# THE CASE AGAINST CROP INSURANCE IN DEVELOPING COUNTRIES

By

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There is a widespread belief that risk aversion causes substantial misallocation of resources in developing countries and that therefore, crop insurance would be an important accelerator of agricultural development.[1] For example, the following is typical:

> Crop insurance is part of the institutional infrastructure essential for the development of agriculture which is basically insecure.[2]

But if economics teaches us anything, it teaches that attempts to legislate economic problems away (e.g., by usury laws, minimum wage laws, rent controls) will be costly in terms of production opportunities foregone and may even worsen the very problem that they were designed to solve (e.g., high interest rates to the poor, low incomes, and substandard housing conditions for the poor).[3] We cannot conclude, therefore, that just because agriculture is risky the government is obligated to remove those risks. Prudent policy prescription in the area of crop insurance awaits a more thorough analysis of the welfare economics of government insurance and empirical estimates of the relevant effects. This paper primarily addresses the first of these issues, but also reports the results of relevant empirical research.

The first section of the paper demonstrates that under certain ideal conditions government sponsored crop insurance could improve

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[1] Mellor (1966), Wharton (1969), Moscardi and de Janvry (1977), and Dandekar (1977).

[2] Dandekar (1977), p. 27.

[3] In other words, "there ain't no such thing as a free lunch."

efficiency. The second section demonstrates that these ideal conditions are unlikely to exist, even approximately, and that the cost of even a well-designed and administered crop insurance system is likely to be far below benefits. In the third section we investigate two objectives of crop insurance which are unrelated to risk aversion and demonstrate that though crop insurance may partially achieve these objectives, it is an inefficient policy instrument compared to the alternatives.

## I. The Case for Crop Insurance

The usual defense of crop insurance goes something along the following lines.

1. Low-income farmers are risk averse, i.e., they are more anxious to avoid low incomes than they are to attain high incomes.

2. The new high yielding technology, especially for rice, tends to give higher profits but is viewed by farmers as being more risky than traditional practices.

3. Therefore, low income farmers will be inhibited from switching to modern practices from the traditional ones.

4. Modern techniques are more efficient, and therefore government should institute crop insurance in order to offset the misallocation of resources induced by risk aversion.

In order to even evaluate the case for crop insurance we need to first remove the ambiguities and estimate under what conditions the case is valid. First, we need a more precise definition of risk aversion. For the purposes of this paper we will assume that the conventional model of expected utility maximization is sufficient to provide an accurate description of farmer behavior.[4] In this model, farmers are unambiguously risk averse if their utility function of income is everywhere concave, i.e. is characterized by diminishing marginal utility of income. Analogously, a risk preferring individual is one whose utility function is characterized by increasing marginal utility of income. If marginal utility of income is constant, the individual is described as being risk neutral. For simplicity, we will not consider in this paper

[4] See Anderson, *et al.* (1977) for an excellent exposition of the expected utility model and methods for application.

the case wherein the utility function may be concave in one region and convex in another.

For this model one technique will be viewed by a farmer as being more risky than another if its associated risk premium is higher. The risk premium of any particular gamble is defined as the difference between the expected income of the risky prospect and the "certainty equivalent" of that prospect, i.e., the amount of guaranteed income which it would take to make the individual just indifferent between the gamble and the sure thing. A hypothetical risk premium is illustrated in figure 4 in the appendix.

One of the theoretical difficulties with evaluating the case for crop insurance is that we cannot say that acting in a risk averse fashion will induce any inefficiencies. As Arrow (1971, chapter 4) has demonstrated, resource allocation will be Pareto optimal so long as risk is completely diffused or shared throughout the economy. (The principle of risk-sharing is illustrated in the appendix.) Complete risk-sharing will induce individuals to act less risk averse than without risk-sharing, but risk averse nonetheless. Therefore, to make the case for crop insurance theoretically sound we must amend 1) above to read as follows: "Low income farmers are too risk averse from a social point of view, i.e., risk-diffusion is incomplete." In addition, we must amend 4) to read: "The efficiency gains of making farmers less risk averse by further diffusing risks via crop insurance are greater than the cost of operating the insurance program."

## II. The Case Against Crop Insurance

### A. *The Irrelevance of Risk Aversion*

Combining items 1-3 above we have the hypothesis that risk aversion inhibits the adoption of efficient (presumably modern) techniques. In many situations however, it is possible that risk aversion exists but is irrelevant for actual choices. For example, it was found that for a sample of Philippine rice farmers, the risk neutral model describes the choice of nitrogenous fertilizer as well, or better, than any of a set of behavioral models which embodied an aversion to the risk that income would fall below some "disaster" level. Furthermore, this result was insensitive to different models and measures of risk aversion. The reason was that, for the technique in question, risk was not sensitive to differences in expected profits. It was generally not possible to reduce risk below the expected profit-maximizing level by decreasing fertilizer below that level. (Indeed, it was more often the

case that risk could be reduced by increasing fertilizer above the level in the risk neutral solution.) The lack of conflict between risk and expected profits is illustrated in figures 1 and 2. Figure 1 shows that risk is generally a U-shaped function of nitrogenous fertilizer. Figure 2 shows that the cumulative frequency distribution (of profits) for

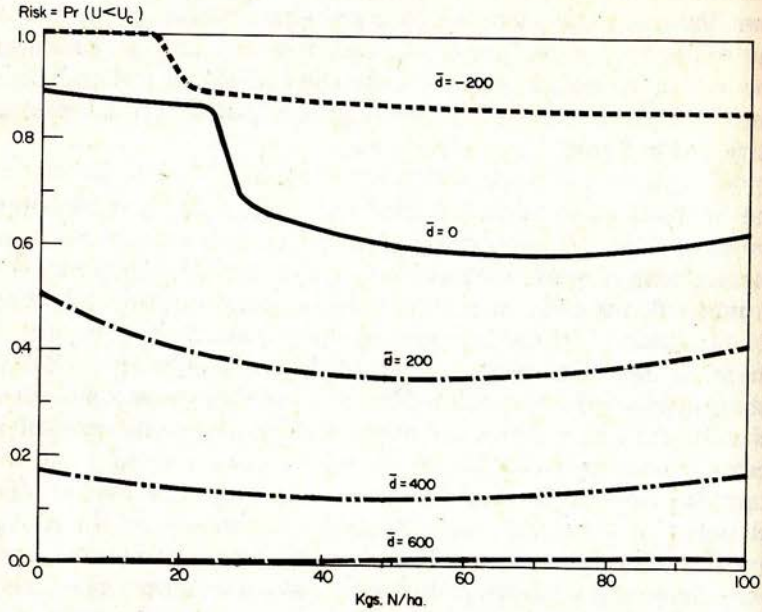


Figure 1. Risk of fertilization at different disaster levels ($\bar{d}$), Biñan, Regime 1.

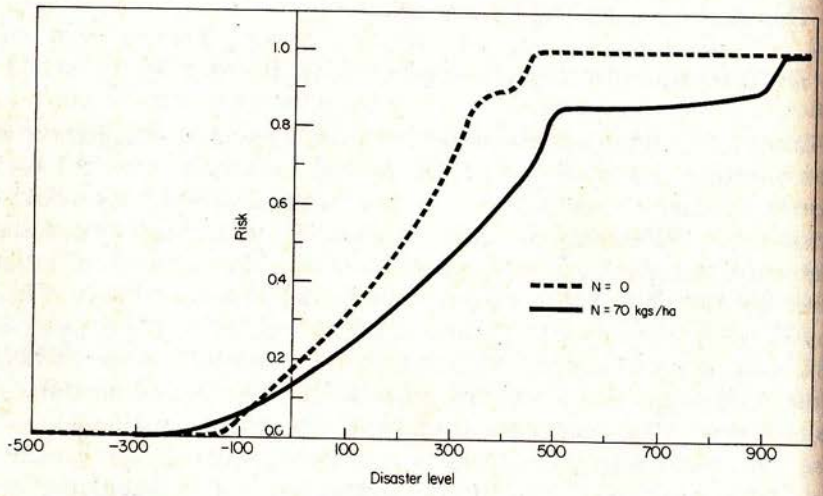


Figure 2. Risk of disaster for two nitrogen levels, Biñan, Regime 1.

the expected profit maximizing level of fertilizer is everywhere above that of no fertilizer except at the extreme left end.[5]

It seems plausible that this same situation is likely to prevail in several other input situations. For insecticide, for example, it seems likely that the input would decrease risk rather than increase it since the purpose of insecticide is to lower the probability of certain unfavorable states-of-the-world, namely insect damage. Nor is it likely that risk aversion has inhibited the adoption of modern varieties. Several authors have shown that diffusion rates of high yielding varieties (HYVs) have been extremely rapid in areas where a clear profit advantage exists.[6]

For other techniques, however, such as fertilization of drought-prone corn (de Janvry, 1971; Moscardi and de Janvry, 1977) and potatoes (Ryan and Perrin, 1973) it appears that fertilization may have a moderate risk-increasing effect. Therefore, we cannot generalize the finding that risk aversion is always irrelevant to choice of technique. Still the combination of factors required for risk aversion to be a major determinant of choice of technique is unlikely to occur with a high frequency. Specifically, what is required is a situation wherein farmers are strongly risk averse and in which the expected profit-maximizing technique is considerably more risky than alternative techniques. In order to demonstrate the importance of risk aversion, one needs to estimate the parameters of a risk averse decision model and show that it outperforms a fully specified risk neutral model for a particular sample of farmers. As discussed elsewhere, studies which have claimed to show the importance of risk aversion have usually misspecified the risk neutral model.[7]

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[5] These results are reported in detail in Roumasset (1976). In that study, however, risk and risk aversion were measured in the context of lexicographic-safety-first models. The hypothesis that risk aversion reduces the demand for fertilizer has been recently retested for the same sample of farmers using an expected utility model. In the latter study actual nitrogenous fertilizer per hectare, N, was regressed separately on the risk-neutral optimum fertilizer application, N*, and the expected utility maximizing amount of fertilizer, N**. The first equation gave a slightly better fit ($R^2 = .58$ vs. .56) causing us to reject the hypothesis that risk aversion inhibits fertilization. (These results are reported in more detail in Roumasset and Setboonsarng, 1978.)

[6] International Rice Research Institute (1975, 1978), David (1975), Herdt and Barker (1977), and Roumasset (1976).

[7] Roumasset (1976, 1977, 1978). Among the common omissions in such

Empirical work in this area still remains scanty, perhaps due to th difficulty of actually measuring risk and risk preferences. Addition studies are still necessary to determine for which type of situation if any, risk aversion may be a constraint in preventing the adoptio of efficient farm practices. Until such studies produce positiv results, however, it is premature to institute policy measures such a crop insurance which are designed to offset the imagined effects o risk aversion.[8]

B. *Limited Potential Benefits of Crop Insurance*

We now turn to 4) above, i.e., the considerations that should b taken into account in assessing the costs versus the benefits of cro insurance. For completeness of the argument, we assume in thi section that risk aversion has a substantial effect on resource alloca tion.

Suppose that the government had a device for perfect risk-di fusion. Arrow's (1971, chapter 4) example of a perfect risk-diffusin device is a stock market wherein shares of all risky assets are bough and sold and with the characteristic that there are at least as many stocks with independent distributions of returns as there are state of-the-world. If risk-sharing is complete, the risk premiums for any asset will be the same for all individuals who hold shares in that asset In this world, all farmers in identical situations would choose the same expected utility maximizing technique regardless of their initial risk preferences. If most people are initially risk averse, then the equilibrium risk premium will be positive across all farmers. A farmer who acted risk neutral in this world would be causing a misallocation

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models are the failure to take account of the covariance between price and yield, learning lags, differences between buying and selling prices, and the dependence of risk on agroclimatic zone and economic conditions. Another, rather unique, fallacy is to define risk aversion as that phenomenon which explains all differences in farmer behavior which cannot be explained on the grounds of an incompletely specified profit maximization model. This fallacy is implicitly committed by de Janvry and Moscardi (1977) although the authors claim to avoid the problem of confounding risk aversion with other explanatory variables by screening out ten (out of fifty-five) farmers who appeared to be using low amounts of fertilizer for other reasons.

[8] We should also note that yield insurance does not necessarily tend to stabilize incomes, especially if price risk is a major source of income risk and since prices are inversely related to yields.

of resources. Thus the proposition that risk aversion necessarily causes misallocation of resources is false.

On the other hand, equilibrium risk premiums are likely to be quite small. Both diversification and risk-sharing reduce equilibrium risk premiums. Thus, to the extent that social wealth is diversified, i.e., that low returns on some assets are offset by high returns on other assets for the same state-of-the-world, then equilibrium risk premiums will be low. Furthermore, to the extent that risk of the nondiversified part of social wealth is shared by a large number of individuals, risk premiums will also be low.

There are a wide range of formal and informal risk-sharing institutions. Insurance markets, stock markets and other financial markets are examples of formal institutions which spread risk. However, informal institutions such as share tenancy and the extended family may be even more important sources of risk-sharing. Thus crop insurance must be viewed only as a supplement to all the other risk-sharing institutions and markets. Furthermore, even with a crop insurance program, risk-sharing is by no means complete. The best we can hope for by instituting a crop insurance program is that risk premiums will become slightly smaller, and as a result, farmers will be slightly less risk averse. Combining the smallness of this effect with the insensitivity of most farming decisions to changes in risk preferences, we would expect the effects of a crop insurance program on resource allocation to be negligible.[9]

### C. *Socially Efficient Risk Aversion*

As discussed elsewhere, much of risk aversion, probably most of it, is created by "market imperfections."[10] Risk aversion is the

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[9] There may be certain pockets where this generalization does not apply. For example, Binswanger (1978a and personal communication) has found that in certain semi-arid parts of Southern India, farmers are generally risk averse and that "modern," cash-intensive techniques are more risky than traditional ones. While these are only necessary, not sufficient, conditions for the validity of the risk-aversion-implies-underinvestment hypothesis, they nonetheless establish the plausibility of that hypothesis. Jodha (1978) has shown moreover that in many of these dry regions, the existing risk-sharing institutions are far from perfect, largely because in times of drought, incomes will be depressed over a fairly large area. This raises the *a priori* possibility that in semi-arid regions crop insurance may have a substantial effect on resource allocation. Sections C and D are written with this possibility in mind.

[10] Masson (1972), Roumasset (1977, 1978).

attitude of hating to lose more than you like to gain. The cause o risk aversion is that the consequences of loss are relatively sever compared to the consequences of gain. But if people had access t perfect credit markets, they would be able to convert a stochasti income stream into a smooth consumption stream by means o borrowing in bad years and lending in good years. In such a worl the consequences of gain and loss would be roughly symmetrical. I the real world, however, borrowing rates tend to be higher tha lending rates due to the costs of financial intermediation, and bo rowing rates tend to rise with the amount borrowed due to th increasing probability of default. As a result, the consequences o loss are not offset by the consequences of gain and risk aversio results.[11]

Risk aversion can be similarly induced by similar "market imper fections" such as differences in buying and selling prices. The cost o buying rice to the farm household tends to be greater than the pric received by farmers for selling rice because of the costs of marketing As a result, the prospect of getting low yields is not offset by th prospect of getting high yields, and the farmer will act as if he is no risk averse. For example, if he is allocating land to one crop which i primarily for subsistence and to a cash crop which has a higher profi rate when sold, he will allocate enough land to the subsistence crop so that his expected yield of that crop is higher than his expected subsistence needs.[12] Thus a farmer who is not inherently risk averse acts as if he is risk averse due to marketing costs which are reflected in differences between buying and selling prices.

For policy purposes it is important to distinguish between ap parent risk aversion which is created by the cost of market exchang and real risk aversion toward lifetime income.[13] It is only the latter that Arrow (1971, chapter 4) has in mind in his discussion of optimal risk-sharing. There are no gains to be had by diffusing risk aversion created by costly market exchange. For example, imagine a world with perfect risk-sharing institutions and sufficient diversification

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[11] Masson (1972).

[12] Kunreuther and Wright (1974) and Roumasset (1977, 1978).

[13] See Masson (1972) and Roumasset (1978) for an explanation of the relationship between risk preferences toward life-time income and risk preferences toward current income.

possibilities such that the social risk premium is zero. Now if a rice farmer who is faced with higher buying than selling prices were to ignore the price difference and act as if he were risk neutral, there would be a misallocation of resources. By ignoring the real cost of marketing, he would be making too much use of the market in the long-run, from a social point of view. Unfortunately, none of the studies which purport to show that farmers are generally risk averse distinguish between apparent risk aversion created by costly markets and real risk aversion toward fluctuations in lifetime income.[14]

### B. *Costs of Crop Insurance*

Against the backdrop of meager potential benefits, what are the corresponding costs of a crop insurance program? For the purpose of the present analysis, it is appropriate to consider the costs of an ideal system of crop insurance. Thus we must first consider the characteristics of such a system. An optimal insurance system can be defined as one which minimizes the sum of the excess burden associated with adverse selection and moral hazard and the costs of partially avoiding those problems.

#### 1. *Adverse Selection and Optimal Screening*

Adverse screening has been described in a provocative article by Akerloff (1970). Using the example of used cars Akerloff shows that since the sellers of cars have more information about the quality of the cars than the buyers, the buyer's offer price will tend to be based on his subjective evaluation of a car in average condition. As a result there will be a tendency for good quality used cars to be held off the market. Once buyers recognize this fact, their estimated condition of the average car on the market will correspondingly lower and so will their offer price. As a result even average cars will tend to be held off the market. In equilibrium, only the market for the worse cars survives, ergo Akerloff's title, "The Market for Lemons."

The same force may be operative in insurance markets. In this case the "seller of risk," i.e., the insuree, has more information about the extent of risk than the buyer, the insurance company. As a result, there may be a tendency for only bad risks to demand insurance.

Adverse selection is not a problem, however, where information is symmetrical, i.e., where buyers have just as much information as

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[14] See e.g., Anderson *et al.* (1977) and Dillon and Scandizzo (1978).

sellers. Thus to the extent an insurance company can discrimina amongst individuals and identify to which risk class each individu belongs, adverse selection can be eliminated. But since gatheri information about individuals and separating them into risk class called "screening," is costly, the insurance company will have t balance the costs of adverse selection versus the costs of screeni The cost of adverse selection is that the "good risks" of each ri class will choose not to buy insurance. Since the individual benefi of crop insurance increase with the number in the insured group,[15] the cost of excluding members from the insured group is that th premiums to the remaining group must rise. Optimal screening occu where the marginal benefits associated with avoiding adverse sele tion equal the marginal cost of screening. In figure 3 below, optim screening occurs at N*.

D2. *Moral Hazard*

Moral hazard refers to the disincentive created when a person be against himself. An insurance policy is an asset which yields a neg tive value in favorable states-of-the-world, i.e., the insurance pr mium itself, and yields a positive value in the case of some subset o unfavorable events, e.g., typhoons, heavy pest populations, an

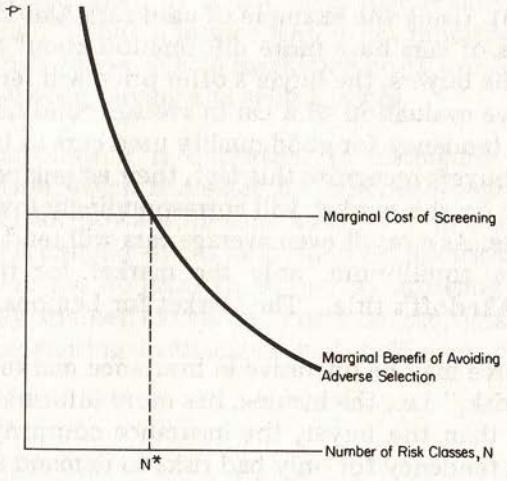


Figure 3

[15] This is a corollary of the proposition due to Arrow and Lind (1970) th the aggregate risk premium summed over all individuals bearing the risk declin with the number of individuals in the risk-sharing group. (See the appendix.)

droughts. But since some of these states of nature are hard to observe, for instance, one may observe the effects of pests on yield but not the incidence of the pests themselves, there is a "confounding of risk and decisions."[16] Since the insurance company will tend to base indemnities on the results of states of nature, i.e., crop yield rather than the states of nature themselves, the insured farmers would have less incentive to avoid the damaging effects of these states than if he were uninsured. For example, he could apply less pesticides.

There are two ways to avoid moral hazard. One is by basing indemnities on the state of nature, e.g., rainfall, wind velocity and pest population, instead of on yields. The cost of such activity is the cost of dividing the farming population into agro-climatic zones and measuring the environmental variables in each area. In practice these areas should be identical to the risk classes referred to above. By tying indemnities to states of nature observed for particular areas, indemnities are independent of farmer behavior, and therefore the problem of confounding risk and decisions is completely avoided, regardless of the scheme for classifying areas. Since the states-of-nature may be hard to measure and combine into a single index, average yield in the area can be used as a proxy for the state-of-nature.[17] This would all but eliminate moral hazard since each farmer would have a negligible effect on average yield, and since tacit collusion to "shirk" inputs is unlikely. The second way to avoid moral hazard is to monitor the behavior of individuals and to base the indemnities partially on the extent to which farmers take suitable precautions against avoidable risks. Such monitoring activity is likely to be extremely costly and dominated by the first method for avoiding moral hazard.

In addition to the costs of optimally classifying farmers into groups, there are also the usual costs of administering the system.

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[16] Arrow (1969).

[17] This is Dandekar's (1977) "homogeneous area approach." The problem with this approach is that "homogeneous areas" are somewhat rare. Even for small contiguous areas, movements in farm yields may not be highly correlated. To the extent a farmer's yield is uncorrelated with average yields in his area, then the crop insurance scheme will not insurance at all. It will simply be adding a random component to income at the cost of subtracting an amount with certainty. Furthermore, if the program is to pay for itself, the amount subtracted from income must be larger than the expected value of the random component which is added.

These will consist primarily of collecting premiums and paying ou indemnities. Administration costs will be higher relative to tot premiums collected the smaller is average farm size.

D3. *Does Government Have A Comparative Advantage in Providi Insurance?*

An advocate of government crop insurance should be prepared t show that risk premiums are too high due to inadequate risk-di fusion, that benefits of further diffusion via insurance are high due t the sensitivity of choice-of-technique to differences in risk prefe ences, and that the costs of government insurance are lower tha these benefits. But this is not enough. He should also show that th government has a comparative advantage in providing the insuranc This requires, in part, answering why, if benefits are greater tha costs, a private company cannot make a profit.

As noted in the previous section, the costs of an ideal insuranc program consist primarily of optimally classifying farmers int groups and administering the collection of premiums and payment o indemnities. But since a government would have to make the sam kind of actuarial calculations as a private insurance company in orde to separate farmers into risk classes, there is no reason to suppos that they could provide insurance at a lower cost than could a privat company. Even if the government has a comparative advantage i collecting information about natural events or yields, it could mak such information available to a private firm.

The one outstanding reason that seems to compel some econo mists to advocate government provision is that government coul make insurance mandatory and thereby eliminate the problem o adverse selection.[18] But adverse selection would only be eliminate by creating problems which are likely to be even worse. Mandator insurance implies that the good risks in each (imperfectly defined) risk class will be subsidizing the poor risks in that class. It would b just as if the government tried to solve the "market for lemons" problem by commanding everyone who owned a used car to sell it a the same price.

Since everyone is not risk averse, the mandatory scheme woul also force a redistribution of income that violates the principles o

[18] Mirrlees (1974), Dandekar (1977).

both vertical and horizontal equity. It would require the risk-preferring, risk-neutral, and mildly risk averse farmers, who get little or no benefit from insurance, to subsidize the substantially risk averse. Furthermore, compulsory insurance would cause the non risk-averse group to misallocate resources. For example, a risk-neutral individual who is forced to buy insurance will subsequently make decisions as if he is risk preferring. In an economy where most individuals are risk averse or risk-neutral this would cause an inefficient allocation of resources. Of course, if actual choices are insensitive to differences in risk preferences, the amount of misallocation will be small. The point is that in a world where risks are imperfectly diffused, some agents make decisions which are too risk averse from a social point of view but some agents make decisions which are not risk averse enough. Instituting a program that makes both groups less averse to risks does not necessarily lead to an improvement in efficiency.

In summary, even in the unlikely event that the expected benefits of a crop insurance scheme exceeded the costs, the government should still be advised not to undertake the program since they have no apparent comparative advantage in administering insurance.[19]

## III. Other Objectives of Crop Insurance

In this section we investigate two other possible objectives of crop insurance — to compensate victims of natural disaster and to induce farmers to try new techniques. We show that while crop insurance can make a partial contribution to both objectives, it is not a cost effective instrument for doing so.

### A. *Crop Insurance as an Instrument of Social Welfare*

One possible objective of crop insurance which is unrelated to risk aversion is to compensate victims of natural disasters. In this view

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[19] Indeed they have a comparative disadvantage since any expansion of government activity, if optimally financed, contributes marginally to tax friction (Musgrave and Musgrave, 1976).

such compensation may be regarded as a public good, and cr insurance may be viewed as part of a country's overall welfare pr gram. That is, the social objective may be equity or income redist bution, not efficiency in the usual sense.

But it is unlikely that the particular pattern of income distributi embodied in a crop insurance program would be considered social desirable. According to the principle of vertical equity, redistributi should involve a transfer of income from the rich to the poor. Cr insurance, if it is unsubsidized, involves a redistribution from farm in low risk situations and with risk preferences not characterized strong risk aversion to farmers in high risk situations and with stro risk aversion. It is unlikely that such a program would involve substantial redistribution across income classes. If the insuran system is subsidized, then the redistribution will be from general t payers to farmers. If a developing country wants to subsidize far ers, however, they should do so in a way which has a major imp on total production. This will directly increase farmers' incomes a indirectly increase the real incomes of the landless poor by lowerin the price of food, which constitutes a major proportion of their to budget.

Furthermore, crop insurance will not compensate victims natural disasters according to their needs. A wealthy farmer wi substantial landholdings will receive large indemnities while sm farmers and landless laborers will receive little or nothing. Thus cr insurance appears to be an inappropriate welfare tool.

B. *Crop Insurance as an Incentive to Adopt Modern Technology*

In Colombia crop insurance is being used selectively to indu farmers to adopt practices which the extension service believes w substantially increase profits. In such cases, crop insurance may be tool of extension. Its purpose is not to diffuse risks but to induce farmer to learn about a new technique. Such a program may justified on efficiency grounds without reference to risk aversion.

Assume that the extension service has a more accurate estimate the frequency distribution of returns for a particular technique th the farmer does. Assume further that the extension service's dist bution reflects a higher probability of high profits and a lower pro ability of low profits relative to the farmer's distribution. Now offering insurance, the extension service can, in effect, shift the far er's perceived profit distribution to the right and induce the farm to accept the recommended technique.

In this view, crop insurance is a substitute for, or at least a supplement to, information about the profitability of the techniques. The extension personnel could simply advise the farmer that his profits will rise with the new technique, but a prudent farmer will not take advice, so easily given, very seriously.

In the Colombian system what is actually insured is the production loan, not the entire crop. If the farmer's net income is below a certain level, say $Y_1$, he is excused from repaying any part of the loan. For incomes above $Y_1$ but less than $Y_1 + L$, the farmer pays back $Y - Y_1$ where Y is actual net income and L is the amount of the loan including interest. For incomes greater than $Y_1 + L$ the farmer pays back L.

The key to successful operation of this type of program is that it is run on a small-scale, selective, and voluntary basis and only offered to farmers for whom the extension service is relatively sure that its recommended technique will substantially increase profits. The indemnity schedule is tied to a particular package of practices. Therefore, the extension service must be prepared to monitor the extent to which these practices are actually followed.

Several things could go wrong if a government tried to implement such a program on a large scale basis. The most important of these is that the extension service would invariably recommend inappropriate techniques for a large number of farmers. Extension personnel tend to be biased toward techniques that are developed at large research centers. But while such techniques are often suitable for farmers with similar conditions as those in the research center, the techniques are often not suitable for farmers in substantially different agro-climatic zones or for farmers who face unfavorable effective prices for outputs and inputs.[20] Furthermore the task of designing appropriate farm plans and monitoring the behavior of most farmers is simply not feasible for a heavily populated agriculturally-based country.

If the purpose of the crop insurance program is to induce farmers to adopt recommended techniques, then a sign of success should be that the insurance program will work itself out of the job. If the techniques recommended are in fact superior, then the extension service will earn a reputation for giving credible advice, and simply

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[20] Baumasset (1976), International Rice Research Institute (1977), Herdt and Barker (1977).

making recommendations will then be sufficient incentive for farmers to at least experiment with the new techniques.

## Summary and Conclusions

It is extremely unlikely that the risk-diffusing benefits of crop insurance would be as great as the costs. First, the combination of circumstances required for risk preferences to make a substantial difference in technique choices rarely occurs. What is needed is a large percentage of strongly risk-averse farmers who have a choice between a risky technique with high expected profits and a substantially safer technique, but one which also has an acceptable expected profit.

Second, even if farming practices were sensitive to risk preferences, the risk-diffusing benefits of crop insurance would be small. Given the existing opportunities for diversification and the formal and informal institutions for risk-sharing, one additional risk-sharing institution would have only a minute effect on the equilibrium risk premium and a correspondingly small effect on resource allocation.

Third, much of risk averse behavior is socially efficient. Risk averse behavior which is created by real costs of market exchange as reflected in different buying and selling prices and different interest rates is necessary for individually rational behavior to lead to optimal use of markets.

Fourth, if the benefits of an ideal system of crop insurance were greater than its costs, a private insurance company could make a profit, and there would be no need for government to be involved. The moral hazard problem can be eliminated by basing indemnities on observed states of nature (e.g., "typhoon insurance") or by basing indemnities on average yields realized in a farmer's agro-climatic zone. Moral hazard therefore is not a source of market failure. Similarly, the adverse selection problem could be minimized by optimal screening. Since the government has no comparative advantage in dealing with the moral hazard and adverse selection problems, there is no apparent need for government intervention. In other words, there is no reason to believe that private profitability is not a good indicator of the efficiency gains to be produced by insurance. Indeed, the fact that private insurance companies typically do not insure crops is evidence that the benefits of crop insurance would be less than the costs. This is especially true for developing countries.

where administration costs are high due to the large number of farmers with small land holdings.[21]

Some economists have recommended that crop insurance be made mandatory in order to avoid the adverse selection problem. But even if the costs of a mandatory program were zero, such a program would probably do more harm than good. Since crop insurance substantially reduces risk, farmers who are not strongly risk averse will now choose techniques which are only optimal for risk neutral or risk preferring individuals. But since the equilibrium risk premium for an economy with risk averse individuals will be positive (though small) these individuals will now be choosing techniques which are not socially optimal. That is, for mandatory insurance, the benefits of making strongly risk averse farmers act less risk averse are offset by the costs of inducing other individuals act risk-neutral or risk-preferring, even though social optimality calls for behavior that is slightly risk averse.

In addition, mandatory insurance redistributes income in an arbitrary way. Farmers who are good risks will be forced to subsidize those who are bad risks, and individuals who are not strongly risk averse will be subsidizing those who are strongly risk averse.

Crop insurance may help satisfy objectives which are unrelated to risk aversion, but it is not an efficient instrument for those objectives. If compensation of the victims of natural disasters is viewed as a public good, then crop insurance will provide some of the necessary compensation. But crop insurance is a relatively expensive way to redistribute income compared to the alternatives, and the individuals who receive the largest indemnities are not those who are in need of compensation. Crop insurance would bestow the largest payoffs to farmers with large land holdings and provide little or no compensation for small holders and landless laborers.

Crop insurance may also be used as a tool of extension. If the extension agent knows more about farming a particular piece of land than the farm operator who has been working the land over a period of years, then crop insurance can be a relatively inexpensive device for convincing farmers that trying the recommended practices is in their own best interest. If several extension agents make recommendations which are not well-suited to particular farms, however,

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[21] Binswanger (1978b).

the government will be faced with both a loss of agricultural produ tivity and a huge bill for indemnities due. Furthermore, the insuran would only be necessary if farmers had very little confidence in th extension personnel. Once confidence is restored there should be n further need for insurance. It is especially important that if insuran of this type is to be used, it should only be used for a few selecte farmers for whom the recommended technique promises a dramat increase in profits.

These thoughts should help dispel faith in crop insurance as risk-reducing panacea and direct attention to the more pressi problems of agricultural development. As a final note it seems appr priate to recall Frank Knight's (1921) dictum that, in an econom based on free enterprise, profit and risk are the carrot and stick progress.

## Appendix: An Intuitive Demonstration that Risk-Sharing Decreases the Aggregate Risk Premium

Arrow and Lind (1970) provide a formal proof of the followi theorem.

> As the number of individuals sharing the returns of a risky ass goes to infinity, if the returns of the assets are independentl distributed from the rest of social wealth, then the total ri premium summed over all individuals in the society goes t zero.

In this appendix we provide an informal and intuitive explanation this result.

Figure 4 illustrates a fifty-fifty gamble involving outcomes A a B and the utility function for a risk averse individual. The ri premium is defined as the difference between the expected incom E(Y), and the certainty equivalent, C.E. (see also Arrow, 197 chapter 3).

Figure 5 illustrates the risk premium for the same individual whe he shares the risk and now owns one-half of the risky asset and fac returns A′ and B′. Notice that expected income is the same but th the risk premium is less than half what it is in figure 4. Thus the su of risk premiums for two identical individuals sharing the risk is le than the risk premium without risk-sharing. As the risky asset

shared with more and more people its total risk premium gets closer and closer to zero.

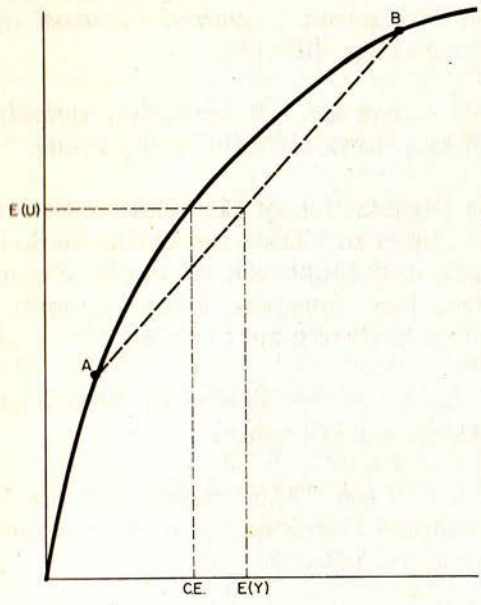


Figure 4

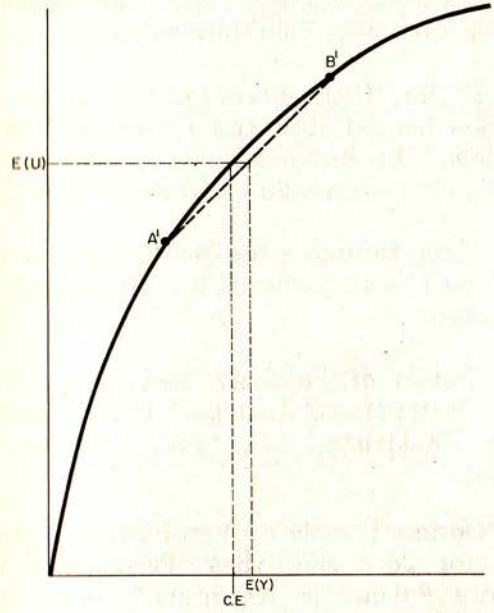


Figure 5

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