Weather Insurance in Semi-Arid India

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March 23th, 2005

I. Introduction

Weather risk is a major source of income fluctuations for rural households in developing countries, and shielding consumption from the effects of weather on agricultural profits is therefore vital for farming households living close to subsistence level.

With complete and frictionless financial markets, protecting household consumption from weather shocks would be fairly unproblematic, but rural financial markets in developing countries are fragmented and formal credit markets are, at best, emerging. In practice, although credit is an important means of consumption smoothing, it tends to be complemented by an array of other ex-post risk coping strategies, such as asset sales, remittances from family members and other risk-sharing arrangements. Unfortunately some of these mechanisms may be rather less effective against weather fluctuations because of the aggregate nature of these shocks. For example, during a regional drought, neighboring households will tend to experience declining incomes at the same time, making risk sharing less beneficial. Concomitantly, asset prices will also be likely to fall.

Households can also reduce their exposure to weather risk ex ante. This could occur through precautionary saving, or by income smoothing strategies like implementing more conservative agricultural production strategies, generally exchanging expected profits for lower risk. Production-based risk diversification thus comes at a cost in terms of efficiency, a cost which most likely exceeds the actuarially fair price of being insured against such risk.

Public crop insurance schemes are often available to farmers as a means of reducing the costs associated with crop failure. However, these schemes suffer from both moral hazard and adverse selection and are very costly to implement as payout eligibility is determined by a crop damage assessment for each individual farmer.

An alternative solution is to introduce explicit weather insurance, designed to provide additional income to farmers in times where adverse weather conditions reduce agricultural profits. The design of weather insurance sidesteps moral hazard and adverse selection problems, since payouts are solely based on public data from local weather stations and thus cannot be manipulated by the farmer. This reliance on public data also makes such schemes far cheaper to implement than traditional crop insurance programs. Weather insurance is a novelty in developing countries, made possible by the expansion of the financial sector into rural areas, mostly through microfinance institutions and their outreach to the rural poor, and by the increased willingness of reinsurers to absorb part of the risk assumed by the sellers of weather insurance. These developments represent new opportunities to providing direct risk relief to rural households in developing countries by diversifying local weather risk to the global market. In the long run, the potential welfare implications of the introduction of weather insurance can be substantial, both directly reducing consumption volatility and the probability of starvation, and also allowing farmers to focus on agricultural production strategies aimed at maximizing expected income rather than minimizing risk.

This chapter presents a practical case study of weather insurance by studying a rainfall insurance scheme recently implemented in the state of Andhra Pradesh, India. The chapter first reviews the existing evidence on informal insurance mechanisms used by rural households, as described in the insurance literature on risk sharing and consumption smoothing, with a particular emphasis on the smoothing of weather shocks. Then, we describe the case of a real-world weather insurance scheme implemented in semi-arid India, with focus on its design, institutional set-up, and marketing and sales. We also discuss a new survey of farmers designed to assess the effects of the weather insurance scheme; this survey provides an unique opportunity to study the introduction of a new insurance market using a natural-experiment program evaluation design. Although survey results are not yet available, in anticipation we discuss the expected determinants of rainfall insurance take-up and the possible effects its introduction may have on agricultural production strategies and existing informal insurance mechanisms.

II. Insurance Literature Review

How do rural households cope with risk and income fluctuations? A series of studies have looked at households' ability to smooth consumption through risk coping strategies, thereby insuring themselves against income fluctuations. Rosenzweig and Binswanger (1993) emphasize the useful classification of these into ex-ante and ex-post risk coping strategies. Ex-ante risk management tends to involve income smoothing mechanisms, whereas ex-post risk management focuses on consumption smoothing.

Informal insurance mechanisms

Ex-ante strategies are characterized by diversification of income sources and choice of agricultural production strategy. The agricultural production strategy of the farmer is an important means of mitigating the risk of crop failure. Traditional cropping systems in semi-arid India rely on crop diversification and plot diversification. Crop diversification and intercropping systems are means to reduce the risk of crop failure due to adverse weather events, crop pest or insect attacks. Morduch (1995) presents evidence that households whose consumption levels are close to subsistence (and are therefore vulnerable to income shocks) devote a larger share of land to safer, traditional varieties of rice and castor than to riskier, high-yielding varieties. Morduch also finds that near-subsistence households spatially diversify their plots to reduce the impact of weather shocks that vary by location.

Apart from altering agricultural production strategies, households also smooth income by diversifying income sources and thus minimizing the effect of a negative shock to any one of them. According to Walker and Ryan (1990), most rural households in the ICRISAT surveyed villages of semi-arid India generate income from at least two different sources, typically crop income and some livestock or dairy income. Off-farm seasonal labor, trade and sale of handicrafts are also common income sources. The importance of income source diversification as part of risk management is emphasized by Rosenzweig and Stark’s (1989) finding that households with more farm profit volatility are more likely to have a household member engaged in steady wage employment.

The development economics literature has also identified a substantial range of ex-post risk coping strategies. Buffer stock accumulation of crops or liquid assets, and the use of credit present obvious means for households to smooth consumption. Lim and Townsend (1998) show that currency and crop inventories function as buffers or precautionary savings. A series of papers have examined the role of access to formal credit, informal credit, and transfers through social networks, e.g. Cain (1981), Udry (1994) and Rosenzweig (1988). Ex-post income smoothing mechanisms also exist. These will typically be sale of assets, such as land or livestock, (Rosenzweig and Wolpin, 1993), or reallocation of labor resources to off-farm labor activities. It is argued by Gadgil et al. (2002) that southern Indian farmers are able to quickly shift from 100 per cent on-farm labor activities to largely off-farm activities if the monsoon rains are expected to be poor. The importance of having labor flexibility built into the production strategy is emphasized by Fafchamps (1993) in his analysis of rainfed West-African farmers.

Weather risk makes access to water for irrigation important. Some farmers therefore engage in the risky investment of digging wells. However, with prolonged periods of drought well digging becomes even more risky as many surface water reserves dry out (Walker and Ryan, 1990). Well digging is thus an expensive and risky enterprise with potential high returns, but also a major cause of increased indebtedness among farmers.

Efficiency of informal insurance mechanisms

How efficient are these informal insurance mechanisms in smoothing consumption? A range of papers have tested the complete market hypothesis of the existence of full insurance against idiosyncratic shocks. Townsend (1994) examines villages in semi-arid India, and concludes that there is a considerable degree of consumption smoothing does take place. However, he rejects the strong hypothesis of complete risk-sharing within the village. Similar conclusions of fully or partially efficient informal insurance mechanisms to smooth consumption are found by Udry (1994) in Northern Nigeria, by Jacoby and Skoufias (1998), and Rosenzweig and Binswanger (1993) in semi-arid India, and by Kurosaki and Fafchamps (2002) in Pakistan. However, other studies have strongly rejected the hypothesis of fully efficient informal insurance mechanisms, e.g. in rural Thailand (Townsend 1995), and in rural Cote d'Ivorie (Deaton 1994).

Paxson (1992), Jacoby and Skoufias (1998), and Paulson and Miller (2000) all focus in particular on households' response to income fluctuations caused by rainfall shocks. Interestingly, much of this literature suggests that rural households are able to effectively smooth consumption in response to fluctuations in rainfall. Paxson (1992) finds that in Thailand that 'all extra income due to transitory rainfall is saved rather than consumed'. Jacoby and Skoufias (1998) find using Indian data that even though aggregate rainfall shocks have differential effects on the income of different households in the village, household consumption is insulated from this idiosyncratic component of weather shocks. Finally, Paulson and Miller (2000) find in Thailand that remittances are sensitive to regional rainfall shocks and thus provide an additional source of informal insurance.

Although on the face of it these results suggest the welfare benefits of direct rainfall insurance might be modest at best, several important caveats apply. Firstly, the tests in these papers generally have relatively little statistical power to identify moderate deviations from a permanent income or complete risk-sharing benchmark. For example, Paxson (1992) finds that during the planting season in Thailand, rainfall variation produces almost exactly offsetting effects on household income and household savings, leaving consumption essentially unaffected. But her standard errors are sufficiently large that it is not possible to reject, for example, an alternative hypothesis that the savings response is only half as large as the change in income. Secondly, some results from these papers suggest that in fact households are not well insured against weather risk, for example Jacoby and Skoufias (1998) find that the aggregate effect of rainfall shocks on village income does affect household consumption for two of the three villages studied. Thirdly, these results do not reflect any welfare costs associated with the possibility that farmers smooth risk by selecting excessively diversified (relative to the first-best) ex-ante production strategies. Finally, substantial anecdotal evidence suggests that farmers in developing countries are extremely concerned about weather risk, and even that suicide rates in rural areas are sensitive to the quality of the monsoon.[1]

The overall picture for semi-arid India points towards considerable consumption smoothing through different risk coping strategies to overcome idiosyncratic shocks. However households seem to be less able to insure themselves against aggregate shocks. Adverse weather is a major source of aggregate shocks, in particular can prolonged dry-spells or the delay of the monsoon have considerable negative effects on the harvest yield. These are shocks that affect everyone in the local environment and are therefore harder to diversify locally. The ex-post consumption smoothing possibilities therefore become more limited and households have to rely on the ex-ante capabilities of mitigating the risk.

Rosenzweig and Binswanger (1993), Morduch (1995) and Kurosaki and Fafchamps (2002) analyze the cost of risk on ex-ante agricultural production strategies. They all find considerable efficiency losses associated with risk mitigation, typically due to lack of specialization. Rosenzweig and Binswanger (1993) consider the impact of increasing the weather risk in terms of the start of the monsoon by one standard deviation. They conclude that the poorest quartile of the households would experience a reduction of 35 percent in agricultural profits, whereas the median household would experience a drop of 15 percent in agricultural profits. Variation in the rainfall distribution has a clear negative effect on profit, despite the mean level of rainfall remaining the same. Hence, farmers trade-off income variability with profitability. Likewise, Morduch (1995) tries to estimate a willingness to pay for a risk free stream of agricultural profits, and concludes that given moderate levels of risk aversion, farmers should be willing to give up at least 16 percent of their income to achieve perfect consumption smoothing.

[1] For example, a 2004 BBC news report titled ‘Suicide Spree on India’s Farms’ describes the rise in suicide rates in Andhra Pradesh during the recent three year drought. See http://news.bbc.co.uk/2/hi/south_asia/3769981.stm.

An obvious response to aggregate weather shocks is for rural households to engage in risk sharing with households or institutions from areas where the weather conditions are largely uncorrelated with the local weather conditions. Such extra-regional risk sharing systems have been noted in the existing literature, e.g. through credit and transfers with distant relatives (Rosenzweig, 1988, and Paulson and Miller, 2000); through migration and marriages (Rosenzweig and Stark, 1989); or through ethnic networks (Grimard, 1992). Although these studies find some degree of risk sharing and thus of insurance against weather, none of the systems are so widespread that they cover all households, nor are they even close to provide a fully efficient insurance mechanism. Most households are therefore still left with no insurance against aggregate risks, the main source of which is weather.

In their detailed analysis of the ICRISAT-surveyed villages of semi-arid India, Walker and Ryan (1990) discuss the negative impact of weather risk on rural households. One of their recommendations is to introduce rainfall lotteries as an alternative to traditional crop insurance schemes. By dividing the monsoon season into discrete intervals and allowing the farmer to bet against the accumulated rainfall at the local rainfall gauge for each interval at the start of the season, Walker and Ryan suggest farmers would be able to guard against unfavorable events. The formal weather insurance case study described below essentially puts these principles into action, though payoffs are adapted to the actual cropping pattern of the monsoon season for the most prevalent crops in semi-arid India, groundnut and castor.

III. Case Study: Formal weather insurance in semiarid India

ICICI Lombard, a national Indian insurance company, piloted in 2003 a formal rainfall insurance scheme for groundnut and castor farmers in the semi-arid tropical areas of India. The insurance policy was developed with the technical assistance of the Agriculture and Rural Development Department of the World Bank and was designed as insurance against deficient rainfall. This section describes the design, the marketing and the institutional context of the weather insurance sold in the Mahaboobnagar and Anantapur districts of Andhra Pradesh in 2003 and 2004. Similar products adapted to the specifics of the local environment and the agricultural characteristics were also developed and sold in northern India (rainfall insurance for citrus) and Ukraine (frost insurance for fruit trees).

The Design of the Rainfall Insurance Policy

Two insurance policies were designed, one for each of the two main cash crops in the region: castor and groundnut. These two crops are more profitable than other food crops, like pulses, but they are also more sensitive to drought. In addition, since the seeds are relatively expensive, some farmers purchase them using crop loans, but when harvest fails these loans are often difficult to repay[2], (Hess 2002).

The coverage for both policies is the prime cropping season, the Kharif (monsoon season). The policy triggers, phases and payouts try to maximize the correlation between the economic loss and rainfall events.

The triggers are set in mm of accumulated rainfall, as measured in local weather stations. When it rains less than a certain 1st trigger level within a given period, there is a payout per mm of deficient accumulated rain per acre insured. If the accumulated rainfall is below a 2nd (lower) trigger level, then there is a maximum lump sum payout of the insurance. In order to maximize the correlation between rainfall and crop production, the Kharif season is divided into three different phases, each with its own trigger and payout: sowing, podding/flowering, and harvest. The phases thus follow the stages of the cropping pattern closely and the dates are based on the agricultural calendar. The payout for the full Kharif season in year *t* for one crop is thus given by the sum of the three phase-payouts,

[2] Andhra Pradesh has experienced 3 years of consecutive drought that has resulted in widespread indebtedness among farmers and increasing despair according to national and international newspapers (NY Times June 6, 2004).

$$p_t = \sum_{i=1}^{3}\left(I\left[r_i^{**} < r_{it} < r_i^{*} \right](r_i^{*} - r_{it})\, p_i^{*} + I\left[r_{it} < r_i^{**} \right] p_i^{**} \right)$$

where r_{it} is the actual accumulated rainfall in phase i of year t. The 1st and 2nd trigger levels for each phase are given by r_i^{*} and r_i^{**}, respectively. The payout per mm of deficient accumulated rainfall for each phase is given by p_i^{*}. This payout is only activated when the actual accumulated rainfall lies between the 1st and the 2nd trigger level, as shown by the indicator function. The maximum lump sum payout for each phase is given by p_i^{**}, and this is only activated when the actual accumulated rainfall is below the 2nd trigger level. The payout levels in each phase are different to reflect how critical rain is to having a good harvest. The importance of rain in each phase was assessed with the PNUTGRO model (Gadgil et. al, 2002) and interactions with farmers. In addition to deficient rainfall, in some areas there is also the risk of excess rain towards the end of the Kharif. Excess rains can seriously damage the harvest so the design of the policy for these areas included an additional payout if it rained more than a daily threshold for several consecutive days.

The target clientele is small and medium size farmers that typically own between 2-10 acres of land and have an average yearly income of Rs 15-30,000[3]. Their willingness to pay and other relevant characteristics restrict the choice of the coverage period, the trigger levels and the size of the payouts. While the first trigger is set equal to the crop's water requirement or the average accumulated rainfall of the mandal, (whichever is lowest), the second trigger is equal to the water requirement necessary to avoid complete harvest failure. The amount of the payouts is calibrated to the expected economic loss incurred by the farmer due to rainfall deficiency. If the rainfall deficiency is only moderate, it activates the first trigger level and the insured will receive payouts proportional to the scope of rainfall deficiency. If the lack of rain is substantial, the second trigger level can be activated and the insured will receive a maximum lump sum payout.

[3] This is an estimate provided by BASIX.

The premium is the actuarially fair price, as it is the sum of the average payout, 25 percent of its standard deviation and 1 percent of the maximum sum insured in a year. The latter is a provision for the worst case scenario where the second trigger level is invoked in all three phases of the coverage period. The yearly payout, p_t, is calculated as shown above for every year with available historical rainfall data from each rainfall station[4]. The total number of years with available data is noted by T. The premium is then given by

$$\text{Premium} = (1+0.102)\left((1+0.25)\left(\frac{1}{T}\sum_{t=1}^{T} p_t + 0.25\sqrt{\frac{1}{T-1}\sum_{t=1}^{T}\left(p_t-\overline{p}\right)^2} + 0.01\sum_{i=1}^{3} p_i^{**}\right)\right)$$

where a 25 percent administrative fee to ICICI Lombard and a 10.2 percent government service tax are added.

However, the premium (as given in the above formula) may be too high, especially in the more drought prone areas or areas with high variability in the rainfall, in the sense that farmers may no longer find the insurance policy accessible, despite its actuarially fair nature. Conversations with farmers revealed that they were not willing to pay more than Rs 250 per acre. In this pilot phase, ICICI Lombard adjusted the premium amount in a variety of ways to satisfy this restriction. First, it lowered the weight on the standard deviation. Second, in some instances the premium did not include the 1 percent of the maximum sum insured as a provision for the worst case scenario, but rather 1 percent of the maximum yearly payout ever generated by the rainfall data. Finally, the second trigger level was adjusted in the case of Atmakur.

[4] The actual start of the rainfall series depend on the quality of the data from each weather station, but a minimum of T = 25 years of daily rainfall data is available for all weather stations.

Notice that although the policy is designed for a specific crop, and thus targeted to castor and groundnut farmers, anyone can purchase the insurance, regardless of whether the specific crop is grown or not. In essence, the policy insures against weather related production risk, and as such it may prove beneficial to other rural households in the village[5].

Castor weather insurance in Mahaboobnagar district, 2004

As an example of an actual insurance product sold in 2004, consider the insurance policy for castor sold by BASIX/ICICI Lombard in Mahaboobnagar.

Table III.1 below shows the trigger levels and their payouts as well as the actual accumulated rainfall and the actual payouts for each phase in 2004. The table is divided by mandals, where the weather stations are located. In Mahaboobnagar district, three mandals have reference weather stations, Atmakur, Mahaboobnagar and Narayanpet. All households within a mandal refer to the same weather station and thus all households face the same insurance product, trigger levels, accumulated rainfall and therefore the same actual payouts per acre of crop insured.

Table III.1 BASIX 2004 rainfall insurance: trigger levels and payout per acre of castor.

Mandal	**Premium per acre** Rs	Phase	**1st trigger level** mm.	**Payout per mm deficient rain** Rs	**2nd trigger level** mm.	**Maximum lump sum payout** Rs	**Actual rain** mm.	**Actual payouts per acre** Rs
Atmakur	250	*1*	60	10	25	1500	94.2	-
		2	100	15	5	2000	90.0	150
		3	75	15	30	2500	184.0	-
		*4**	-	-	-	-	4 days	1500
Mahboobnagar	150	*1*	60	10	20	1500	31.0	290
		2	100	15	50	2000	96.0	60
		3	75	15	50	2500	171.0	-
Narayanpet	200	*1*	60	10	20	1500	12.0	1500
		2	100	15	40	2000	84.0	240
		3	75	15	50	2500	177.0	-

Note: Phase 1: June 10 - July 14, phase 2: July 15 - August 28, phase 3: August 29 - October 12.

[5] ICICI Lombard is considering the implementation of a more general rainfall-based livelihood insurance targeting the rural poor households, though the exact details have not yet been developed.

*Phase 4: September 1- October 10 for excess rainfall of more than 10 mms per day for 4-7 consecutive days. Payouts are Rs 1500 for 4 or 5 days, Rs 3000 for 6 days, Rs 6000 for 7 days or more.

In 2004, the premium for insuring one acre of castor in for instance Narayanpet was Rs 200 and the total maximum payout was Rs 6000 in the unlikely event of the 2nd trigger level being activated in all three phases of the Kharif. As it happens, Narayanpet only received 12 mm of rain in the first phase; 84 mm of rain in the second phase and 177 mm of rain in the third phase. This resulted in a maximum lump sum payout of Rs 1500 in the first phase, because the accumulated rainfall within the phase was below the 2nd trigger level of 60 mm. Rainfall during the second phase was also deficient, but only activated the 1st trigger level and resulted in a payout at Rs 240 per acre insured[6]. However, rainfall was above both trigger levels in the third phase. Thus, all insured households in Narayanpet got in total Rs 1740 per acre for their Rs 200 premium, whereas the insured household in Mahaboobnagar only got a total of Rs 350, as the rains were better throughout most of the Kharif.

The payouts for excess rainfall were of Rs 1500, Rs 3000 or Rs 6000 for 4, 6 or 7 consecutive days of more than 10 mm of rain per day, respectively. In 2004, this resulted in a payout of additional Rs 1500 per acre because Atmakur experienced 4 consecutive days of heavy rain.

As can be seen from the above discussion, the insurance company makes sure that the weather insurance policy is tailored for each specific crop and mandal to maximize the correlation of a rainfall-induced harvest failure and the insurance pay-out, i.e. to maximize the probability of actually alleviating the farmer from the weather risk associated with rainfall[7]. ICICI Lombard expects that the payouts will cover 70-90% of the associated economic. However, as is the case with any weather insurance, the buyer bears some basis risk due mainly to the distance between his plots and the reference weather

[6] Rs 240 = (100 mm - 84 mm)*Rs15

[7] ICICI Lombard have plans of improving the 2005 insurance product even more in this direction by capping both the lower and the upper levels of the daily rainfall contribution to accumulated rainfall. This is because very little rain does not add much moisture to the ground since most of it evaporates and excess rain results in flooding. Thus if it rains less than for instance 3 mm, the addition to the accumulated rainfall that day will be 0 mm and if it rains more than say 75 mm, only 75 mm will be added to the accumulated rainfall of the phase.

station and they way rainfall affects the land. The basis risk due to distance, is limited by selling policies only in villages located within a 20 km radius of the reference weather stations.

Institutional Context

In most areas of rural India, the only available formal insurance relating to agricultural production is the public crop insurance scheme. All farmers are required to purchase this insurance if they take a crop loan (typically for seeds) from a state bank. This rule introduces adverse selection in the insurance scheme, as richer farmers are able to self-finance. Since payout eligibility is based on crop damage assessments relative to experimental plots, it requires a team of agricultural extension agents that visit farmers individually if they claim crop failure. This clearly introduces problems of moral hazard, especially if farmers know that payout levels are high. The system is thus inefficient and onerous to the government. In fact, payouts are often delayed for a year and thus provide limited insurance against consumption fluctuations. In addition, the payout levels are based on a three year moving average formula,. From 2000 to 2003 Andhra Pradesh experienced a severe drought, and thus, given the formula, payouts have been very low, although farmers lost most of their harvest.

The weather insurance thus provides a good alternative both to farmers and the government. Farmers get an actuarially fair insurance with swift payouts and little administrative costs. Both the national Government of India and some of the state governments[8] have shown considerable interest in the weather insurance scheme and are discussing possibilities of a national or state coverage with ICICI Lombard.

[8] These include Rajastan, Punjab, Haryana, Uttar Pradesh, and Himachal Pradesh

Although ICICI Lombard designs the insurance policy, it lacks the local infrastructure to sell them. Therefore, ICICI Lombard has teamed up with a young and dynamic microfinance institution, BASIX. BASIX has marketed and sold the rainfall insurance on behalf of ICICI Lombard against a provision for each insured acre of either castor or groundnut.

BASIX was among the first microfinance providers in India, established in 1996. It now works with over 190,000 poor households in 44 districts and 8 states of India and has been a rapidly growing institution[9]. It strives to integrate the provision of microfinance, in particular micro-credit, with technical assistance and now also with micro-insurance while at the same time maintaining a sound business and high repayment rates. Since defaulting loans in rural areas tend to be highly associated with drought and failed harvests, BASIX has a clear incentive to market and disperse rainfall insurances in particular to their own clients.

One very attractive feature of a weather insurance is that part of the risk can be reinsured in the world weather market. However, international reinsurers will only write contracts with reference weather stations that meet certain criteria. The Indian Meteorological Department (IMD), with historical data on daily rainfall dating back to the 1960s, satisfies these criteria. As already mentioned, the ICICI Lombard policies are referenced to the mandal weather stations, not IMD stations, so ICICI Lombard can reinsure the portfolio risk as measured by the IMD stations closest to the mandal stations and only bear the risk attributed to the differences in measured rainfall between mandal and IMD stations. Another attractive feature of weather insurance is that a certain degree of portfolio diversification can also be achieved if weather events are not correlated across stations[10].

The Marketing of the Weather Insurance

[9] See www.basixindia.com
[10] Given that ICICI Lombard only has a pilot in AP, there is presently limited scope for portfolio diversification.

The insurance product was piloted in Mahaboobnagar and Anantapur districts of Andhra Pradesh in 2003 and again in 2004. In 2003, the weather insurance was sold to 148 farmers in 2 villages, mostly to members of borewell users associations. In 2004, the product design was improved, the marketing was intensified and expanded to new areas. The insurance was sold to 315 farmers individually in 43 villages covering 570 acres of crop and insuring a total sum of Rs 3,409,200 equivalent of Rs 10,822 per farmer or roughly USD 240 per farmer[11].

Table III.2 Sale of weather insurance in Mahaboobnagar and Anantapur, 2003 and 2004.

	Number of buyers		**Number of which were BASIX clients**		**Number of acres covered**		**Total sum insured (Rs)**		**Number of villages**	
	2003	**2004**	**2003**	**2004**	**2003**	**2004**	**2003**	**2004**	**2003**	**2004**
Rain gauges of Mahaboobnagar district										
Atmakur	56	32		27		83		498,000	1	4
Mahaboobnagar		75		26		128		768,000		12
Narayanpet	92	125		90		199		1,183,200	1	12
Rain gauge of Anantapur district										
Hindupur		83		50		160		960,000		15
Total	**148**	**315**		**193**		**570**		**3,409,200**	**2**	**43**

According to the 1991 census of IndiaStat, the villages in Mahaboobnagar district have on average 230 farming households out of 320 households, while Anantapur villages district have on average 350 farming households out of 540 households. Thus with average sales 7-8 farmers per village (villages where no policies were sold are not included above), there is still ample scope for improved marketing. However, it should be noted that the insurance product is still being piloted and the villages are likely to go through a process of learning about the product.

In 2004 there was considerable variation in the take-up per village and BASIX sold between zero and 45 policies per village. This variation is partly due to the marketing process. There are 4 main criteria based on which the villages are chosen for marketing the insurance: There must be (i) BASIX customers residing in the village to ensure that there is some degree of trust in the institution; (ii) preferably 200-

[11] Using an exchange rate of USD 1 = Rs. 45

300 of acres of groundnut and/or castor in the village to ensure that there is a market for the weather insurance; (iii) a reasonable number of small and medium size farms with 2-10 acres of land each; and (iv) less than 20 km to the nearest rainfall reference station.

A list of villages matched these criteria, but due to late finalization of the insurance policy design, the marketing was conducted in a very short time span and not all villages were reached. BASIX had only 10 days to market and sell the insurance product before the start of the Kharif season and thus of the coverage period. The strategy was to talk first to a trusted opinion leader or progressive farmer in the village and explain the insurance product to him. He would then function as the motivator in the village and inform his fellow villagers about the product and an upcoming marketing meeting a few days later. At the marketing meeting a list was made of the attendants and after a general introduction to the insurance product at the meeting, interested attendants would then be visited by BASIX representatives in their home. Policies were sold during these home visits. Apart from the initial visit to the chosen motivator, BASIX agents would spend one day in each village for marketing and sales.

The large differences in take-up rates are therefore, according to BASIX, likely to be associated with the choice of the motivator, his understanding of the insurance product, his respect in the village and own interest in the insurance; with the prior presence and knowledge of – and thus trust in – BASIX in the village; with the number of rainy spells prior to and on the day of marketing (it being hard to sell a weather insurance against lack of rain on a rainy day); and finally with the cash availability among farmers at the day of the marketing, as farmers in some villages had just received payments for their milk delivery and therefore had cash in hand, whereas in other villages, in particular in Anantapur, government subsidies to groundnut seeds have just been released and most farmers had spend their savings purchasing seeds.

A more general problem encountered during the marketing process was that the timing of sales coincided with the period in which farmers need to purchase seeds and other inputs for crop production. It was exactly the time of the year in which farmer are in most need of cash and when savings from the previous Kharif harvest are running low. In addition, the insurance product itself is very complex. It covers 3 periods and payouts are decided by the end of each period. Payouts can take two forms, either as payouts per mm of deficient rain or a lump sum pay out. As discussed above, this is done to tailor the product as carefully as possible to the situation of the farmer, but it also requires considerable explanation. Finally, most farmers have no understanding of millimeters of rainfall; their measure is based on soil moisture. The marketing job of the field agent is thus by no means easy, and some degree of learning should be expected.

IV. Expected take-up and impact of the formal weather insurance

In order to study the actual take-up and analyze the possible impact of the weather insurance provided by ICICI Lombard in semi-arid India, a household survey is currently being fielded by ICRISAT and World Bank. The survey covers a total of 1073 households, 748 households from villages where the insurance was marketed and 325 households from control villages, where the insurance was never marketed. The control villages are on the list of possible villages for marketing, but due to the 10 day time constraint of the marketing process, BASIX did not have time to go everywhere. The control villages thus comply with the four requirements mentioned above for qualifying as a possible marketing village, although the BASIX entry into these control villages might be more recent than in some of the villages where the insurance was actually marketed.

Within each of the marketed villages, there will be a group of buyer households and a group of non-buyer households. Among the non-buyers, some knew about the insurance because they participated in the marketing meeting, but decided not to buy it and others did not know about the insurance at the time of sales and therefore did not buy. The sample will include a total of 282 buyer households and 466 non-buyer households from the marketed villages. In total 38 villages will be covered, sampling a minimum of 25 households in each.

Determinants of the insurance take-up have to be studied by analyzing the characteristics of buyers and non-buyers in the marketed villages, whereas impact of the introduction of a formal insurance has to be studied by comparing buyers and non-buyers in the marketed villages and in particular by comparing buyers in marketed villages with similar farmers, i.e. potential buyers, in control villages. With the first 2004 round of data collection, it will be possible to conduct a detailed analysis of take-up, whereas only limited conclusions are likely to be drawn with respect to the impact of introducing a formal insurance. Impact is not likely to be instantaneous and therefore future rounds of data collection will be necessary to determine how the availability of a formal insurance affects risk coping strategies and the informal insurance mechanisms of the households.

What is expected to determine take-up of the formal weather insurance?

The demand for the formal insurance product will depend on each individual farmer's willingness to pay for insurance against weather risk and on the correlation between actual payouts and economic losses from adverse weather events. There is thus a range of factors which are likely to determine each farmer's decision to buy insurance.

First, personal characteristics of the farmer such as the level of risk aversion and impatience (discount rate) will be important. Other things equal, we should expect risk averse and impatient farmers to be more likely to purchase insurance.

Second, the insurance policy is priced according to historical rainfall data. However, the farmer's weather perceptions and expectations may not coincide with the historical data. If the farmer's weather perceptions do not coincide with the historical data, he or she may perceive the actuarially fair premium to be too low (if the farmer is pessimistic) or too high (if the farmer is optimistic). By eliciting the farmer's weather expectations and past experience in the survey questionnaire, it will be possible to compare how closely the farmer's weather assessment compares to the local historical rainfall data, as well as how optimistic he or she is about future weather events.

Third, it is important to understand what current risk management strategies are. If the farmer has an array of ex-post strategies available, such as buffer stocks, credit access and asset holdings, his ability to smooth consumption and absorb even aggregate shocks might be such that he or she has little interest in purchasing a formal insurance policy. However, if his ex-post risk coping strategies are more limited and he relies more on informal insurance networks with fellow villagers, a formal insurance against aggregate weather shocks might be a relatively attractive solution to ensure consumption smoothing in such adverse events. Furthermore, any farmer that relies on ex-ante risk coping through his production strategy should stand to gain from the introduction of a formal insurance for two of the main crops. The production diversification can be costly in terms of efficiency loss, sacrificing profitability for lower income variability. As mentioned above, this is especially the case for the lower quartile of the wealth distribution, because these farmers are less capable to smooth consumption ex-post and therefore have to smooth income ex-ante as much as possible. One prediction would therefore be that the formal insurance is relatively more attractive to the asset-poor households.

Fourth, a key determinant for the take-up of the insurance product is the farmer's ability to understand its terms and conditions. From the pilot testing of the survey, it became clear that not all farmers understand the concept of insurance, or the units in which the triggers are specified. That, in itself, could prevent farmers from buying an insurance product that would otherwise be attractive.

Finally, other external factors such as cash availability on the day of sales, basis risk in terms of distance to the rain gauge, and whether or not the farmer is able to irrigate his plots are all obvious factors that should be expected to affect the demand for the insurance.

What impact should be expected from the introduction of formal weather insurance?

With the introduction of the formal insurance, the crops mix should change as cash crops which used to be profitable, but risky, will now be safer. One should thus expect a shift in the cropping patterns towards the insured crops. By reducing the degree of riskiness in agricultural production, farmers will resort less to ex-ante risk coping mechanisms. One should therefore expect increased specialization and higher profits, as farmers focus on maximizing the output of the insured crop, rather than on diversifying the weather risk through the cropping system.

Furthermore, the need for ex-post risk coping mechanisms is reduced. This may have several effects. First, there is less of a need for consumption credit to smooth consumption. The demand for credit might thus drop for some households, whereas other might decide to use their creditworthiness for investment loans rather than consumption loans. Coupled with improved profit margins, this could spur agricultural investments.

Second, with a reduced need for ex-post risk coping mechanisms, there will also be less of a need to keep crop inventories as buffer stocks. Farmers will therefore be able to decide when to sell his harvested crops based on market prices rather than on his need for consumption, thus optimizing income from sales rather than smoothing consumption.

Third, with a reduced need for credit and transfers, the informal insurance networks could be affected. Depending on the inherent nature of these networks, it might result in a change of members: households who previously were outsiders, might now qualify as insiders if they are insured; or it might result in a partial dissolution of these networks, because their arrangements weaken when the possibilities for self-insurance increase, see Morduch (2003).

Finally, Morduch (2003) also points out that there might be distributional effects through the prices as a consequence of the insurance. The purchasing power of the insured will not drop as a consequence of an adverse weather event, whereas it most likely will for the uninsured. The higher purchasing power of the insured will keep prices high and thus negatively affect the uninsured.

V. Preliminary Findings and Conclusion

During the pilot testing of the survey in Mahaboobnagar, it became clear that weather is indeed the main source of risk in this area. And with it another important issue emerged, the risk of unsuccessful investments in well digging. Among the 30 interviewed farmers, many had tried digging for a well in their lands, and many had failed despite a number of attempts. They were thus facing zero returns on their investment and unpaid bank loans. Deficient rainfall is thus driving some farmers into risky investments with potential high returns. The question is whether access to formal weather insurance will reduce the incidence of well-digging attempts.

It was also clear form our conversations with farmers in the 3 villages we visited, that the choice of marketing through a motivator can be crucial for subsequent sales. It was clear to all who were among the progressive farmers in the village, and their production strategies were looked upon by others as examples to follow. Furthermore, there was widespread membership of self-help groups, both for men and women. The groups functioned primarily as a source of information dissemination, especially among farmer, and the women's groups as sources of credit through chit funds. Both the progressive farmers and the self-help groups would thus be important entry points for the introduction of new technologies, including weather insurance, into these villages.

Substituting existing crop insurances with weather insurance in India will thus not only introduce a more efficient and low-cost insurance scheme for the Government, but it will also provide a more transparent and actuary fair insurance product to the farmer. By providing direct risk relief to farmers, they will be able to alter their production strategies towards maximizing output, rather than diversifying risk, and to shift their demand for credit from consumption loans to investment loans. This is likely to result in increased specialization and investment, and thus contribute to increased profits and the wellbeing of the rural population.

VI. References

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