (with a large or small variance) will have in the portfolio variance.

Some interesting examples of portfolio concentration and diversification are given in Table 7.4. The most dramatic case of portfolio concentration is the one of the program in Costa Rica. Rice is grown in one region and planted most of it at the same time (region-wide), and it accounts for 72.3 percent of total coverage. Rice has not been the crop with the largest loss ratio, but losses have occurred every year. Therefore, because its weight in the portfolio is so large, there is not chance that it could be balanced with other crop for which losses do not occurr in the same year. A recent study of the Costa Rica insurance program pointed at this as one of the main reasons for high costs to the government (La Academia de Centroamérica, 1980). The portfolios of Israel and the United States are more diversified in the number of crops and relative shares of each of them in the total coverage. It should be pointed out that total coverage is determined by the number of hectares times the coverage (value or cost of production) per hectare.

Portfolio diversification is part of the proces of growth of the programs. For example the Israelí program began its operations in 1966/67 insuring five crops with a total coverages of IL.86.5 million. By 1978/79 the program included 21 crops and poultry with a total of IL.10.620.2 million. IFNRA operates with premiums paid 50 percent by farmers and 50 percent by the government.[12]

Table 7.4. **Diversification of Various Agricultural Insurance Portfolios in Terms of Coverage.**

Item	Israel 1967/80	USA 1948/78	Costa Rica 1970/80	Panama 1982	Japan
Citrus	31.48*	1,27	-	-	-
Cotton	23.06*	3,84	16.26	-	-
Vegetables	7.78	-	-	-	-
Corn	3.65[1/]	28,23*	1,20	11,44	-
Apples	4.71	-	-	-	-
Poultry	18.29	-	-	-	-
Barley	-	1,44	-	-	-
Sorghum	-	1,40	8,86	8,20	-
Tobacco	-	26,56*	-	-	-
Wheat	-	18,84	-	-	-
Rice	-	-	72,37*	37,62*	90.00*
Beans	-	-	1,31	-	-
Vegetables	-	-	-	8,61	-
Livestock	-	-	-	33,66*	-
Sub Total	88.97	93,26	100,00	-	-
Other	11.03[2/]	6,74[3/]	-	-	10.00[4/]
Total	100.00	100,00	100.00	100.00	-

[1/] Includes corn and other grains

[2/] Includes 17 crops and broilers

[3/] Includes 22 crops

[4/] Wheat and barley

Note: The asterisk (*) denotes the dominant items

IFNRA's portfolio is highly concentrated in citrus which on the last three years averaged 31.48 percent of total coverage. Cotton, citrus, vegetables, grains, apples and poultry, currently account for 89 percent of total coverage. The correlation matrix of the loss ratios is shown in Table 7.5. Out of the relevant 15 correlations coefficients, 10 are negative while only 5 are positive. None of the negative coefficients are statistically different from zero, while only one of the five positive coefficients is statistically different from zero. In addition, the negative correlation coefficients are on the average larger than the positives ones. Although no claim can be made for statistical significance of the correlation coefficients, the fact that 10 out of the 15 are negative provides evidence for a well structured portfolio. It should be recognized, however, that although citrus is not highly correlated with other items except poultry; its large weight in the portfolio posses a potential danger. In a closer analysis of performance it was observed that except for 1974/75, loss ratios greater than one were always reported for at least two crops and for as many as ten. It is obvious that without such a well diversified portfolio IFNRA would have not remained financially solvent without recurring to government grants or subsidies.

The U.S. crop insurance program began in 1948 with seven crops in forty states. The program grew at a conservative rate in terms of coverage until 1975, when due to energy costs which increased production costs, it grew significantly. Although the number of counties has increased considerably within those states; the number of policies issued has been in the last five years (1974/78) almost 30 percent smaller than ten years before; thus following the path of land ownership concentration.

The FCIC program is well diversified over regions. However, nine crops (out of 31) currently account for 92.6 percent of total coverage. Moreover, three crops (corn, tobacco and wheat) account

Table 7.5. Israel, Correlation Matrix of Loss Ratios of Six Main Crops[1/]

	Citrus	Cotton	Veget.	Grains	Apples	Poultry
a	31 48	23 06	7 78	3 65	4 71	18 29
Citrus	1 000	-0 276 (0 4400)	0 871 (0 0005)	0 038 (0 9106)	-0 190 (0 575)	0 034 (0 926)
Cotton		1 000	-0 122 (0 705)	-0 130 (0 720)	0 188 (0 579)	0 032 (0 933)
Veget.			1 000	-0 110 (0 747)	-0 361 (0 248)	-0 013 (0 971)
Grains				1 000	-0 343 (0 302)	-0 078 (0 831)
Apples					1 000	-0 273 (0 444)
						1 000

1/ These crops account for 89 percent of total coverage. Other 17 crops account for the remaining 11 percent. The analysis uses data for the period 1967/68 to 1979/80.

a Percentage of total coverage (average of last years).

for 73.6 percent of total coverage. Although these three crops are grown in different regions of the country, they are in most cases positively correlated in their loss ratios. The correlation matrix is shown in Table 7.6 correlations coefficients, 14 are negative while 22 are positive. On the average the positive correlation coefficients are larger than the negative ones, and at least three of them are strongly significantly different from zero. The most serious cases are the correlations between soybeans/corn, soybeans/sorghum, wheat/barley, wheat/soybeans, and wheat/tobacco. The case of the U.S. illustrates clearly that crop diversification and geographical dispersion per se are not a sufficient condition for a well diversified portfolio.

The most recent and interesting experience of benefits are costs of portfolio diversification can be found in the case of Panama. Sorghum has been the only crop which, since the creation of the program until 1981/82, had an average lost ratio greater than one (single average equal to 2.52). But over the same period sorghum represented only 11.2 percent of the total portfolio. Therefore, indemnity payments of sorghum help to build the image of "ISA as an insurer that pays". It should be roted also that the difficult position for ISA in the 1982/83 year is due to a great extent to the generalized drought on rice, which in contrast with the previous four years passed from 32 percent to 45 percent of the portfolio's coverage and its loss ratio passed from a weighted average of 0.47 to 1.20.[13] A closer analysis of ISA's experience on rice reveals however, that the lost ratio over the last five years has increased as follows,

1978/79	0.08
1979/80	0.25
1980/81	0.41
1981/82	0.73
1982/83[14]	0.20

Table 7.6. United States, Correlation Matrix of Loss Ratios of Nine Main Crops[1/]

	Barley	Citrus	Corn	Cotton	Sorghum	Peanuts	Soybean	Tobacco	Wheat
a[2/]	1.44	1.27	28.23	3.84	1.40	2.47	9.21	26.56	18.84
Barley	1.	-0.056 (0.779)	0.164 (0.450)	0.204 (0.351)	-0.152 (0.521)	-0.271 (0.291)	0.013 (0.951)	0.183 (0.402)	0.294 (0.174)
Citrus		1.	-0.002 (0.991)	0.136 (0.490)	-0.106 (0.655)	-0.191 (0.460)	0.090 (0.675)	-0.102 (0.606)	-0.295 (0.126)
Corn			1.	0.098 (0.600)	0.163 (0.491)	-0.152 (0.561)	0.339 (0.105)	0.029 (0.876)	0.191 (0.303)
Cotton				1.	0.193 (0.415)	-0.101 (0.698)	0.467 (0.021)	0.017 (0.926)	0.033 (0.856)
Sorghum					1.	-0.035 (0.894)	0.339 (0.144)	-0.269 (0.252)	0.072 (0.762)
Peanuts						1.	0.234 (0.365)	-0.113 (0.666)	0.189 (0.466)
Soybean							1.	-0.210 (0.325)	0.336 (0.108)*
Tobacco								1.	0.418 (0.019)
Wheat									1.

[1/] These crops account for 92.26 percent of total coverage. Other 22 crops account 7.74 percent. The analysis uses data for the period 1948 - 1978.

[2/] Percentage of total coverage (average of four last years).

These figures make one wonder about the long term perspective for rice insurance in Panama; but they also make one wonder about whether panamanian rice farmers have learned the benefits of insurance to rice, as did their Costa Rican neighbors.

G. The Use of An Insurance Portfolio Management Model[15]

A portfolio management model was used with the objective of analyzing ISA's current portfolio and to provide guidelines for its improvement. The study evaluated the trade-offs involved in the optimization of the portfolio and it discussed the necessary conditions for future growth, as well as its implications for planning.

In its most simple form the model 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 $V^* > V$.

It was assumed the number and total amount of claims is stochastic with a probability distribution whose variance is finite. In addition, the cost of income variance was represented by the interest rate on borrowing, and by the premium rate for reinsurance, but reinsurance demand was not endogenous to the model, hence not responsive to alternative compositions of the portfolio.[16]

The objective of the insurance agency was assumed to be profit maximization and social effectiveness: 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. In the model, the objective function of the institution was to maximize profits while guaranteeing insurance coverage to a basic combination of crop and provinces, as mandated by farm policy. Then was also a constraint on the 'desirable' amount of coverage for crops and livestock hence the model had

limited possibilities for portfolio diversification. In addition, there was required a minimum loss ratio of 70 percent 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.

Data for the analysis came 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 7.7 shows the compositions of ISA's portfolio for 1976/77 to 1980/81. The model was solved for 1980/81, when ISA insured crops and animals for a total of 13 million dollars. Approximately 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 unpland rice with approximately 25 percent.

The value of crop and animal losses, in proportion to their coverage, is shown on Table 7.8. 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 7.9. 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

Table 7.7. ISA - Summary of Insurance Operations, 1976/77 - 1980/81

	1976/77	1977/78	1978/79	1979/80	1980/81
COMBINED PORTFOLIO					
Coverage (US$)	25,898	1,129,579	2,636,498	8,131,592	13,114,208
Number of Policies Issued	9	351	809	2.114	2.722
Indemnities Paid (US$)	1,588	17,784	102,462	194,642	402,143
Net Premiums (US$)	1,165	58,723	113,815	331,567	519,579
Loss Ratio	1.36	0.30	0.90	0.59	0.77
CROP INSURANCE					
Coverage (US$)	25,898	1,129,579	1,887,511	4,575,710	6,806,637
Hectares Insured	122	5.410	7.307	13.988	16.183
Number of Policies Issued	9	351	525	1.284	1.446
Indemnities Paid (US$)	1,588	17,784	93,731	130,451	290,013
Net Premiums (US$)	1,165	58,723	103,741	269,630	356,261
Loss Ratio	1.36	0.30	0.90	0.48	0.81
LIVESTOCK INSURANCE					
Coverage (US$)			748,987	3,555,882	6,307,571
Number of Head Insured			3.392	11.677	18.969
Number of Policies Issued			284	830	1.276
Indemnities Paid (US$)			8,731	64,191	112,130
Net Premiums (US$)			10,074	61,937	163,318
Loss Ratio			0.87	1.04	0.69

Source: [ISA, Memoria Anual, various issues]

Table 7.8. Loss Cost by Activity and Province, 1977/81 (In percent of coverage)

	Chiriquí	Los Santos	Herrera	Cocle	Veraguas	Panama-Colon
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 7.9 Administrative Expenses by Activity and Province. 1980/81 (In percent of coverage).

	Chiriqui	Los Santos	Herrera	Cocle	Veraguas	Panama
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

additional time spent in claims assessment. 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 Panama and Colon, and sorghum in Cocle and Veraguas, the premium rate adjustment can not be as high as the loss cost due to their short actuarial history.

The optimal model solution is shown in table 7.10. 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 of ISA's actuarial losses. Furthermore, such activities also account for high administrative costs brought about by the cost of assessing 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 portfolio i.e., beans have a relatively high loss cost and high administrative costs. Their presence in the optimal solution obviously obey to model restrictions. Rice and breeding cows are the main activities in the solution, followed by the coverage of bulls and feeder cattle.

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 7.11). As indicated in the second column of the table, optimization under current conditions leads to a reduction of 43 percent 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 percent 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.

Table 7.10. Optimal Portfolio for 1980/81

Agricultural Insurance	Percent of total Coverage	Livestock Insurance	Percent of total Coverage
RICE		FEEDER CATTLE	
Chiriqui	20.0	Panama-Colon	12.0
Los Santos	8.4		
CORN		BULLS	
Cocle	4.38	Chiriqui	9.4
Veraguas	2.62	Los Santos	6.44
		Cocle	2.16
SORGHUM		COWS	
Los Santos	2.01	Los Santos	4.15
Cocle	0.463	Herrera	13.46
Veraguas	1.99	Veraguas	2.39
Panama	0.54		
BEANS			
Chiriqui	0.6		
TOMATOES			
Los Santos	9.0		

Table 7.11. 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

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 the cropping activities (Table 7.12). Portfolio performance, as previously shown in Table 7.13, is slightly improved under the new rates. The net deficit is now 56 percent 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 percent 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

Table 7.12. Optimal Portfolio Under New Premium Rates.

Agricultural Insurance	Percent of total coverage	Livestock Insurance	Percent of total Coverage
RICE		FEEDER CATTLE	
Chiriqui	20.0	Herrera	12.0
Los Santos	8.4		
CORN		BULLS	
Coclé	4.5	Chiriqui	6.35
Veraguas	2.5	Los Santos	5.64
		Cocle	2.5
		Panama	3.52
SORGHUM		COWS	
Veraguas	4.5	Chiriqui	3.05
Panama	0.5	Los Santos	6.96
		Herrera	9.0
		Panama	0.98
BEANS			
Chiriqui	0.6		
TOMATOES			
Los Santos	9.0		

Table 7.13. Portfolio Performance Under Increasing Loss Rates (in percentage 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

*Threshold loss rate for reinsurance.

alone. It is clear that lowering the administrative costs is also necessary. In order to bread even, the administrative costs should decrease to 1.41 percent of coverage if current premiums 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 relationship 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 in fairly certain.

Premium rate adjustments is an entirrely 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 suggest 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 Panama, the need for a subsidy becomes clearer. The above argument may be better understood in the case of a bad year. Model results indicated that when the value of losses relative to premiums

received is high, the actuarial component of the insurance program bears most of the burden. As shown in Table 4.14, 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.

For a compulsory scheme, such as the agricultural credit insurance program in Panama, 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 substaially just to reach a break even point. This suggest several 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 ratio. 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 grnnts 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 America 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 Panama 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 asset by its clients.

Even with is current limitations the model is useful for simulation of new premiums rates, cost subsidies, returns on reserve allotments, loss ratio, reinsurance rates, and loss costs 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 investment of insurance premiums. The model should in this sense 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. A revised version of the model was not developed, but the following section provides some discussion of points to consider in the improvement of the model.

H. Seasonality of Agriculture and Management of the Insurance and Investment Portfolios[17]

The seasonality of agricultural production has important implications for resource use and financial management of the insurer. First, crops are planted at different points in time during the year, hence policy issuance can be dispersed. Second, crops have different lenghts of their growing cycle. Hence the longer the duration on the growth, the larger the risk exposure and the larger the needs of personal for field supervision and inspection. However, longer periods of exposure may not necessarily mean larger risks. Third, not all crops are affected in the same magnitude and at the same time by disasters.

In the case of Panama historical insurance data shows that the occurrence of crop disasters presents a critical period every year, implying that a aseasonality in the occurrence of disasters in many agricultural areas of the country does exist. This critical period extends from September to March, when 82 percent of the crop disasters are reported.

This seasonality in the occurrence of crop disasters means that during this period, ISA's human and physical resources have to be intensively utilized not only in field inspections but in other administrative arrangements such as payments of indemnities to farmers. It is also evident that in the current insurance's portfolio there are agricultural activities that require more intensive human attention than others. These activities are those with greater rate of disasters such as sorghum, tomatoes and beans.

Due to these factors, intertemporal management of the insurer's financial resources ought to be performed as accurate as possibly to reduce institutional losses and for the total cost of the agricultural insurance program to be minimized.

These aspects condition the demand for physical and human resources at different points in time, hence when the institution has some fixed amount of such resources, it is in its interest to optimize their use. From another point of view, keeping a policy on the books, also demands resources, hence the insurer may be interested in some mixed strategy of risk minimization and resource use, therefore, there may be room for trade offs between maturity and risk of the various assets.

Another very important implication of seasonality stems from management of the cash flow. The insurer generates premium incomes throughout the year and its has a stochastic demand for indemnities depending on the crops, and the magnitude of the disasters. If a total diaster occurs, indemnities should be paid immediately regardlless of the time of occurrence. The earlier a disaster occurs, the smaller the indemnity because coverage is provided only on the actual investment. If however, a partial disaster occurs at any point in the crop cycle, indemnities could be paid only after evaluating the actual yield loss at harvest time.

The above implies that the disposable funds can be put in investments of different maturity, subject to a stochastic demand for idemnities. Hence, there would be some optimal maturity composition of the investment portfolio that minimizes te opportunity cost of excess cash holdings. The above is of greater importance under inflation, especially when interest rates on securities vary significantly depending the investments maturity.

I. The Reinsurance of Agricultural Insurers

Reinsurance is a means of risk sharing and it generally arises when the insurer is asked to issued coverage, which it could not prudently carry entirely at its own risk. The nature of

catastrophic risks in agriculture implies a strong need for reinsurance, yet there is a limited market for agricultural reinsurance.

Among the forms of reinsurance, Hanson (1981) suggested the non-proportional forms as more appropriate for the case of agricultural insurers. With stop-loss reinsurance for example, the insurer will pay the total amount of all claims in a specified period (a year) up to a total limit determined in advance for the period, the limit may be a dollar amount or a percentage of earned premium. The reinsurer pays a predetermined proportion (up to 100 percent) of losses in excess of the limit for the period, subject to a predetermined maximum reinsurance benefit. With catastrophe reinsurance, the reinsurer will pay the insurer a predetermined proportion of claims in excess of a deductible that arises from a single catastrophic event.

Under these forms of reinsurance, or under any form by that token the reinsurer should not demand changes in premiums charged by the insurer if the program is actuarilly sound, i.e., if premiums cover indemnities. However, under the current circumstances that this is not the case. Hence the observed historical loss ratio shown by the insurers has affected the terms of the reinsurance contracts. This has included the cases of reinsurers demanding higher premium than those charged in the past. In the case of Panama for example, between 1977/78 and 1981/82, the ratio of indemnities to coverage on sorghum was on the average equal to 14 percent but premiums were only 5 percent.[18] When negotiationg the reinsurance contract, the reinsurer would not cover sorghum unless the premium rate was rised to 14 percent. A consultant (Y. Kahane) recommended three alternatives, a) Changing the insurance premium

(perhaps up to 11 percent) and renegotiate the reinsurance contract, b) selling sorghum insurance with a higher deductible or, c) stop selling insurance to sorghum.

It has been recognized by some of the agricultural insurance experts (Gilboa and Maurice, 1979) that "the threat of catastrophic losses is the single most effecitve deterrent to the introduction of comprehensive crop insurance programs in developing countries". The authors gave this argument as the strongest reason for agricultural insurers to rely on reinsurance, hence prudently avoiding the dependance on excess reserves or need from government contributions. Although highly justified and apparently a necessary condition for self-financed agricultural insurers, there is not yet a widespread market for this type of reinsurance. There are few programs that currently have reinsurance on those in Mauritius, Puerto Rico, South Africa, Zimbabwe, Rhodesia, Israel, Chile, Panama, Spain (with government subsidies), but most of these experiences are rather short and it is not known whether the terms of the contract are improving or deteriorating over time, implying in this later case that reinsurance premiums grow as a percentage of reinsurance protection. Other countries that do not have commercial reinsurance have managed to receive huge amount of government reinsurance, as in the case of Japan, United States, Canada, Sweden, Costa Rica, and Mexico. Perhaps the agricultural reinsurance market will develop, as reinsurer know that agricultural insurers are well managed as financial institutions.

FOOTNOTES

1/ Based on the work of Pomareda (1983), chapter 16 in Hazell, Pomareda and Valdes.

2/ This is not to say however that cost minimization is the insurers' objective.

3/ As the programs in Bolivia, Ecuador and Venezuela are at too early stages we have not included them in cost comparisons.

4/ Labor, vehicles repairs and maintenance and fuel may be the main costs.

5/ This supports Hazell's (1981) arguments for selling insurance lottery, which anybody could access by buying tickets.

6/ For related comments see Walker and Jhoda (1983).

7/ In the case of frost the main issue concerns the temperature at which fros can occur. Generally the data available is air temperature at 1.5 meters over the ground, but this temperature is different from that on the leaves, the reproductive organs of the plant and that on the soil. Similarly in the case of drought, usually defined as insufficient water on the soil for good plant growth, there are complexities for its estimation from data of evapotranspiration for fields with different gradient and soild depth. For a more extensive discussion see Lhomme, J.P. and O.E. Rojas, 1983.

8/ The number of years of available data vary by station but it ranged between 26 and 35.

9/ The study was performed for 12 stations in the Department of La Paz.

10/ See the work of Lhomme (1976).

11/ Based on the work of Pomareda (1981).

12/ When establishing IFNRA, the government granted it a guarantee that any deficits would be coveraged by the government (50 percent as a long term loan). This guarantee has been used only once as a result of a severe frost in the winter of 1972/73, when the overall loss ratio was 3.66. The only other time when the overall loss ratio exceeded onw was in 1973/74 (1.05). During the other 11 years it fluctuated between 0.22 and 0.85.

13/ Rice has very low correlation of loss ratio with corn (0.151) and sorghum (0.547), the next two most important crops in the portfolio.

14/ Preliminary until February 1983. The cycle closes in June 1983.

15/ Based on the works of Hogan (1980) and Arcia (1982).

16/ 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. The inclusion of a riskless asset implies borrowing costs, while large stochastic cash demands imply emergency loans and reinsurance. Both are considerate important for ISA's purpose, but they are not included in the current version of the model.

17/ Based on the work of Pomareda and Villalobos (1983).

18/ The ratios of indemnities coverage for the five consecutive periods were 2.02, 16.24, 5.28, 7.76, and 27.98.

VIII. THE LESSONS LEARNED: A REVIEW OF THE VIABILITY OF CROP CREDIT INSURANCE

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A. Introduction

The PP stated that the crop credit insurance project's purpose "is to develop viable, national level crop (credit) insurance programs on a pilot basis to serve small farmer needs". The pilot projects were developed to test the thesis that a reduction of risk would promote the flow of credit to small farmers who were otherwise not eligible for loans and to facilitate technology adoption. These new insurers were to be semi-autonomous agencies of the Ministries of Agriculture. A research program would focus upon different methods of providing insurance as well as upon the impact of the insur- ance on credit availability and demand, technology adoption, crop mix, employment and welfare.

We have now reached the point in this report and in time, as the project is concluding, when we must state as clearly and succinctly as possible what has been learned. It is necessary first to address the issues set forth in the PP and then to go beyond the concerns of that document to state what has been learned over the life of the project.

B. "Viable Programs"

Viability is an infinitely flexible word and one whose definition is slippery at best. At worst it covers many errors of commission or omission. For present purposes, we will use the original PP language but define it to mean one of two things. Insurers are "viable" if they are either self-financing or self sustaining. As the first criteria is the most demanding we will turn to it first.

C. A Self-Financing All Risk Crop Credit Insurance.

The experience of the project argues strongly that self financing by the three present insurers is for in the future and perhaps unachievable. The reasons are numerous but can usefully be divided into several categories.

Premium levels

The experience of the three project countries based upon a dozen collective years of experience indicates that the average pure risk premium alone is in the 10 percent range for an all risk scheme. In Panama with seven years of experience, the agricultural portfolio has suffered losses as high as of over 20 percent of the total agricultural coverage issued*. Premiums over the life of the project have met about 60 percent of the losses, the government the remainder. Experience, though only for two years, in Ecuador and Bolivia suggests pure premiums of about 10 percent in the former and 7.5 percent for irrigated agriculture and 15 percent for rainfed agriculture in the latter.

It may be argued that the project covers an atypical time period as all three project countries were affected by the "El Niño" phenomena. Our data suggests otherwise. In fact, the Panama loss experience is somewhat better than normal. Due to the small size of the initial program, losses were kept below premium levels. While

*In Costa Rica which insurers principally rice on the dry Pacific coast between 1970 and 1979 losses of 295 million colones were incurred on 1.3 billion colones of coverage. These losses, due principally to drought, totaled 23% of th coverage issued. This implies a pure risk premium of that amount just to meet losses costs. Subsequent losses have push this premium even higher. The actual premium charged was between 5% and 6% to cover both losses and administrative costs a premium of over 30% would be required.

"El Niño" produced a more severe drought in one year than is normally experienced, the overall level of drought losses were not in excess of those that could be expected. The same appears to hold true for Ecuador and Bolivia.

A pure premium of around 10 percent then must be added on top of a subsidized interest rate of 12 percent in Panama. The Ecuadorian interest rate is higher but probably negative in real terms while the Bolivian interest rate may reach 36 percent but still, in an economy with 100 percent inflation, be strongly negative. The effect of this premium on farmers will obviously vary in these circumstances. In Panama it is a real cost that will weigh heavily on farmers, especially given that the price of cereal grains is kept artificially low.

In the other two countries, given negative real interest, insurance is less burdensome. But likewise, unless policies in the future are indexed, the indemnity will be eroded by inflation. The premium is paid at the outset while the indemnity is most frequently received after the end of the agricultural cycle. This implies that the real premium is higher than the nominal premium, as inflation erodes the value of the indemnity. In Ecuador, the nominal premium of 5 percent is increased to a real premium of only 6 - 6.5 percent due to the erosion of the value of the indemnity (in those years that one is paid). In Bolivia, given the enormous inflation the premium in real terms may be twice as high as the nominal premium but still clearly far from adequate for a self-financing scheme.

Can farmers pay premiums in the 10 percent range? The most obvious answer is that farmers themselves say that they cannot, claiming that their marketing margins are insufficient. A more complete answer is however far more complex. Some can and some cannot.

Many of the farmers the project has worked with simply cannot sustain an additional 10 percent pure premium charge and remain profitable. This is so even if over time, they recover the entire amount with interest. These farmers tend to be small, poor, and marginal producers. Larger commercial producers with adequate technology and a larger asset base such as the commercial tomato farmers in Panama can absorb the premium. An intermediate case is the highland Bolivian potato farmers who were able to use a credit-insurance-technology package to markedly increase yields. Given the new and higher levels of income (even when averaging in bad years, which are very bad with high yield technology), the insurance premium is not particularly onerous. It should be noted that in both of these cases, producers have received subsidized insurance. While they would have the cash flow to sustain profitable operations with the larger premium, many certainly would not voluntarily accept a 10 percent premium rate.

Another variable in determining the ability of farmers to sustain premiums of around 10 percent is the alternatives available to them. In many cases, there is a cost free alternative--loan default. If producers can simply not repay their loans in allegedly bad years, why purchase insurance? Without entering the debate over why default in the agricultural lending banks of Latin America is so high, it is clear, based on the project's experience, that when loans are vigorously collected, insurance is actively sought. When, whether for reasons of bureaucratic malaise, institutional weakness, or public policy, loans are forgiven, insurance is vigorously resisted at whatever premium rate.

Administrative Costs

Pure premium levels for rainfed agriculture in Latin America are high, prohibitively so for many small farmers but not necessarily so

for the larger, more commercial operations. To the pure risk premium must be added the cost of administering the program. The available evidence from the project indicates that initial costs are extremely high at the outset. In Bolivia and Ecuador, $500 - $1,000 costs per policy are the norm. Panama, with a much larger, geographically dispersed program has reduced costs to around $175 per policy, or 3 cents per dollar of coverage*. Likewise in Chile where the average policy size is much larger than in Panama the inspection cost is around $150.

There is no conceivable way that the initial start-up costs could be borne by the insureds unless the policies were at the outset very large. The cost of agricultural insurance is largely fixed. It is the cost of putting an inspector on the farm. Once there, it is only marginally more expensive to inspect 100 acres instead of one acre--and only a small fraction as costly as inspecting 100 one acre plots. If the administrative costs are to be borne by insureds, they must be quite large producers. For smaller producers, it is not possible to pay the administrative costs at the outset. They are simply too high and must be subsidized. Even in a large scale program they are likely to add 3 percentage points to the premium, assuming the insurer retains a very tight reign on costs. This translates to about a 30 percent increase in the pure premium to cover administration, or a risk premium plus administrative costs of around 13%.

In time however, economies of scale will produce a very marked decline in the costs per unit of coverage. In Panama, the present 3 cents per dollar of coverage will in the best case decline to about

*Again, this is an average cost for crop credit and livestock policies.

1.5 cents. Thus, Panamanian farmers would have to bear an average annual premium of 13 percent at present but declining to 11.5 percent over time. It is most unlikely that either Ecuador or Bolivia will be able to reach this level of costs in the near future--and may not be able to do so in the long term for reasons discussed below.

If one were to assume that Ecuador and Bolivia were simply suffering high start-up costs, then it would be necessary to consider three variables, farm size, farm accessibility, and wage rates. The larger the farm, the less expensive per hectare or per dollar of coverage the inspection costs. Likewise more accessible farms are less expensive to inspect. Higher wage rates also increase costs. Thus Panama with moderate access, moderate size farms and low wage rates has an inspection cost (on a per policy but not per dollar of coverage) similar to Chile with very large farms, excellent access and relatively high wage rates. Substantial portions of highland Ecuador and Bolivia would have to be excluded on the basis of farm sizes and more importantly accessibility if these costs were paid from premium income. Only limited areas around the capital, large cities and on the Ecuadorian coast would offer a combination of size and access to make a self financing program possible. Most small farmers cannot be expected to pay the administrative costs that arise from their small plots sizes, limited access and geographical dispersion.

Reserves and Reinsurance

A third cost of insurance is the cost of either creating a reserve and/or establishing a long-term reinsurance relationship. Reserves and reinsurance are essentially the same in that for a

given risk, enough capital must be available to pay the worst possible loss, whether the insurer owns the capital or in effect "rents" it through the reinsurance mechanism. While it is very difficult to estimate the maximum possible loss in agricultural insurance, as nearly everyone loses at once, it is obviously very high, especially when drought and flood risks are included. These catastrophic risks can easily and frequently do produce losses in excess of the 20 percent of coverage that Panama lost in 1982/83. To take a single example of an all risk catastrophic loss insurance program to illustrate the phenomena, we may look at the Puerto Rican programs losses due to hurricanes David and Frederic in August and September, 1979. The total coverage for both Puerto Rico's agricultural and poultry program was about $9 million, premium was $615,000 and indemnities about $3.5 million. Hurricane losses were almost 40 percent of total coverage and 5.7 times premium income.

While this is polar example, it is all the more instructive as losses of this magnitude may occur at any time, including the first year or two, as was the case in Ecuador. In fact, they may reoccur almost immediately. Witness the back-to-back hurricanes in Puerto Rico or multiyear droughts in the U.S.

There are two alternatives for an insurer if it is to meet the "worst possible loss". It either must capitalize a reserve or purchase reinsurance. In a self-financing scheme, the insureds must pay as part of the premium a reserve capitalization cost to enable the insurer to gradually retire the venture capital he put forward as a reserve or to pay the reinsurance premium. Usually, the insured pays some of both. Like administrative costs, these costs are not expressed independently but are aggregated into the premium. As we are working backwards, we must try to estimate them and their impact on the overall premium rate.

These are the most difficult costs to estimate as the mix of reserve and reinsurance will vary from insurer to insurer over time. As a general rule, the international reinsurance community has shown a cautious interest in new agricultural business. The reinsurance offered has generally (Chile excepted) been on the lower levels of risk, not on catastrophic layers. Thus, insurers have to bear the catastrophic risk themselves.

In a self-financing program, an insurer would need a reserve in the 30-50 percent range of total coverage written to provide reasonable certainty that it could pay its losses plus some reinsurance so that the reserve would be kept intact in the case of small losses. Together the two would enable the insurer to pay losses in the range of 70-80 percent of total coverage. Let us assume that for present purposes that reinsurance is a financially neutral transaction--that over time insurers receive in indemnity approximately what they pay in premium. A prudent insurer would want to gradually expand his reserve by generating a surplus over and above indemnities in agricultural insurance operations. This would enable him to continue to extend more and more coverage. A modest 2 percent seems a reasonable margin to allow a slow and gradual expansion of the reserve.

Through this hypothetical exercise, we have approximated the premium level likely to be required for a nationwide, principally small farmer all risk crop credit insurance in Latin America, a program similar to the one envisioned in the initial PP. Pure premiums are likely to be about 10 percent with administrative cost for a large scale program on the order of 3 percent. While reinsurance and/or reserving is harder to estimate but likely in a reasonable scenario to be around 2 percent. Thus under optimistic assumptions, a self-financing premium for such a program is likely to be

in the about 15 percent for an all risk program financed by the insureds.

It should be borne in mind that this exercise assumes a) that the initial reserve is donated, presumably by government, b) that the initial start up costs are borne by subsidies, c) that neither a) nor b) is repayed and, d) that reinsurers charge a reinsurance premium that does not have a heavy "loading" or charge to build up a catastrophic loss reserve. Conditions a), b) and c) are the norm, d) is not. If any of these conditions do not hold costs are higher and consequently premiums.

In any case, there would be very little reason to believe _a priori_ that many farmers would voluntarily accept a premium in the 15 percent range* or that any but the most authoritarian government could successfully impose it on top of high interest rates. Yet it is this rate that is required by a small farmer, all-risk programs in Latin America. If small farmer all risk insurance is to be made available, it will require a subsidy at least for a very substantial time, and most likely permanently. The size of the subsidy will vary inversely with the amount of administrative costs and premium that the government is willing and able to pay.

In reality, these costs could be even higher. We have assumed a very tight reign on administrative costs and a modest reserve capitalization fee. In the research section, we have surveyed programs around the world and have discovered an average cost of 20 percent. While we believe that this cost may be unnecessarily high, it is not feasible to lower it by more than 5 percent. In either

*And, unlike interest rates, premiums are inflated, not deflated, by the inflation rate. Thus, in real terms, the premium is higher as the real value of the indemnity is eroded.

case, we do not believe that more than a small faction of producers can bear an additional heavy production cost of this magnitude.

D. A Self Sustaining Insurer

In the preceding section, we have argued that a small farmer, all-risk program would under near optimal conditions be too expensive for most farmers and very substantial numbers would have to be excluded due to the cost of serving them. The likelihood of self-financing is therefore remote. In this section, we shall test "viability" against a less demanding set of criteria to determine if it is possible to establish a self-sustaining insurer. By self-sustaining we mean an institution that can with moderate levels of subsidies function effectively and persist over time as a competent insurer. It should be borne in mind that the discussion in this section applies with equal strength to the preceding section and viceversa.

In assuming that the insurer will receive an administrative and perhaps a premium subsidy, we loosen the financial constraint and thus focus attention on a different set of issues, structure and management of the insurers and the availability of reinsurance for a large scale program. If we assume that government guarantees finance, is it then probable that a viable insurance institution will result?

The Structure and Management of the Insurer

The PP assumed that the new insurers would be "semi-autonomous agencies of the Ministries of Agriculture". Our experience indicates that this option should not be considered for several reasons.

First, Ministries of Agriculture are generally among the weakest in the government of Latin America. Their share of the budget is small. Their expertise is in agriculture. Insurance is a highly sophisticated, very specialized and broad ranging financial activity. While agricultural insurance obviously requires agricultural expertise, it also requires highly specialized financial expertise. It requires a very substantial knowledge of local and international financial markets, financial analysis capabilities and insurance management and marketing expertise. These skills in our experience are not found in ministries of agriculture in Latin America.

Insurance is an activity which requires that management exercise very substantial autonomy in the area of financial and human resources. The bureaucratic norms and rules of a government agency impose some substantial obstacles. Investment decisions are especially critical. To protect the reserve and the policyholders, it is necessary to maintain investments in either hard currency or relatively liquid assets, such as real estate, which retain their value in periods of inflation. Transactions with foreign insurers and reinsurers are also essential. Many financial transactions which are routine for insurers are often specifically forbidden by public law (such as holding hard currency reserves), others (such as payments abroad) are very difficult and time-consuming. Still others are not permitted by bureaucratic personnel rules. It is not, for example, generally possible to pay insurance field men a sales commission or a sales bonus due to personnel rules. Yet, it is essential if the sales force is to be vigorous. Likewise, public sector insurers are usually not able to change middle management either because they fail to reach the goals of the insurer or even if they prove not suited to the task.

The personnel problem is further complicated by the fact that the manager is usually a political appointee. This raises perhaps the most intractable of all problems. The situation of a politically appointee is an extraordinarily difficult one in which to the extent that he/she succeeds as a manager he/she erodes the political support that is the basis of continuing in the position. As a general rule, the people appointed to manage insurers are not insurance professionals. That is a problem that can be overcome. However, to the degree that insurance expertise is acquired and exercised, the continuity of management is endangered.

The technical operation of an insurer very frequently clashes with political goals. An insurer must at a very minimum protect its reserve against decapitalization, charge adequate premiums and pay only the losses that fall within the terms of the policy. The politiccal system operates in a very different culture. It need to respond to demands for relief from producers who claim to have been hurt by natural disasters or who claim to be saddled by unsupportable premium rates. It is an unfortunate fact that when risks are high so too are premiums. It is also evident that large losses cannot be completely compensated by insurance without still larger premiums. It is also true that insurance by its very nature, has a surveillance function that frequently is resented by the insureds.

A usual result of a public sector insurer is that the political system and the insurer are under pressure to offer coverage at unrealistically low rates and to pay indemnities disproportionate to the premium charged. At the same time, the inspection function is sufficiently resented so that there is pressure to reduce it. A manager who can resist these pressures would be extraordinary indeed--and in most cases without the job of managing the insurer.

The basic issue here is one of financial discipline. Insurers must amass huge amounts of liquid reserves. We have seen that losses not infrequently exceed 50 percent of the total coverage issued. Insurers must collect an annual premium and in most years not pay an indemnity. Insurers must adjust losses strictly, depriving policyholders of undue indemnities that they think they deserve and that they think would be insignificant to the insurer given its reserve. These functions are especially difficult to reconcile with the workings of the political system. Liquid assets are frequently used to meet clear and pressing problems. Premiums that are "too" high are brought down and indemnities that are "too" low are raised, quite frequently with little consideration of the insurer's ability to sustain a similar loss in the near future.

Insurance is not a magic machine that makes money; it is simply a redistributive mechanism that transfers funds from area to area and year to year. It is especially hard to impose this discipline on the political system when needs are immediate and acute and funds are short. In fact, it is seldom done. Most government insurers charge premiums that are too low and few, if any, have been able to keep their reserves intact over time.

At the same time, government are reticent to supply large reserves to the insurers they have created, usually offering guarantees instead. Likewise annual appropriations to permit an expansion of coverage and recapitalizations are difficult to secure. These funds held by the insurer appear to be idle. Yet when disaster strikes the pattern we have seen in Panama of financial improvisation is the rule.

A survey of the public sector insurance programs around the world shows this to be a consistent pattern of behavior. In Latin America, we have seen Mexico build an insurer that according to a high official of the treasury (Hacienda) cost $500 million per year in 1982 but has no reserve. It is a huge cash flow operation--and more a creature of the treasury than an insurer. A similar phenomena on a smaller scale occurred in Costa Rica, where the government used most of the insurer's reserve and left it unable to pay its losses. Within our project all three insurers are under pressure to keep premiums lower than the indemnity costs without any additional capitalization. There is a structural tension involved in operating a public sector insurer that does not appear to have a solution. While some of the problems of public sector financial management and personnel rules are subject to solution (though we do not know of a case in the developing world where a solution has been attempted), the tension of managing insurance on technical grounds within a political system has not been successfully addressed. The usual result is that the insurers become insurers in name only. Large expensive bureaucracies with high administrative costs far above those we cited in the preceding section as being necessary are the usual results. Insurance is usually converted into a disguised subsidy or income support payments.

It is therefore, our view that a public sector insurer, especially one situated in a Ministry of Agriculture, is unlikely to be self-sustaining. Rigidities such as financial and personnel policies severely handicap an insurer. Far more serious, however, is that the technical management of insurance is likely to conflict with the goals of the political system. The requisite financial discipline to collect, protect and prudently manage large pools of

money clashes with the pressing need of the political system (frequently under pressure from the insureds themselves) to respond to the urgent problems of the rural population.

E. Risk Spreading and Reinsurance for All-Risk Crop Credit Insurance

In the preceding sections, we have made passing mention of reinsurance. It is so important as to merit a separate and extended treatment. The need for risk spreading mechanisms was recognized at the outset. The PP argued that "it is especially needed by small countries to protect against catastrophic losses which would otherwise place an impossible drain on a nation's budget." The then prevailing view was that commercial reinsurers would probably not be willing to accept a cession of risk from the new insurers due to the "substitution of the profit motive with a social/political hazard." Instead what was proposed was the planning in the first five year phase and the funding, in the second five year phase of a regional reinsurance pool called ALARA (Agencia Latinoamericana de Reaseguro Agrícola) capitalized by funds from several international donor sources. ALARA would provide reinsurance and over time develop loss adjusting capabilities and thus overcome this social/political hazard.

In earlier sections we have noted that the insurance programs seldom had an adequate initial reserve--excepting those created in Ecuador and Bolivia with the assistance of the project staff--and frequently operated without reinsurance. Despite these very disadvantageous financial circumstances, early work indicated that the ALARA idea had very severe problems--so severe in fact that it seemed unwise to press ahead with the planning stage. These problems were both financial and administrative.

Financially, ALARA would require a massive initial capitalization if it were ever to be able to serve the number of insurers that the project contemplated creating. At the outset, three tiny pilot projects would poise no financial problem. Their reinsurance needs could be met with a several million of dollars. Even if the Costa Rican program were included there still would be no insurmountable capitalization problem.

The first problem arose when the Mexicans expressed an interest. As the first and largest Latin American insurer, there is no apparent reason to exclude them. To reinsure the Mexican program, the amount of capital required increases from several million to several hundreds of millions of dollars. Amounts of this magnitude were (and are) not available.

A more severe problem arose from the fact that the payments into ALARA had to be made in hard currencies. Most of the countries are chronically short of these funds in most years.

While these problems could be solved, the intractable irreducible fact that two major programs (Mexico and Costa Rica) were designed to lose money doomed the idea. A basic tenant or reinsurance is that the reinsurer follows the fortunes of the reinsured company. In insurance schemes that are systematically underrated and open to politically influenced decision-making, it is impossible to develop an adequate reinsurance premium to cover this risk. Furthermore, to the extent that ALARA raised the reinsurance premium, the temptation to magnify the amount of losses would be increased. While it is difficult for a national government to leave a large, apparently "idle", reserve intact, it would be doubly diffi- cult not to be severely tempted to draw down a large donated hard currency reserve.

Administratively, ALARA had the severe problem of having to gainsay the pronouncements of national governments. In a region where the tradition of interregional cooperation is weak and there is little interregional bureaucracy (such as in the EEC), the idea of an outside and impartial assessment of the severity of loss would be unacceptable. While the countries were perfectly willing to draw down funds according to their own assessment of the severity of loss, there was considerable reluctance to submit to a supranational quasi-police authority. This authority would necessarily involve itself in measurement of the magnitude of loss as well as in adjusting the basic rates and improving the underwriting and loss adjusting procedures. If ALARA were not so involved, there would no way to protect itself from a steady gradual decapitalization of its reserve. The countries--at least at the ministerial level--were not willing to consider seriously the creation of a supranational bureaucracy that would be involved in these aspects, without it, ALARA appears to be a large pile of money up for grabs on a first come, first serve basis.

Several of the pilot projects have in fact been able to acquire commercial reinsurance. Panama was able to reinsure both its agricultural and livestock portfolio. The reinsurance however was not catastrophic loss cover. It was instead quota share in which a portion of the premium equal to the same amount of the risk is ceded.* On top of that a rather small layer of "excess of loss" coverage was available under which losses over 100 percent of premium up to, say, 200 percent of premium are paid by the reinsurer

*For example, a 30 percent quota share transfers to the reinsurer 30 percent of the risk for 30 percent of the premium, minus some expense commissions. The reinsurer then pays 30 percent of the losses.

in return for a nonproportional share of premium. Bolivia was able to obtain similar coverage but only for its livestock and live insurance business.

The international reinsurers are willing to experiment very cautiously with all-risk cover but to date have been unwilling to reinsure the catastrophic loss potential. It is simply too catastrophic and too volitile. If the initial years of experience are favorable, they are willing to gradually expand their coverage but will not in the near future be likely to accept the truely catastrophic risks.

Chile is something of an exception. The Chilean program insures highly commercial fruit and cereal grain producers who are both technically advanced and experienced. In this case, reinsurers were willing to accept a very large part of the total risks. It should be borne in mind that drought is largely excluded.

Would it then be reasonable to expect that as technically viable, limited risk (as opposed to all risk) insurers emerge and gain experience that the commercial reinsurers would gradually extend them reinsurance? The answer would appear to be a rather limited yes on a tentative basis. Reinsurers are prepared in a limited way to experiment with the emerging agricultural insurers around the world provided they are run on a technical basis.

Two caveats however must be cited. First, we have noted that in a given country there is little or no independence of loss. Reinsurance that operates worldwide would appear the means to spread these risks, balancing severe losses in one country with favorable results in other countries. At this stage, knowledge about the

incidence (frequency) and severity of agricultural losses on a worldwide basis is undeveloped. It is intuitively tempting to believe that the world provides enough spread of risk to make reinsurance possible. Recent experience indicates that in, at least some years, that is not the case. The "El Niño" phenomena affected most of the world and caused massive losses on four continents. It is impossible in this case to think of any reinsurance portfolio whose individual components would not have been severely affected as would have the entire portfolio. At this stage, not enough is known to decide if it is possible to develop an adequate risk spread of agricultural risks to permit the development of a portfolio that will produce satisfactory results.

Second, the supply of reinsurance is called "capacity." It is flexible, though finite. At present, knowledgeable sources estimate that the worldwide capacity is in the $2-3 billion range. The amount of capacity varies, principally with interest rates, within a limited set of parameters. With falling interest rates it could reach perhaps as much as $5 billion. This amount of capital to back all the new reinsurance that could be written for all classes of business is miniscule in terms of the agricultural risks of the world.

To put this in perspective, we need only look at the aggregate value of production data. In 1982, Latin America the aggregate value of the agricultural sector's production was about $28 billion.[1] To reinsure only 10 percent of the value, almost all of present existing capacity of the world for <u>all classes</u> of reinsurance would be absorbed. It is first very unlikely that the world reinsurance community would accept this much functional risk concentration in one class of business and even less likely given

the recent "El Niño" phenomena that reinsurers would accept a geographical concentration of risk of this magnitude.

At present, the existing programs that are reinsurable are few and have limited premium volumes. They then poise no capacity problem--although political decision making may make them uninsurable. However, there is a very real limit to the amounts that reinsurance markets will accept from Latin American agricultural insurers. To the extent that insurers grow and new ones emerge, this problem will become a real constraint on future growth. It is very difficult indeed to believe that the currently existing reinsurance markets could play a major catastrophic risk spreading role for a substantial number of nationwide agricultural insurance programs. To be able to do so, the reinsurance markets would need a substantial infusion of capital and a suspension of the traditional reinsurance wisdom as to geographical and functional concentrations of risks.

In concluding, the experience of the project indicates that the concept of a reinsurance pool such as ALARA is not viable for several reasons. First, some insurers are designed to lose. To participate, they would need adequate premiums (or subsidies) for the risks they accept and a management not subject to political decision-making. Second, and more important, the operation of such a scheme implies a supranational authority which would in some cases modify the decisions made by national authorities. Any modification of the traditional concept of national sovereignty would need to be negotiated at a high political decision-making level, as would the rules of access for inspection of both the insurer's operations and its losses, as most insurers are and will continue to be in the public sector. Without such an agreement, the reserve of ALARA could not be protected and the likelihood of destructive conflict would be very high.

Commercial reinsurance has a role in accepting some of the basic risks and perhaps part of the intermediate level risks. It can play an useful and salubrious role in the development of soundly rated, well-run schemes. The world's reinsurance markets do not appear to have the capacity nor inclination to spread the truely massive catastrophic risks that arise from the widespread destruction of agricultural production. Indeed, given the present level of knowledge about the massive losses, it is far from clear that an adequate reinsurance portfolio of risks around the world could be assembled.* While this is not an immediate problem, to the extent that the 30-40 programs around the world, existing or being planned, look to reinsurance markets, it will become a real constraint.

In the final analysis, reinsurers will accept some risks from viable, soundly rated schemes but the risk of infrequent catastrophic destruction of agriculture will have to borne by the nation-state. To date, none have to the knowledge of the project staff prepared in a systematic way to confront that risk.

F. The Data Constraint

Previously we have argued that a viable insurer (whether self-financing or self-sustaining) must have realistic premiums. The previous discussion has assumed, somewhat mechanistically, that the setting of an adequate premium is a technical exercise. Unfortunately, that is not so. Indeed the problem is complex and the state of knowledge so poorly developed, so a correct premium determination is a difficult task.

*This is especially true under competitive conditions and U.S. anti-trust legislation which would make an industry-wide coordinated approach to the problem difficult and perhaps illegal.

In the simplest terms, there are three data-related problems, what data, how much data, and what to do with the data.

A premium rate is in it barest form the amount of money required in the form of a premium to permit an insurer to pay its losses over time. While there are many complicating factors, the basic element is the average loss cost over a span of years.

Working backward with the existing data on agriculture to try to arrive at a premium is a complex and frequently frustrating exercise. First one must decide what data to utilize. The project has used basically production data, and more specifically yield data. The reasoning is quite simple. Most agricultural lending banks utilize yield data in setting the amount of credit they will extend. Likewise, insurance that covers the amount of credit issued can rely on yield data.

The problem arises when this yield data proves both too aggregate and too inaccurate for insurance purposes. Credit operations and insurance operations require somewhat different levels of accuracy. It is of relatively little importance if a bank lends 100+ percent of the value of the expected yield, as it has a right to recover its loan in any case. On the other hand, this level of insurance coverage would create a severe moral hazard. If a producer can collect equal amounts from insurance and hard labor, a substantial number will do the former.

Farm yields vary dramatically in Latin America, even within a very small area. While widescale variations are fairly easily detected, farm-to-farm variations due to microclimates, soils, technology and the skill level of the farmer are much more difficult

to capture. Over time, by retrorating* the premium, an approximate premium rate can be reached. But there is an opportunity to retrorate only when there is a loss. This system is useless to estimate initial premiums and requires years of use of achieve an approximate premium. A more accurate method requires collecting sample data in both good years and bad.

The use of sample frames are not theoretically, or even administratively, complex, they are simply costly. As an insurer must insure numerous crops in many areas with very different planting dates and different production practices, the cost can be very substantial. The alternative, accurate farm records, generally are not available.

Yield data is "end result" data. One cannot always infer from it what produced the loss. Agricultural insurers must know what produced the losses they pay. Assuming sufficiently disaggregated data, it is not always possible to determine what actually produced the observed change in yields. While it may be a drought, just as often upon inspection one finds losses that were claimed as drought arose from one or more of the following, poor soil preparation, late planting, mistaken technology usage, non-recommended seed varieties, poor cultural practices, and abandonment.

A partial solution is to combine the "end result" yield data with climatological data. While it does not obviate the need for inspections to detect the problems cited above, it does make it considerably easier to infer the causes of losses. Many phenomena are reasonably wide spread and of extended duration such as drought,

*Retrorating is essentially a running average. Bad experience raises premiums, good experience lowers them.

freezes and floods. While localized hail, flash flood, fire and sometimes freezes cannot always be detected from climatological data, it is generally sufficiently disaggregated to be able to detect most insured phenomena and to raise the alarm when one farmers suffers losses and others around him do not.

Climatological data, as useful as it is, has one major drawback. There is too much of it and it is very costly to collect and analyze. These data must be collected, analyzed, and put into useful form for insurance work. In the research section, we report on the initial tests of the utility of this data.

Again, there is no theoretical problem. What is required is skilled manpower, good hardware, better software and a considerable amount of field work. It is a complex process, as well as costly, but once the basic infrastructure is in place, the insurers can procede at a certain cost to collect and analyze yield and climatological data.

The problem of "what data" is an operational and financial problem that is easily managed through organization and resources. "How much" data is a problem of a different magnitude. It is apparent that available time series data is too short to make accurate premiums. Obviously five years is far too short, 20 years is probably too short, and somewhere between 50-100 years may provide an accurate estimate of weather patterns that affect agricultural yields. It may be sufficient but only if one assumes that a) there

are observable, repeated patterns of weather and b) a means is found incorporated parameters to permit a compensation for technology change.

While it is obvious that certain phenomena, (e.g. drought) reoccur, it is not demonstrable that they are sufficiently cyclical to permit accurate rate making. Time series data are too short to determine if there is a consistent pattern. Likewise, we do not have enough data to even begin to estimate multiyear patterns, as in most cases the data contains only one or two of these patterns in which droughts occur for two or even three consecutive years. Thus, if there are patterns, we cannot, given the data base, do more than measure them in the roughest manner.

More troublesome is that this data needs to be adjusted for technology change. Leaving aside obvious phenomena like the installation of irrigation, there is ample evidence that over time a phenomena such as drought or heavy rains will have a variety of impacts on the insured crops. The most obvious examples are drought resistent cereals or semi-dwarfs varieties less affected by heavy rain or wind that would topple tall varieties. Likewise, we have observed in Bolivia that modern technology is far less productive under suboptimal conditions than are traditional cultivation practices. Thus, much work is yet to be done on agricultural weather patterns and particularly, on their impact upon an agricultural production system characterized by a changing technology.

Perhaps the most intractable problem is the theoretical problem of how to make this data useful to an insurer. While collecting and processing the data required for agricultural insurance rate making is a costly, time consuming and relatively sophisticated process, the perhaps unique nature of agricultural losses makes the theory building work complicated.

A fair evaluation of the theory of agricultural insurance rate making at the present stage of work would need to come several conclusions. 1) The data base is inadequate. 2) Collecting additional disaggregated data is a long-term and costly enterprise involving a field survey capacity as well as substantial investment in data processing hardware, software, and personnel. 3) There is no presently adequate theory to permit the data to be organized for rate making, and 4) further theoretical work is likey to exceed the individual or even combined capacities of the existing agricultural insurers.

This is not to argue that the problem has no solution, only that it exceed the time and resources available to the project. Nor is it an argument that agricultural insurance cannot be done. Instead, the theoretical work to date suggests a slow cautious approach coupled with a very large reserve. Major errors of judgement are almost inevitable. The best that can be done at present is a series of sequential approximations--such as those of the linear programmed portfolio management model installed in Panama--to permit the insurer to adjust premiums to experience. There is currently no hard theory, nor is there much likelihood of creating one without a major research effort. For the near future, calculation based on inadequate data and judgement based long experience and intuition will carry equal weight in rate making. It is to be hoped that future insurers will balance the inevitable errors of calculus and judgement with a reserve sufficient to pay for mistakes.

G. The Art of the Possible

The Structure, Finance and Administration of Agricultural Insurance

The largest set of problems confronted by the crop credit insurance project has been the issues of the structure, finance and

This leads us to a paradoxical situation. Only the public sector can launch a major all risk agricultural insurance program and, given the catastrophic risk, only the state can guarantee its long-term solvency. Yet, those launched in developing countries seldom have fulfilled the purpose for which they were created.

Given this simple fact, there are two possible brief that could be presented. First, one could argue that government should not become involved in the activity, as that involvement will likely convert an intended incentive into a disincentive or even a payment for inefficiency. Following Schultz,[2] it is possible to argue that a major problem of agriculture in the LDC's is bad policy. Public sector, all risk, small farmer agricultural insurance on the historical record, at least in the LDC's, is a bad policy mistake that should be avoided.

The other brief, in our view more realistic, recognizes first that some forms of agricultural insurance can be very useful to modernizing farmers but should be left to private sector initative, perhaps with some support from the public sector to provide farmers with the incentives necessary to turn "sand into gold".[3] By arguing the virtues of the market mechanism unencumbered by direct state intervention, one is knocking on an open door. Most of the LDC's recognize that many forms of state intervention have proved too costly and counterproductive. They have not yet come to this conclusion about agricultural insurance because there has been no study of the issue until this project. Thus, many LDC's appear on the verge of launching ill-advised public sector programs. But, to argue that they should do nothing and depend upon the independent iniciative of the private sector is to consign a useful policy tool to oblivion.

The experience of the project argues strongly that government should not become directly involved, notwithstanding that agricultural insurance can prove a useful if limited development policy. The experience to date strongly suggests the negative consequences outweigh the positive gains. This does not lead however to an anti-interventionist recommendation. Instead, it leads first to a very strong warning that it is quite impossible to mount an inefficient, coercive, large-scale program characterized by spiraling costs, a lack of financial discipline, and blanket guarantees of solvency with empty coffers. This is the usual result of public sector programs. Secondly, experience suggests another more modest, but more effective, strategy will be needed in developing countries.

A More Modest Beginning

In trying to mount public sector, all-risk, small farmer agricultural insurance programs, the LDC's have gone a bridge to far without laying a firm financial and administrative basis upon which to build. Under existing circumstances, the chances of success appear slim indeed. However, in our work over the last five years, it has become apparent that there is a wide range of insurance coverages that are both useful to and widely demanded by the rural population. There are also established ways of making this coverage available at acceptable to at least a portion of the rural population.

We propose that the public sector step back from the actual issuance of coverages and concentrate its efforts on opening the way for existing insurers to begin to build a stronger rural financial market.

Existing insurers have several very marked advantages. First, somewhat tautologically, they exist. There is no need to create a new special purpose institution characterized by high start-up costs during an extended period. Second, existing insurers already have trained management and have acquired standard insurance technology. Most have long standing reinsurance agreements. Adding some agricultural expertise to an existing insurer is an easier task then building a new specialized insurer, and considerably less costly. It is likewise not frought with the severe hazard of politically influenced decision-making.

It is in stimulating this interest of the insurance industry in the vast agricultural hinterlands that government can play its most useful role. There are several steps in this process. First, government need to remove some very substantial obstacles. As a rule, insurers are quite heavily taxed through direct as well as indirect taxes. Particularly onerous is the requirement that a substantial part of reserve funds held by the insurer must be invested in low interest government securities. By removing this requirement for the rural sector, government can provide a very substantial incentive. If insurers could invest funds generated in the rural sector at market rates instead of being forced to buy low interest government securities, there would be a strong incentive to sell its products to the agricultural sector.

Second, the public sector can provide insurers with very substantial services at slight marginal costs. We have cited the cost of data collection and processing. Agricultural insurance requires large amount of accurate data. Much of this cost can be borne by government as part of the agricultural sector planning process. By collecting, organizing and processing data useful to insurers, both a duplication of efforts is avoided and insurers are provided with

the information required. At present, much of the information collected could be useful if organized differently and much other information such as sample frames could be useful to both insurer and government planner. Costing data services as well as lending agricultural personnel to insurers could help to offset the higher administrative costs of serving the agricultural sector.

Third, loosening a series of restrictions on reinsurance and foreign transactions will stimulate the growth of agricultural insurance. Governments must realize that only a small amount of risk can--or should--be retained in the country and that large amounts will need to be reinsured. Likewise in periods of high inflation and exchange instability, a substantial portion of the reserve needs to be kept in hard currencies. While this is a general problem of insurance in LDC's, it is particularly acute for agricultural insurance as catastrophic risks implies much more spreading through reinsurance as well as the maintenance of a larger more liquid reserve.

Fourth, differential tax treatment for the part of the insurers' portfolio invested in agriculture would provide an incentive to make insurance available in the rural areas. Likewise, a favorable tax treatment of profits earned in the rural sector would encourage insurers to move beyond the cities.

Finally, government supervision to protect against the insurers' insolvency would help to provide policyholders with the confidence to purchase policies. Many LDC's have reasonably effective regulations and regulatory agencies, which have intervened to help guarantee insurance company's solvency. By developing agricultural expertise, the regulatory agencies can effectively work to guarantee the solvency of insurers working in the agricultural field. This check on the rate structure would help prevent the unwise from offering rates too low to meet indemnities, thus prevent farmers from being left holding worthless paper.

Under these conditions, it is reasonable to expect some insurers to begin to experiment slowly with new lines of insurance for the rural population. It is most likely that at first life insurance and life insurance related products would be offered. These products have several advantages. They are first of all non-catastrophic. They are also long-term and have quite predictable results. Reinsurance is easily available and the technology is well known. Administrative costs are very low. Life products create long-term investment capital pools that are lacking in most developing countries.

A second line of insurances would be the extention of casualty covers to the rural areas. Traditional fire and windstorm insurance on agricultural buildings as well as specialized agricultural covers such as machinery or dam breakage insurance are feasible.

We have noted that in Panama and Bolivia livestock insurance is both feasible and in demand. Livestock covers are essentially health maintenance programs for animals. The premium charged by the insurer contains both an amount for a death (or loss of function) benefit as well as an amount to cover the cost of keeping the animal healthy. When it is offered on a herd basis, the administrative cost can be kept quite low. Our experience indicates that the results are fairly even across years and seldom catastrophic. Reinsurance is easily available.

Agricultural covers that do not actually insure the growing crops are also currently feasible. Storage, transport, and processing activities are easily insured against loss.

The most difficult cover--and the focus of this project--crop or crop-credit insurance will be somewhat slower to develop. Once an insurance infrastructure develops in the rural areas, insurers can

begin to offer crop covers without incurring insupportable administrative costs. It appears most likely that larger more commercial farmers would be insured first. The coverage is likely to be limited risk or named peril. As experience is acquired, more of the value of the crop and additional risks can be insured. Large scale insurance coverage will occur slowly and in all likelihood will be confined to the commercial agricultural sector. Catastrophic losses will still poise a major problem as there is little reinsurance capacity available for them. At the outset--and for a considerable time--it is probable that some major sources of loss will not be insured. Drought can be covered when irrigation is available but water supplies are infrequently inadequate or floods only when drainage is adequate for most years. In our view, it is unreasonable to expect an insurer to accept these catastrophic risks which arise as much from the lack of infrastructure as from the vagaries of nature.

A role for international technical assistance and financial donor institutions is indicated, albeit a more limited one than at present. The first, and perhaps the greatest service, is to attempt to persuade governments not to proceed with ill-advised all-risk schemes based on a hope and a prayer instead of sound management and a large reserve. Limited technical assistance to help restructure existing schemes as well as insurance codes and tax policy to foster the development of soundly financed and managed rural sector coverages could return substantial benefits at slight costs. Likewise, technical assistance to insurers attempting to penetrate rural markets could substantially expedite the process. Areas such as management, finance, data collection and processing and especially agricultural and livestock insurance practices would help insurers to reach the rural sector. Maintenance of an on-going information clearing house service on programs, policies, experiences and reinsurance of agricultural programs would assist in promoting an interchange of information.[4] Finally, the available expertise is

very slight indeed. To the extent that it could be provided at low or no cost for the crucial design stage, insurers adding agricultural covers could avoid the mistakes of the past as well as benefit from the lessons learned.

We are aware that to many these objectives will appear too limited and the goals short of those envisioned in the original project. In one sense, that is correct, as an initial objective of the project was not to study and experiment with the removal of barriers that limit the rural market for insurance but to mount and experiment with small farmer all-risk, public sector agricultural insurance. In another sense, these objectives are consistent with the experience of the project to date. They appear, as reflected by the title of this section, to be "the art of the possible."

In the complex, dynamic and interdependent process of a society deciding what public goods can be provided, when government should remedy "market failures" through intervention and when it is better to facilite change rather than be its direct agent, what is "possible" changes. Under present conditions of heavy indebtedness at home and abroad, irregular and falling export prices, heavy budget deficits and an already too costly, inefficient and frequently counterproductive set of agricultural sector incentives, there appears little justification for mounting another public sector program which has a limited chance of success. If it fails, the consequences can be quite severe and will aggravate the already acute financial distress of the country. While agricultural insurance is useful to commercial farmers and costs theoretically can be contained, the chances against this occurring appear to be quite modest in a public sector, all-risk program. For the present and forseable future removing obstacles to a freer financial market,

providing fiscal incentives, information, limited and auxiliary services to an existing insurance industry appears wiser public policy.

The markedly reduced role for AID and other possible international sponsors arises from a contraction of the initial conception of the project to a considerably more modest proposal. It appears unwise to launch public sector all-risk, small farmer program unless AID is prepared to acquire a long term, increasingly expensive commitment. "Graduating" these programs to financing with national resources and/or premiums is in the far future. Likewise, establishing an interregional pool such as ALARA is not advisable until the underlying national programs are financially sound and until an agreed upon set of enforceable rules for access to the fund and oversight by the fund of the national programs has been formalized. To do otherwise is to sponsor a financial giveaway which will foster the rapid development of other national programs to participate in the giveaway before the funds are consumed.

Constricting both the clientele and the risks that the insurance covers was necessitated by the cost of serving some potential clients, in the first case, and by the difficulty of bearing nationally and spreading internationally the losses in the second case. Premiums will be quite high in the best of cases and unsupportably high for the small and isolated farmer. In many cases, a small farmer program will prove too expensive for the farmer and will surpass the capabilities of government to sustain a large scale program even when very tight discipline is maintained. That financial discipline, we argued, is unlikely. Reinsurance cannot transfer all of the risks of a large scale nationwide program. Much of the catastrophic risk must remain at home. It is

not advisable to have insurance without preparing to meet the contingent liability. This implies creating and maintaining a large liquid reserve. The financial discipline to do so is thus far absent.

In these conditions, a more modest beginning is indicated. The LDC's are not developing under the same conditions as the more developed countries. They cannot always adopt the same institutional arrangements. In the circumstances of the 1980's, establishing a public sector all-risk small farmer insurance program appears both too costly and probably with too limited benefits. A more modest beginning is to build upon existing financial institutions by offering fiscal relief and incentives to enter the new rural market. These development policies have served many nations well in promoting the development of new industries and the modernization of old ones. While they work slowly, and sometimes too slowly, they are financially supportable. And, to the extent that insurance enters rural markets, savings can be increased and pools of investment capital created. For the present, this less costly, less risky, less ambitious strategy seem indicated given the financial state of most of the Latin American economies. What is not done today can always be done in the future, what is done cannot as easily be undone, especially when the vital interests of many are adversely affected. There will perhaps be a time for dramatic solutions to the problems of risks in agriculture. For the present, neither the institutional structures nor the finances of the Latin American agricultural sectors appear adequate to undertake such a course of action. A more modest gradual approach would for the present appear more viable and advisable public policy.

H. Some Recommendations to Donnor Agencies

Based upon the five year pilot project and the extensive field and analytical research program the following recommendations are made.

Donnor agencies should finance no further host government activities in the field of all risk crop or crop-credit insurance targeted primarily at small farmers. These coverages are almost always extremely expensive to administer although over time that cost may be reduced to an acceptable level in some cases. The cost is inversely proportional to the size of the farms insured. More importantly however is that these government supported programs are open to politically motivated decision-making. This in turn has a high risk of converting insurance into a covert subsidy. The cost of these programs on a national level can be staggering, exceeding the resources of all but the wealthiest countries. They are of dubious benefit as income support programs, and appear not to be the most cost-effective way to promote either technology adoption or income stabilization for the small farm sector.

No further attempts should be made to procede with the establishment of an interamerican or world wide agricultural reinsurance institution such as the proposed ALARA.

Donnor agencies should encourage and provide limited technical assistance to commercially viable, limited risk insurance offered by private companies at premium rates calculated to realistically reflect the risk transferred to the insurer. For medium to large farmers, insurance is an extremely useful financial device for planning and for effecting intertemporal capital transfers. It appears useful to help foster agricultural modernization in the commercial sector.

Agencies should actively encourage and assist in the development of livestock insurance schemes. Livestock insurance is far more stable and much less costly to operate when done on economies of scale. It should quickly become self-financing and provides a most useful policy tool to foster upgrading of stock. The coverage as in recommendation 1 should be sold at a viable commercial rate.

Agencies should give special attention to the development potential of life insurance and life insurance related products for rural dwellers. Since life insurance funds have historically been a major source of development capital, it can be said that a major source of capital accumulation, and development opportunity has been overlooked. In Latin America, it is probable that only a fraction of a percent of people have life insurance in the countryside and only several percent in the cities. Life insurance is easily sold at low premiums, its administration is extremely simple (the policyholder is either dead or not), and the funds collected are held for long time periods, thus available for long-term lending. The business is very predictable and not subject to violent fluctuations. This potential should be explored within the context of a general insurance development program designed to assist private insurers to extend their coverages, upgrade their management and in general modernize their business practices and investment policies to begin penetrate the rural market.

Agencies should consider providing a limited technical assistance capacity to help plan financially viable schemes as well as to assist countries remove administrative, fiscal and legal obstacles that inhibit the expansion of insurance to the rural sector. They should consider funding an information clearinghouse to make the experience of the schemes around the world available to both governments and commercial insurers and reinsurers.

End Notes

[1]International Development Bank, Annual Report, 1982.

2 Theodore W. Schultz. Distortion of Agricultural Incentives. Indiana University Press, 1978.

3 ________________. Transforming Traditional Agriculture. New York, Amo Press, 1976, p.5.

4 For example, both Israel and India have large, apparently successful livestock insurance programs. The latter is reported to have over 15 million head insured on a completely commercial basis. The Chilean program merits careful study as do several other schemes around the world (i.e. South Africa and New Zealand) that appear to be effective but unknown outside their native lands. It has gone unnoticed, for example, that Brazilian tobacco producers' have run a cooperative scheme far over 30 years to insure their crop.

ANNEX No.1

PUBLICATIONS

A. Journal Articles

GUDGER, W. M. "Análisis preliminar del Primer Ciclo de Seguros en Bolivia. Una nota de Investigación en Marcha.. Desarrollo Rural en las Américas, 13(3).173-177, Set.-Dec. 1981.

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