

**Rainfall insurance and vulnerability:**  
**Economic principles and cautionary notes**

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**Introduction**

Most poor households live in rural areas and earn their livings from the soil. But agriculture is a risky business, and not only do many households suffer from low average incomes, they also face substantial income fluctuations from year to year. Developing simple, cost-effective crop insurance programs would clearly help.

But good ideas and good intentions have been countered by practical difficulties. Even in the United States it has cost as much as \$5 of public subsidy for every \$1 of insurance provided to farmers (Yaron and others, 1997). The problems are several. First, it's hard to provide crop insurance in a cheap way, since contracts are generally small and damages have to be assessed by insurers on an individual basis; scale economies are thus limited. Second, moral hazard is omnipresent; once insured, farmers have reduced incentives for vigilance in maximizing chances of success. Third, adverse selection undermines the viability of insurance as the farmers in the riskiest situations are the first (and sometimes the only ones) to purchase insurance.

Against that background, rainfall insurance provides new promise. Rainfall insurance seems potentially workable in places where information and incentive problems (adverse selection and moral hazard) have dogged crop insurance. In being a simpler contract than crop insurance, transactions costs should fall too.

The beauty of rainfall insurance is that the insurance company pays clients when rainfall (as measured at a local weather station) fails to reach specified targets. Since rainfall is determined by higher powers than those commanded by the typical client, client behavior and client characteristics have no bearing on the probability of adverse events. The insurer's problem is simplified to setting prices appropriate for the specified weather patterns. With short data series, this is an imprecise science, but at least it is mainly a technical exercise.

The other beauty of rainfall insurance is that in principle the market is open to everyone. With crop insurance, only farmers are clients. But with rainfall insurance, the local cobbler or tailor may want to insure as well and in that way gain a bit of protection from weather-related demand fluctuations.

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This note describes economic principles of rainfall insurance, addressed from the vantage of overall economic and social welfare. It also provides cautionary notes. Issues discussed include reinsurance, basis risk, price effects, and spillovers to other markets.

### **Conceptual perspectives**

The initial excitement about rainfall insurance has come from viewing the innovation from the insurer's perspective. It comes from the possibility of answering these questions affirmatively: (1) Does moving to a rainfall insurance contract allow profitability where crop insurance programs have come up short? (2) Is rainfall insurance easier to run administratively?

A different, complementary perspective is to view the situation in the context of overall improvements in social welfare. Will introducing rainfall insurance enhance the economic efficiency of the economy? To what degree is rainfall insurance likely to address the needs of poor households? Could it ever worsen the lot of poor households? These questions have received far less scrutiny, but the answers are at the heart of the social and development objectives of the program.

Little below breaks new ground conceptually. But since the key issues were not part of conversations I was part of during the World Bank mission to Nicaragua in Summer 2000 (and since the broad concerns were of interest to the Nicaraguan counterparts), I sketch them here.<sup>2</sup>

### **Reinsurance**

There are two big hurdles with rainfall insurance that are often noted. First: reinsurance. On its own, an insurance company will likely have difficulties handling claims made for events (like regional drought) that affect a great many people at the same time. A large company can diversify its portfolio by selling contracts in very different climatic zones, but possibilities are limited in a relatively small place like Nicaragua. Selling part of the portfolio to an international reinsurer provides local insurers with a way to limit their risk to acceptable levels. The down-sides are that the local insurer must do the administrative leg-work involved in collecting premia and disbursing payments, must conform to the wishes of the reinsurer in terms of types of coverage, and then must split a share of profits with the reinsurer. But, as they say, these are just the unavoidable costs of doing business; with skillful negotiation, everyone comes out ahead.

The bigger, practical tension is that the need for reinsurance necessitates scale and sophistication. Unlike microfinance, say, it's not practical to start very small and slowly scale-up; here, the local insurer must start big if they are to entice an international reinsurer to be interested. Things will likely change, though, once the reinsurer is on board and is familiar with the region and products. Then, it should be much easier to entice the reinsurer to expand their business to include other similar local organizations interested in providing rainfall insurance contracts. It is the "first mover" that faces the largest hurdles, and, subsequently, others can reap the positive externalities. It's easy to

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<sup>2</sup> The mission included Mario Miranda (consultant), Paul Siegel (consultant), and Panos Varangis (mission leader). Carlos Arce coordinated the visit for the Ministry of Agriculture of Nicaragua.

see why rainfall insurance is not now common -- even if, once it gets going, it will be seen universally as a vast improvement over what exists. In principle, the coordination failure can be overcome, but in practice information problems hinder efficient solutions.

### **Basis risk**

The second well-recognized problem is basis risk, and this is mostly a technical issue. In much of Nicaragua, variations in elevation translate into widespread microclimates. The frequency of microclimates adds to the idiosyncrasy of rainfall patterns within a region, reducing the correlation between incomes and rainfall as measured at the local rain gauge or weather station. The greater the degree of idiosyncrasy, the less useful is rainfall insurance to potential clients.

There are two forces that combine to create basis risk. First, the local rainfall gauge may simply be too far away to provide data relevant to conditions throughout the region. This can be solved in principle by putting up more rainfall gauges. In practice, this increases transactions costs for the insurer, particularly as premia should be gauge-specific and this requires having historical data on rainfall patterns for every gauge. If data were lacking, using data from nearby gauges would be insufficient – since the problem in the first place is the lack of correlation across gauges. Lack of disaggregated time series data on rainfall patterns turns out to be an important constraint in Nicaragua.

Second, note that typically the relevant gauge of idiosyncrasy is not the idiosyncrasy of rainfall across plots. It is idiosyncrasy in the correlation of rainfall and crop outcomes across plots: a low correlation of correlations. In principle, all farmers could face exactly the same rainfall patterns, but differences in slopes and soil qualities could lead to differences in how the patterns affect yields. This would in turn affect the premia that the farmers would be willing to pay to be covered for *particular* rainfall events. (There is an element of endogeneity here; introducing a given rainfall insurance contract could reduce idiosyncrasy as farmers prepare their fields and choose crops in order to reduce basis risk.) Again, *in principle* this is not a problem. In a fully efficient market with no transactions costs and perfect information, premia will be actuarially-fair and based on the probability of specific rainfall events occurring, with potential contracts against any and all rainfall patterns. In practice, transactions costs (and the likely wishes of the reinsurer) dictate that only a narrow range of rainfall patterns can be insured – the date of onset of the rainy season, for example, or the occasion of serious drought.

From the demand side, the farmer will ask himself why he should tie up his money paying for rainfall insurance when it too often fails to pay out in times of need. Putting funds to less efficient but more flexible uses may be superior – for example, putting money into the bank (or under the mattress). Still, there *are* common shocks, and, *if priced appropriately*, rainfall insurance has to be better than nothing. One question is whether costs faced by the insurer will be low enough to allow them to charge premia at rates low enough that farmers will buy the rainfall insurance despite the basis risk.

These are issues where basis risk matters directly, and the issues are, for the most part, well understood. Below I discuss some ways that basis risk can matter *indirectly*, sometimes exacerbating other tensions.

### **Price Effects**

The first important indirect of rainfall insurance involves possible changes in the pattern and level of consumer prices. In Nicaragua, rainfall insurance is designed to provide support in the event of wide-scale droughts. The idea is that low rainfall is associated with low yields. Of course what farmers most care about is *incomes* (and, ultimately, consumption), and if prices and yields are negatively correlated, risk is attenuated; this has led Newbery and Stiglitz (1981), among others, to argue that yield-based insurance benefits are often over-stated. All the same, prices and yields are rarely close to being perfectly negatively correlated, so rainfall insurance remains a useful weapon to have in the arsenal against risk. Moreover, while net producers can gain from inverse movements of yields and prices, net consumers cannot. One of the advantages of rainfall insurance is that, in principle, it can be sold to anyone interested, no matter whether they are a farmer or not.

But what if everyone is not covered by rainfall insurance or a similar arrangement? (This might be because prices for premia are too high for liquidity-constrained households, for example, or perhaps marketing is ineffective.)

It's useful to turn to Amartya Sen's work on the Great Bengal Famine. He describes how the famine resulted from price increases faced by poor households – in a situation where food availability was not low enough to create famine conditions by itself. The positive side of price rises was mentioned above (they can help stabilize farm incomes by compensating for low yields); this tends to be good for net producers. But it can create large difficulties for landless laborers and others who have no way to gain from price increases.

Landless laborers are often the ones worst off in droughts. Will introducing rainfall insurance improve their lots – or possibly worsen them? An advantage of rainfall insurance over crop insurance is that now landless laborers have the possibility of purchasing insurance against drought, something that's impossible when only crop insurance is being sold. If they buy rainfall insurance, landless laborers will have added purchasing power in times of crisis. This should be a great advantage.

The flip side is that if landless laborers *do not* have access to rainfall insurance (or an equivalent), their plight could be made substantially worse by the introduction of rainfall insurance. Now farmers (who are insured) will have added purchasing power to pay for whatever food and services are available in the market during the drought. Prices will naturally rise, further diminishing the lot of the landless. The landless can be made worse off than in a world without rainfall insurance.

The problem arises because insurance is unevenly distributed. The same could happen with crop insurance of course. Here, though, basis risk creates an extra dimension. Consider just the *rainfall-insured*. Some who are insured may suffer worse than others, but their insurance payout will be the same as everyone else's in the region. Similarly, some who are insured may suffer less and will get the same payout. This is just the luck of the draw, and surely rainfall insurance is better than nothing. But inequality in luck can be exacerbated by subsequent price movements and it is not clear (when there is considerable basis risk) that rainfall insurance dominates crop insurance, warts and all. The role of price effects here has not been investigated to my knowledge, but it is germane to assessing the ultimate costs and benefits of introducing rainfall insurance versus crop insurance (which, without basis risk, is in principle less likely to kick the under-insured when they're down).

The bottom line is that price movements can have important welfare consequences in times of drought. Introducing insurance can effect those price movements, with implications across the income distribution. Rainfall insurance has very positive elements, but, if it is not accompanied by other measures for the poor, it can exacerbate losses for some of the most vulnerable populations. The magnitude of costs and benefits of rainfall insurance is an empirical question and there is no *a priori* reason to assume the worse. But there is an *a priori* reason to be careful about distributional effects.

### **Spillovers to other markets and the second-best: the return of adverse selection and moral hazard**

An often-discussed strength of rainfall insurance is that it eliminates the insurer's concerns about moral hazard and adverse selection. This is certainly so from the perspective of the provider of rainfall insurance. But it's so from a global perspective; introducing rainfall insurance can improve or worsen moral hazard and adverse selection in other markets.

One part of the "theory of the second-best" holds that when markets are incomplete and imperfect, introducing a new market or institution will not necessarily improve global efficiency. Even if the market works well on its own terms, it may exacerbate inefficiencies elsewhere.

For example, provision of rainfall insurance could make informal risk-sharing arrangements work less well. Informal insurance in this example is characterized by the inability to write binding, enforceable long-term contracts. Thus, the arrangements stay together only as long as the expected value of staying true to the arrangement exceeds the value of renegeing and self-insuring. The arrangements weaken when the self-insurance option improves.<sup>3</sup> Rainfall insurance hurts by improving the fallback position for those who renege on their obligations and are thus left to their own devices (which, lucky for them, would now include buying rainfall insurance). Of course, partially displacing

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<sup>3</sup> For useful discussion and references, see Debraj Ray (2000); a related example of "dysfunctional crowding out" in an insurance context is provided by Arnott and Stiglitz (1993, *American Economic Review*).

informal arrangements by introducing rainfall insurance here could, on net, be a good thing, but there will inevitably be winners and losers (Morduch, 1999).

Again, I know of no empirical evidence to suggest that these spillovers will be critical, but they are there in principle and are worth keeping an eye on. The bottom line is that moral hazard and adverse selection remain factors in the economy and providing rainfall insurance is apt to have some bearing on them.

### **Concluding thoughts**

I have sketched places where rainfall insurance can have unintended consequences on social welfare. Many of these instances are no worse than what would occur under crop insurance (and possibly better), but then crop insurance tends to be thin on the ground. As rainfall insurance moves into view, it's important to see what it can do and what it can't. No one thinks it's a panacea, but it *is* promising. In particular, it cuts through many of the problems faced by providers of crop insurance. It is also possible to expand the market to sell to landless laborers, merchants, and others whose livelihoods correlate with rainfall patterns.

The view put forward here is that looking at it just from the insurer's perspective can be misleading and can, possibly, lead to mis-steps. Failure to take into account the broader perspective of social welfare can lead to programs that can increase the vulnerability of some populations, even as others see their conditions improve. As with all major programs, there will be important distributional implications. Among the most important are those tied to general equilibrium price effects and spillovers to other markets. These effects will likely not be obvious at first glance. The next step is empirical assessment and, if warranted, a search for constructive solutions.

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