Innovations in Index Insurance for the Poor in Lower Income Countries

Jerry R. Skees

This article focuses on innovation in weather insurance designed to fit the special circumstances of the poor in lower income countries where rural and agricultural financial markets are largely underdeveloped. Index insurance is an innovation that circumvents many of the fundamental problems that hamper the development of insurance for weather risks in lower income countries. With index insurance, payments are made based upon an objective and independent *index* that serves as a *proxy* for significant losses to crops, livestock, or other property. For example, the index can be based upon extreme rainfall measures that create either drought or flooding. Weather stations or even satellite imagery coupled with computer models can be used to create reliable "indexes" as the basis of payments. This article reviews this innovation by providing the background for its development and the motivation for using the innovation for the poor.

Key Words: index insurance, financial innovation for the poor, weather insurance, correlated risk, poverty trap, ex ante risk management

This article examines an innovation in risk mitigation—index insurance for weather risk. To establish the context and justification for insurance interventions, the article first explores the nature of risk and, specifically, the impact of weather risk on agricultural enterprises and rural households. Agriculture remains a dominant economic activity for the poor in many lower income countries, comprising more than 40 percent of the work force on average. Furthermore, some 60 countries had more than 20 percent of their gross domestic product tied to agriculture in 2004 (World Bank data set). In the economic development literature, there is increasing recognition that the lack of rural financial markets for the poor is one reason so many poor are locked into poverty [Anderson 2002, Barnett, Barrett, and Skees (forthcoming), Barrett and McPeak 2005, and Carter et al. 2005].

This article first examines the effects of weather on income, behavior, and economic activity, and why weather-based agricultural insurance is needed in lower income countries. To provide background to the need for innovation in agricultural insurance, the article also provides a brief review of traditional agricultural insurance mechanisms used in higher and middle income countries, and the limitations to using those mechanisms in lower income countries. Next, the article explores how index insurance works, the advantages, constraints, and preconditions to developing these products, and the role of government and donors in supporting development of index insurance.

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The article closes with a discussion of the applications for index insurance and a look to the future.

For simplicity, the products discussed in this article are referred to as index "insurance." Nevertheless, as explained later, national regulatory agencies differ in how they define the term "insurance." Thus, these products may not be considered insurance products under every system (Hazell and Skees 2006).

Effects of Weather Risk in Lower Income Countries

In agriculturally dependent economies, weather is a significant factor for economic well-being. Particularly in areas of rainfed agriculture, variations in the weather are a major determinant of agricultural production. While variations are expected, natural disasters such as torrential rain, flooding, and prolonged drought can devastate a rural economy by damaging the major source of household, regional, or national income. Where there are no mechanisms in place to protect against large losses from extreme weather events, income and economic activities are likely to be depressed. Unmanaged weather risk can contribute to poverty and inhibit development. Beyond the immediate effects of a disaster, the chance, or risk, that a disastrous event will occur influences behavior and economic activity in the following ways:

- agricultural households can experience loss of income and assets,
- agricultural households will choose low-risk, low-return activities, and will not risk investing in technology,
- financial institutions may restrict lending to farm households, and
- overall investment in the rural sector may be deterred.

Weather-related disasters can quickly destroy sources of current income such as growing crops. Even more devastating, they can also destroy household assets—often accumulated over years of savings and productive investments—that are needed to generate future income. In lower income countries, an extreme weather event can push rural and smallholder farm households, often with few resources, into a cycle of poverty, as illustrated in Figure 1 (Carter et al. 2005).

Figure 1 shows the asset positions for two hypothetical households: A and B. Initially, both households experience upward growth in their asset level and income, though B is still close to the poverty line. If a catastrophic weather event takes place, both households may experience an immediate decline in their assets and income due to loss or damage to productive assets, or to the cost of recovery. Household A retains more productive assets and is therefore able to recover more quickly. For a poorer household, such as B, the depletion of assets may push the household below the poverty line. Once the asset position of a household falls below the poverty line, its recovery may be slow or it may be unable to generate sufficient new income to rise above the poverty level and regain its previous economic position. This situation is referred to as a poverty trap because once households on the margin slip into poverty, they often lack the assets needed to improve their economic well-being. Weather insurance that targets poorer rural and farm households could help households avoid the poverty trap by compensating for weather-induced losses, thus enabling lost productive assets to be replaced and stimulating faster recovery.

Recognizing the potential for losses from weather events beyond their control, households that are highly vulnerable to shocks often manage risk by engaging in low-risk strategies that have lower expected return. This decision reduces the financial risk but also prevents the household from pursuing activities that would generate more income. While low-risk strategies such as crop diversification and supplemental off-farm employment may have less income variability, the prospects for economic growth are also much lower than would be the case if the household were investing in more profitable activities (Anderson 2002, Dercon 2004, Carter et al. 2005). Livelihood strategies with the prospect of a higher expected return would involve investments in productive assets—such as farm improvements, intensification, new technology, and education—in addition to start-up costs associated with new endeavors. These higher-return strategies are risky because limited resources would be invested in something that has an uncertain return in the presence of a potentially destructive weather risk.

Still, in many cases low-risk, low-return strategies are not entirely effective at reducing exposure to extreme weather risk. For example, in

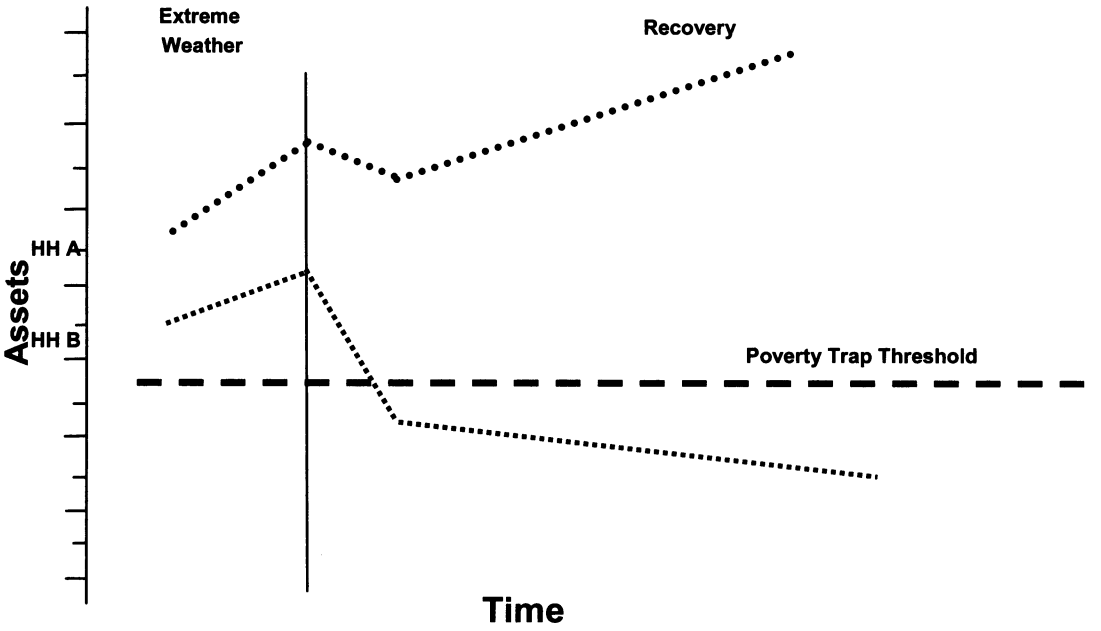

Figure 1. Economic Impact of a Natural Disaster on Households with Different Asset Positions
Source: Adapted from Carter et al. (2005).

many countries it is common practice to hold livestock as an asset that can be used to smooth income and manage risk. In the event of an illness or a minor economic downturn, some of the livestock can be sold to support the household's basic needs (Dercon 1996). However, if a loss event is serious and widespread, and affects many households in the same area—like drought—too many livestock enter the market at once, lowering the value of the asset just when it is most needed. In addition, holding livestock as an asset can be an unreliable strategy because livestock are also susceptible to weather risks (drought, floods, and freezes).

Households employ a variety of other mechanisms to reduce their risk or to cope with a financial loss. Informal loans made by relatives, other members of the community, or moneylenders are another common way in which households can access cash following a crisis. Though the interest on informal loans is often much higher than a bank rate, informal loans are more accessible to the rural poor. These strategies, while not necessarily economically efficient, do allow rural households to deal with temporary economic hardships resulting from illness, injury, or some other unexpected expenditure. However, when a major weather-related disaster strikes, these informal strategies often break down as correlated catastrophic losses occur. If an entire community experiences disastrous weather effects, the social networks that could be relied upon for assistance may be unable to offer support because all members may be experiencing hardship. It is difficult to help your neighbor when you are also suffering from the same event.

Financial institutions and other enterprises are cautious about extending credit to rural households and agricultural enterprises beset by weather risk. Though there is potential for growth in rural areas and the agricultural sector, the potential for widespread economic loss in these areas is an inhibiting factor. Restricting the amount of investment in the agricultural sector is one way for a bank or other enterprise to reduce exposure to these risks. Underinvestment in the agricultural sector is a rational yet inefficient way to reduce exposure to weather risk.

Without access to more efficient alternatives such as insurance, inefficient strategies may be the only choice for rural households to cope with their risk and for financial institutions and other

enterprises to protect their business investments. The strategy of risk avoidance and conservative investment behavior may be effective at reducing risk exposure to some extent; however, the trade-off, or cost, is that opportunities for growth are hindered. Research from Tanzania suggests that rural households faced with exposure to major shocks may give up 25 percent of their potential income by adopting less risky strategies (Dercon 1996). Rosenzweig and Binswanger's (1993) work in an Indian village suggests that this "risk premium" is as high as 50 percent.

Weather risks are unpredictable in terms of both frequency and severity. The uncertainty surrounding when a damaging event could occur and what its effect might be can deter investment and growth. Individuals or enterprises may be unwilling to invest their limited resources in opportunities that promise higher expected returns if there is also a risk of total or partial loss. Insurance is one way to remove some of the uncertainty about future economic status. Individuals will be more willing to invest in economic activities that offer higher expected returns if they can use insurance to protect themselves from potential losses resulting from an extreme weather event. Insurance is a way to reduce operational risk, making it possible to take more financial risk to finance new technologies, education, or infrastructure [Barnett, Barrett, and Skees (forthcoming)].

Why Weather-Based Agricultural Insurance Is Needed in Lower Income Countries

There are a number of positive benefits that weather insurance could offer in helping rural households mitigate risk, including improving their access to rural and agricultural finance. In place of these viable formal alternatives, many of the strategies used by rural households in lower income countries to manage weather risk are inefficient and inconsistent with longer-term growth objectives. Various informal strategies for coping with correlated risk, such as mutual aid networks and semi-formal microfinance activity, can suffer from many of the same challenges that make it difficult to develop formal financial markets.

There are also significant benefits in finding mechanisms that will allow lower income countries to transfer weather risk into global markets. Depending on the type of product developed, households, intermediaries such as rural banks or agribusinesses, and even national governments should be able to benefit from weather insurance (Hess et al. 2005, Skees and Barnett 2006).

Weather Insurance Can Spur Rural Financial Markets by Transferring Risk

Formal-sector financial services in higher income countries include a wide array of opportunities for saving, borrowing, and insuring to manage risk and plan for a more secure future. Each of these three complementary components is needed for rural financial markets to be effective. Following a loss event, households may borrow money to smooth consumption or replace lost productive assets. However, many of the poor in lower income countries simply cannot borrow due to a lack of available financial services, credit history, or collateral. Savings and insurance solutions are activities that occur before the onset of a loss event. For some types of insurance, the only requirement is to pay the premium. Thus, in some cases, insurance can be obtainable by the poor who have no ability to borrow. It is also possible that insurance could serve as a substitute for collateral. Financial services provided by the formal sector can prove to be less costly and more efficient than many of the informal risk-coping strategies used by the rural poor as described above.

Access to rural finance is increasingly acknowledged as a means to help alleviate the persistence of poverty traps in lower income countries. The practice of microfinance entities making small loans to the poor is growing. To the extent that these small loans are made to individuals on the margins of poverty, there will be significant repayment problems when their livelihoods are affected by natural disaster. Given that many natural disaster events are widespread and affect many people at the same time, the correlated losses of the individuals have the potential to create a significant default on the portfolio of micro loans. For example, in the northern regions of Peru, El Niño events such as the one that occurred in 1998 can cause major flooding. While not entirely tied to El Niño, following the last such event, default rates on microfinance loans increased from a rate of 8 percent to nearly 18

percent in the northern department of Piura. It is a common banking practice to both restrict access to credit and charge higher interest rates when these types of risks are present.

In short, correlated risks from weather events can be a major constraint to the development of formal financial services. The banking systems of most countries are not designed to absorb natural disaster risk. Natural disaster risk must be transferred into a global market to be diversified into a global portfolio of insurance risks. Thus, insurance markets can be the missing link for stronger development of rural finance. Financial institutions in lower income countries should be more willing to provide credit to rural and farm households that have weather insurance because these households will be able to utilize insurance indemnity payments to repay their loans. Weather insurance products could also be used by the financial institutions themselves to protect their portfolios against excessive loss due to defaults associated with extreme weather events. This protection should also improve institutions' willingness to provide credit to agricultural enterprises and rural households. Skees (2003), McCord (2003), and Skees and Barnett (2006) address the possibilities for linking index insurance to agricultural and micro lending.

Weather Insurance Can Support Development and Improve Government and Donor Response to Natural Disaster in Lower Income Countries

Using weather insurance to manage the risk of catastrophic weather events should stimulate economic development by improving stability and opportunities for growth in the agricultural and financial sectors. Weather insurance can also be used to improve government and donor response to natural disaster by providing quick access to resources for disaster relief and recovery needs.

Natural disasters can depress economic output, damage infrastructure, and increase fiscal demands on governments and donor organizations. Weather insurance for quick response for emergency assistance can have an immediate impact on reducing vulnerability to weather risk in the following ways:

- protecting rural livelihoods, thereby reducing poverty,
- protecting the productive capacity of rural enterprises and farm households,
- protecting financial institutions against weather-related loan defaults, and
- financing disaster relief and encouraging social safety net policies.

When resources are limited, disaster response may cause financial resources to be diverted from other budget allocations and programs. Over time, other potential benefits can emerge that contribute to development, including the following:

- promoting investment in higher-return activities among rural households,
- expanding rural finance through improved access and better terms of credit for farm households and agricultural enterprises, and
- providing a mechanism to manage the most costly source of risk, so that government funds can be used for other social purposes during a natural disaster.

Traditional Agricultural Insurance

Traditional crop insurance mechanisms used in higher and middle income countries are not suitable or even feasible for lower income countries. Besides inherent constraints associated with these mechanisms, most of these traditional crop insurance programs are subsidized to lower the cost of the premiums. In addition, farm households make up a small fraction of the population in most of the countries that provide subsidized crop insurance. The same is not true in many lower income countries, which makes it even more unlikely that lower income countries can afford to adopt the practice of subsidized crop insurance.

Constraints to Traditional Weather Insurance

As mentioned, weather risk is often correlated risk and can be a major constraint to the development of formal rural and agricultural financial markets because a widespread, severe weather event may result in excessive loan defaults across the affected area (Skees and Barnett 2006).

Since traditional approaches to insurance attempt to assess the risk of the insured individual, this can be an expensive undertaking subject to many administrative problems, especially for farm-level agricultural insurance. Two dominant problems associated with using traditional insurance at the farm level are adverse selection and moral hazard. Adverse selection occurs when potential insurance purchasers know more about their risks

than the insurer does, leading to participation by high-risk individuals and non-participation by low-risk individuals. Moral hazard refers to the careless, irresponsible, and even fraudulent behaviors of the insured after they purchase the insurance.

Insurance is a business that depends upon trust. Insurers deal with adverse selection and moral hazard by incurring more cost to obtain more information, and charging higher premiums, or not insuring at all. The financial goal of any insurance program is to operate on an actuarially sound basis, where indemnities paid out and the cost of operation (including profits), on average, equal total premiums collected.

Two Types of Traditional Crop Insurance: Named Peril and Multiple Peril Crop Insurance

Most agricultural insurance is traditional insurance that makes an indemnity payment when the farm household incurs a loss. To pay indemnities, the insurance provider must make estimates of loss for each farm household that makes a claim. Most of this discussion focuses on forms of crop insurance. Insurance for livestock is of a different class because weather events are not generally the major risk for livestock.

There are two dominant types of traditional crop insurance: (i) named peril, and (ii) multiple peril. Named peril insurance involves assessing losses based upon a specific risk or peril. Hail insurance is the most common named peril insurance. For well over 100 years, hail insurance has been available mostly in North America and Europe. Hail damage is easily identifiable and special procedures have been developed to make field assessments of the degree of damage. Because hail losses are typically localized events, hail insurance has been offered in the marketplace without government subsidies. By contrast, multiple peril crop insurance, which covers losses due to any of a large number of risks, has rarely been offered without government subsidies. Implementation of multiple peril crop insurance becomes increasingly complex. If one is insuring for multiple perils, it is nearly impossible to first identify the "set of events" that may have created the losses and then perform a loss assessment that attempts to separate the actual loss by event. If there is crop loss, there is no clear way to tell if the loss is due to a weather event or to management practices. In North America, the "average" yield is estimated using individual farm records. If the yield is below a certain percentage of the average yield, a payment is made.

To provide weather insurance such as multiple peril crop insurance based on losses of individuals, an insurer must know a great deal about the individual who is being insured. There is almost always an imbalance of information that creates the twin problems of adverse selection and moral hazard. Monitoring and administrative costs to control adverse selection and moral hazard are costly (Hazell 1992, Skees and Barnett 1999).

Financing correlated losses is another major challenge for multiple peril crop insurance, as it is for most types of weather insurance. The correlated risk covered by most types of weather insurance can result in large numbers of claims at the same time in the same geographic area. This means that in the event of a severe weather event in the early years of establishing the indemnity fund, premiums may not be adequate to cover losses. Indemnities for a single severe weather event can exceed premiums in a single year by several times. Careful planning ensures that adequate capital is available when major events create claims that exceed premiums. These issues are critical to the financial viability of any insurance company offering insurance against adverse weather events.

Subsidizing Traditional Agricultural Insurance

With the exception of hail insurance, most crop insurance has involved heavy subsidies to mitigate the expense of the premiums. For example, both the United States and Canada have three forms of subsidy: (i) a direct premium subsidy, (ii) subsidy in the delivery costs, and (iii) some form of government sharing for the most catastrophic risk. The world experience with multiple peril crop insurance has been particularly troublesome: the amount paid by the farmer is typically a fraction of the total cost of delivering and underwriting this form of insurance. For example, in the United States, the farmer pays only about 30 percent of the total cost. In middle income countries that have tried multiple peril crop insurance, direct subsidies have typically been lower. However, because of poor actuarial performance—indemnities exceeding premiums—there have been

unintended subsidies. Poor actuarial performance will most certainly accompany multiple peril crop insurance programs that are not carefully designed to control adverse selection and moral hazard (Hazell 1992).

Of course, no country can afford to implement a crop insurance program fraught with problems that result in extremely poor actuarial performance. Furthermore, when there are large numbers of households that operate small units, as in lower income countries, it is increasingly expensive to control the adverse selection and moral hazard that lead to poor actuarial performance. Clearly, the focus must be on how to make weather insurance more affordable for lower income countries.

A New Approach—Index Insurance for Weather Risk

Given that lower income countries can ill afford to follow the path of higher income countries in providing subsidies for weather insurance such as multiple peril crop insurance programs, it is important to develop new approaches that focus on lowering many of the cost items discussed above. As will be more clearly developed below, index insurance is designed for that explicit purpose (Hazell and Skees 2006, Skees 2003).

The unique characteristic of index insurance that distinguishes it from traditional forms of insurance is that indemnity payments are based on values obtained from an index that serves as a proxy for losses rather than upon the individual losses of each policyholder. The underlying index is based upon an objective measure (for example, rainfall, wind speed, or temperature) that exhibits a strong correlation with the variable that might generally be used to measure losses (for example, crop yields, or default rates).

Index insurance has a defined threshold and a limit that establish the range of values over which indemnity payments can be made. The threshold marks the point at which payments begin. Once the threshold is reached, the payment increases incrementally as the value of the index approaches the limit. For example, an index insurance contract designed to transfer the risk of drought would begin making indemnity payments if rainfall levels, as measured at an agreed weather station, fall below the threshold over a defined time period, such as a month or a season. Indemnity payments would increase proportionately for each millimeter (mm) of rainfall below the threshold until the agreed limit is reached. The maximum indemnity would be paid when rainfall is less than, or equal to, the limit.

The *payment rate* for an index insurance contract is the same for each policyholder who has the same contract, regardless of the actual losses sustained by the policyholder. The amount of indemnity payment received will depend upon the amount of liability purchased (the value of the insurance).

The following example illustrates the structure of an index insurance contract for drought risk that begins making payments when rainfall is 100 mm or less. The maximum indemnity payment is made when rainfall is at or below 50 mm for the season.

Index variable: Total accumulated rainfall measured at a local weather station for the cropping season

Threshold: 100 mm of rainfall

Limit: 50 mm of rainfall

Liability purchased by the policyholder: $50,000

Payment rate: Based upon shortfalls in rainfall, the payment rate is calculated as the difference between the threshold value and the actual realized value of the index (as the index is actually recorded by a national meteorological agency or another third party), divided by the threshold minus the limit:

= (threshold – actual realized value)/(threshold – limit)

= (100 – actual realized value)/(100 – 50)

Indemnity payment: The payment rate multiplied by the total liability:

= (100 – actual realized value)/(100 – 50) × $50,000.

Table 1 shows indemnity payments due under the contract for different scenarios. The amount

Table 1. Payments Due Under Different Rainfall-Level Scenarios

Total Rainfall	Indemnity Payment Due
110 mm	None. The threshold has not been reached.
80 mm	$20,000
50 mm	$50,000
40 mm	$50,000. The limit of 50 mm has been exceeded.

of indemnity paid per mm of deficient rainfall is calculated by multiplying the payment rate by the amount of liability purchased ($50,000).

If the threshold is 100 mm, the farmer is likely to experience economic losses when rain is less than that amount.

Then, payment when rain is, for example, 80 mm (the second case in Table 1)

$$= (100 - 80)/(100 - 50) \times \$50{,}000 =$$

$$= (20)/(50) \times \$50{,}000 =$$

$$= (0.40) \times \$50{,}000 = \$20{,}000.$$

Regardless of the type of index on which an index insurance contract is based, when the threshold is reached, the amount of the payment made is based not on the actual losses sustained by the person who purchased the policy but on the value of the index relative to the threshold (subject to the limit) and the amount of the liability purchased. The payment could be less than, or more than, the loss sustained by the individual policyholder.

Advantages of Index Insurance

When comparing index insurance to traditional farm-level agricultural insurance, it is useful to recall the various components of the equation above that influence the price of insurance. The advantage of index insurance for lower income countries is that it can be simpler and less costly to administer relative to traditional forms of insurance. Index insurance can control some of the cost factors associated with weather insurance in the following ways:

Simpler information requirements. Because index insurance indemnity payments are not tied to actual losses incurred, there is no need to classify potential policyholders according to their risk exposure. As already discussed, this is a significant informational constraint on traditional agricultural insurance. It is unlikely that the information required for traditional agricultural insurance will be readily available in a lower income country, and it would require a great amount of effort to develop or obtain the information. However, in the case of index insurance based on rainfall, no household-level information is needed. The risk assessment uses historic rainfall data to evaluate the impact and frequency of insufficient rainfall.

No loss adjustment. One of the significant challenges for traditional insurance products is the high cost of loss adjustment. As discussed, under a traditional insurance policy, the insurer has to determine whether each individual household has suffered an insured loss and, if so, the extent of the loss. This can be extremely costly, particularly in remote rural areas. In the case of index insurance, there is no need to conduct household-level loss adjustment. Indemnities are based solely on the realization of the underlying index relative to the pre-specified threshold.

Reduction of moral hazard. Because the indemnity does not depend on the individual's actual losses, the policyholder cannot change his or her behavior to increase the likelihood of receiving a payment.

Reduction of adverse selection. Index insurance is based on widely available information, which reduces the opportunity for informational asymmetries to be exploited or for the most risky individuals to be the primary purchasers of the insurance.

Low administrative cost. Indemnity payments are based solely on the actual realized value of the underlying index as measured by government agencies or other third parties. Without the need for individual risk assessments or loss adjustment, the costs to the insurer can be significantly less, particularly for individuals with very small units.

Standardized and transparent structure. Index insurance contracts can have simple and uniform formats. Contracts do not need to be tailored to each policyholder, and so, again, administrative costs are lower. Thus, index insurance contracts should be more easily understood by the insured than many forms of traditional insurance.

Reinsurance function. Since index insurance pays for large correlated losses, it can also be used to protect local insurers against large losses from correlated weather risks. As mentioned previously, the potential for large financial losses from correlated weather risk is an inhibiting fac-

tor to the development of insurance markets. Using index insurance as reinsurance—insurance on an insurance portfolio—would make it easier for local insurers to offer traditional farm-level agricultural insurance without the threat of large financial losses that could result from a natural disaster.

Limitations and Preconditions of Index Insurance

Index insurance addresses some of the factors that limit the development of traditional insurance in lower income countries. However, it is not without its limitations. This highlights the importance of conducting a thorough feasibility study to determine if index insurance is appropriate. The reader is referred to the original primer (Skees et al. 2006) for further discussion on how to address these issues. Some of the challenges of index insurance are the following:

Basis risk. With an index insurance contract, there is basis risk, which is the chance that the indemnity payment a policyholder receives does not match the actual loss. The insured could suffer a loss and not receive any or enough indemnity to compensate for the loss. It is also possible that an insured who has not suffered a loss could receive an indemnity. Too much basis risk will deter interest because individuals will feel that the index will not be representative of their loss experience and will therefore offer them poor protection against risk. While basis risk is an inherent problem with index insurance, it can be minimized through product design and application.

Reliable and accessible data. For index insurance to be viable, it is critical that the underlying index is objectively and accurately measured. If data used for the index cannot be trusted or are not accurate, the system will fail. Making the data publicly available to both insurers and policyholders can help build confidence in the accuracy of the numbers. Whether provided by government or other third-party sources, index measurements must be widely disseminated and secure from tampering.

Education. Potential policyholders may have no previous experience with insurance or similar products. Educational initiatives are necessary to convey the concepts of index insurance and to help users assess whether or not these instruments can provide them with effective risk management. Local insurers and government regulators are likely to require some education on index insurance.

Financing of large losses. In lower income countries, local insurance companies typically do not have the financial resources to offer weather insurance without adequate and affordable reinsurance to protect against financial losses that could occur if many policyholders suffer losses from the same event. Effective financing arrangements must be made to ensure that some type of reinsurance is available for the insurer who offers index insurance, whether through international reinsurers, national or provincial governments, or international development organizations.

While index insurance can potentially overcome many of the problems associated with traditional insurance, there are still significant challenges that must be overcome for index insurance to become a viable risk mitigation mechanism in lower income countries. Governments and donors can play an important role in addressing these challenges.

Role of Governments and Donors

Governments often feel the pressure to act. However, they may not know what to do or what the options are. In many countries, governments do not consider the role that insurance markets can play in coping with exposure to weather risks. Instead, they tend to focus on the provision of government aid following an extreme weather event. The expectation of this aid among citizens reduces the demand for weather insurance.

Donors and development programs should inform governments of their options and encourage government action that does not distort the market or crowd out the private sector. For long-term sustainability of insurance markets, it is best if the role of government is one of facilitator and not direct deliverer of insurance products. This role includes establishing an appropriate enabling environment and providing certain public goods.

More specifically, a government or donor can support such things as

- improvements in the legal and regulatory environment,
- improvements in data systems and data collection,
- educational efforts about the use of weather insurance,
- product development, and
- access to global markets.

In some cases, governments or donor agencies may choose to provide financing for catastrophic losses as discussed below. In general, however, governments should not be in the business of providing insurance. In any case, governments should not provide direct premium subsidies, which undermine the incentives for private-sector insurance companies. Also, such subsidies generally favor wealthier farm households and thus erode poverty objectives. Even targeted premium subsidies rarely work as planned.

Supporting Improvements in the Legal and Regulatory Environment

Insurance is a highly regulated activity in all countries. Even if the index products are developed as non-insurance products, they will likely be subject to some form of regulatory control. A failure to consider the impact of the regulatory system and to obtain the necessary regulatory authorizations could result in the provision of the index insurance being unlawful, and in the providers of the insurance, and possibly intermediaries, committing a criminal offence. Unfortunately, in many lower income countries, laws and regulations are simply not in place to accommodate the development and use of these types of weather insurance products. Without proper contract law and enforcement, the market for these innovations will not develop.

Government and donor support can be quite helpful in getting technical assistance to lower income countries to update their laws and regulations, making them consistent with international law to improve the chances of gaining access to global markets for risk transfer. Human capacity building within financial regulatory agencies is also a critical public investment.

In many lower income countries, the legal and regulatory systems are not sufficiently developed to facilitate and regulate insurance contracts. Financial regulators may not have the capacity to regulate the special nature of weather insurance. Regulators must ensure that insurers' capital reserves are sufficient to meet potential claims, or that insurers have access to capital through reinsurance to handle extreme losses.

Insurance markets may be missing in lower income countries because of a number of weaknesses in the enabling environment. Stable governments and contract enforcement procedures are preconditions for rural financial markets to work properly. It is also important to have an insurance regulatory body that understands the differences between various classes of insurance.

If an effective legal system is not in place, insurance contracts may lose validity. For example, it is not uncommon for insurance companies to refuse to pay valid claims simply because there is no effective oversight. This, however, can undermine public confidence and demand for insurance. On the other hand, insurers may be reluctant to sell policies if there is a possibility that the government could alter the terms of the insurance contract after the insurance is sold. If judges and lawyers do not have a good understanding of insurance law, insurers may be forced to make indemnity payments in excess of their obligations under the policy.

Supporting Improvements in Data Systems and Data Collection

In supporting the development of weather insurance markets, governments can have a direct and immediate effect by providing greater access to existing data. Data are critical to the development of weather insurance markets and they must be credible. The equipment involved in developing weather data must be reliable, accurate, and secure from any potential tampering, and professionals who work with the equipment must be trustworthy. Most governments have reasonably good systems for collecting weather data, but they are missing quality systems for archiving and sharing historic weather data. Even more troublesome, some countries do not view the collection of weather data using government resources as a public good. Rather, they view it as a profitable resource and consequently charge for access to the data.

Other types of information are also important in the development of weather insurance: for example, yield data and other information on losses caused by extreme weather events, changes in land use and input use intensity, and records of past disaster management activities or infrastructure changes. Government can play an important role in facilitating index insurance by collecting, maintaining, and archiving data needed to develop index insurance for weather risks for public use and also for use by those with commercial interests wishing to develop innovative weather insurance products.

Supporting Educational Efforts about the Use of Weather Insurance

Potential users must be educated about the advantages and disadvantages of index insurance products. To increase the likelihood that information is presented in a balanced way and that sufficient investments are made in a broader educational effort for an untested product, public funds from governments and/or donors may be required. If insurance is not commonly available in the countryside, general education about insurance and risk management may be necessary. Index insurance policies are typically much simpler and easier to understand than traditional farm-level insurance policies. However, potential users may need help in evaluating how well the index insurance works for their individual risks.

Supporting Product Development

One of the challenges associated with private-sector development of new financial products is the ease with which they can be copied and replicated by others. This "free rider" problem discourages many companies from making initial investments in new product development, especially in underdeveloped markets. Thus, some level of government and/or donor support for product development can be justified. These investments should be targeted at feasibility studies and developing pilot tests of new products with the involvement of local private-sector partners. Every attempt should be made to ensure that the knowledge and technology for new product development will be passed on to local experts as soon as possible.

Supporting Access to Global Markets

Ultimately, access to global insurance and reinsurance markets is important for developing sustainable weather insurance instruments. In most cases, domestic insurance companies in lower income countries lack the financial resources needed to withstand the large losses that accompany the significant adverse weather events that damage crops or assets. This is one reason why insurance for weather risk is not offered by domestic insurance markets. Access to external financing to cover large losses when they occur is critical for a solvent insurance market. Regulatory officials must understand how to establish rules and regulations that both facilitate access to global insurance and reinsurance markets and regulate how domestic insurance companies must protect their positions to enable them to make full payment of indemnities if there are significant losses. Besides facilitating access to global markets, the regulator can also provide information about global markets to local stakeholders, change regulations to allow local companies to use these markets, and support locally appropriate product development, as discussed above. These tasks are clearly within a government's regulatory and administrative spheres of influence and can aid in facilitating market development for weather insurance with relatively modest budgetary outlays. Governments should refer to international experience and best practice guidance to establish an appropriate enabling environment, provide public goods that support market development, and undertake any other interventions. Governments should be particularly cautious of pressure from narrow special interest groups for rule changes favorable to their causes.

Supporting Financing for Catastrophic Losses

Until a sufficient volume of business has been established, extreme losses for the insurance pool may need to be underwritten (perhaps through contingent loans from government and/or donors) until international reinsurers are willing to participate in the risk sharing of a new product. For example, the World Bank has a contingent loan for the Mongolian Index-based Livestock Insurance Pilot (Mahul and Skees 2006). If losses for the insurance companies and the domestic rein-

surance fund are fully exhausted, the World Bank loan can be accessed to make indemnity payments.

Another possible role for government or donors is to provide financing for low-probability, high-consequence events. Evidence suggests that those at risk tend to ignore the probability of the most extreme and infrequent loss events, but insurers do not ignore these events and consider the probability of such catastrophic losses when calculating the price of the premiums. This creates a gap between what buyers are willing to pay and what sellers are willing to accept for protection against very infrequent but catastrophic losses. Governments can provide the financing in a number of ways that would still provide incentives to domestic insurers to operate in a proper fashion (Lewis and Murdock 1996, Skees and Barnett 1999, Skees 1999).

Applications of Index Insurance

There are examples of how index insurance is being used to manage weather risk in lower income countries. While index insurance relies upon certain preconditions and principles, each country presents unique challenges that will influence how index insurance is structured and implemented. As the following examples illustrate, index insurance can support several common development objectives, including protecting rural livelihoods and reducing poverty, strengthening rural finance, and improving disaster relief and safety net policies.

Examples of Household-Level Index Insurance

India. Rainfall index insurance has been sold by private companies since 2003 to compensate farmers for agricultural losses due to drought and excess rain. In 2005, the Indian government insurance company also began selling this form of insurance. Thus far, these insurance products are being sold with no subsidies. In 2005, about 250,000 small Indian farm households purchased some form of index insurance for weather risk. The interest has been significant enough that private investments are being made to increase the number of weather stations to reduce basis risk (Bryla and Syroka 2007).

Mongolia. The Mongolian pilot project, supported by the World Bank, offers insurance to herders to protect against high livestock losses due to severe winters (Mahul and Skees 2006). Private insurance companies sold index insurance for livestock to 2,400 herders in 2006, the first pilot year. The participation rate exceeded expectations for the first year—around 9 percent of the herders who were eligible purchased the insurance in the first year. The index is based upon county-level livestock mortality rates that are collected by the national statistics office. Though the index is based on livestock mortality and not on a specific weather event, the major underlying cause of large livestock losses is summer drought followed by severe winter weather. Importantly, the Mongolian project explicitly separates the commercial and the social side of the insurance. Commercial insurers sell the Base Insurance Product, which indemnifies for losses when livestock mortality for the county is between 7 and 30 percent. When losses exceed 30 percent mortality, the government pays for them with a Disaster Response Product. Herders who do not purchase the Base Insurance Product can pay a small administrative fee to register for the Disaster Response Product. Three of the primary rural lenders that are making micro loans to herders have already discounted interest rates for herders purchasing the Base Insurance Product.

Malawi. The World Bank helped to develop a rainfall index insurance pilot in 2005 for groundnut farmers in Malawi to protect against drought losses (Hess and Syroka 2005). Nearly 900 farmers purchased the insurance in the first year (Bryla and Syroka 2007). The intended outcome is to improve access to credit for smallholder farmers. Two rural financial institutions agreed to extend credit to farmers who purchase the index insurance, enabling the farmers to obtain loans for purchasing higher-quality certified seed.

Example of Intermediate-Level Index Insurance

Peru. Developed under a USAID project, an El Niño Southern Oscillation (ENSO) Index Insurance pilot has received preliminary approval by the banking and insurance regulators. The ENSO Insurance is based on an index of sea surface temperatures off the coast of Peru and would pay

when there are anomalies in these temperatures. When the Pacific Ocean warms significantly, there is extreme rainfall and flooding in the northern regions of Peru. These periods of extreme rainfall have caused significant crop failures and damage to infrastructure and the rural economy. These conditions also result in a large increase in the number of loans that are not paid back to rural lenders. The ENSO Insurance is designed to protect the portfolio risk of the intermediaries—the microfinance institutions and other rural lenders. When the catastrophe occurs, the rural lenders incur added costs because they must add more provisions or reserves as their loan problems increase. This occurs at the same time that depositors, due to the disaster, begin withdrawing their money and the poor are requesting more loans to help them face the crisis.

Examples of National- and International-Level Index Insurance

Mexico. The Mexican government is using index insurance to reinsure two disaster relief funds: FONDEN and FAPRACC. FONDEN (Fondo de Desastres Naturales)—the Mexican National Fund for Natural Disasters—was created in 1995 to provide disaster relief funds for the repair of uninsured infrastructure and relief for low income victims of disasters. FAPRACC (Fondo para Atender a la Población Rural Afectada por Contingencias Climatológicas) is a specialized natural disaster fund established to provide immediate assistance to restore the productivity of subsistence farmers by protecting the productive assets of vulnerable populations without access to formal insurance markets (ISMEA 2006). The program offers contingent payments for damage to productive assets caused by drought, frost, hail, excess rainfall and flood, and windstorm. By using index insurance to reinsure the government emergency response, the government is able to maintain the sustainability and solvency of the disaster relief programs.

Ethiopia. The World Bank and the United Nations World Food Programme (WFP) have developed a rainfall index insurance contract to prefinance some share of the WFP emergency operations in Ethiopia (Syroka and Wilcox 2006). The index insurance, purchased through a global reinsurer, AxaRe, is designed to provide the WFP with rapid and predictable funding and is expected to improve the timing of its response to a drought crisis by four months. The amount of the protection purchased was a fraction of the total food needs, demonstrating that blending emergency food reserves with financial solutions that use index insurance may be a better way to deal with these problems than simply depending on deploying food aid after an event. While an international donor purchased this food security index insurance, it should be possible to structure similar indexes that could be sold to a wide range of donors, NGOs, or local entities that need quick response when events clearly suggest that a food security problem is emerging.

A Look to the Future

Index insurance for weather risk has many potential applications. For example, feasibility work funded by the Inter-American Development Bank focused on using measurements of the inflow of water into an irrigation reservoir in Mexico to pay when the storage of water is well below normal and results in large cutbacks in released water. This type of risk mitigation could be used to facilitate water markets, and, given the importance of irrigation in many lower income countries, could be a highly important innovation. There are also reported examples of private-sector transactions in lower income countries whereby agribusiness intermediaries such as input suppliers and processors are using index insurance to protect against business losses that are correlated with adverse weather events. This type of use has been extended to other industries. In India, for example, rainfall index insurance is being offered to salt and brick manufacturers whose production can be disrupted by excessive rainfall. Exporters, importers, and processors of agricultural products may also find value in using index insurance that pays when there are certain adverse weather events.

Advances in technology are increasing the availability of data that could be used to support index insurance. Satellite technology is quickly evolving to provide more and better quality information on flood events as well as crop and pasture conditions. The cost of these data has declined considerably in recent years. The gov-

ernment of Vietnam is considering the use of radar satellite technology that penetrates cloud cover to support flood index insurance for rice production in the Mekong Delta. Satellite information is reliable and can provide up-to-the-minute data. It could be used by the private sector, NGOs, governments, or international organizations to provide index insurance for agricultural production or disaster relief.

Indeed, the potential applications of index insurance are noteworthy. Still, these innovations and applications will not come without careful consideration of where index insurance for weather can work and where it cannot. As emphasized throughout this article, development of index insurance products requires careful dialogue with government policymakers and regulators. Though weather risk can be a major constraint in economic development, it is by no means the only constraint. Managing weather risk may not be the highest priority or the most beneficial endeavor for a country. Developing effective and sustainable insurance programs requires time and a commitment from stakeholders. Discussions with stakeholders will reveal their needs and priorities. A thorough feasibility study should determine if index insurance would be appropriate, beneficial, and economical. While this dialogue may not result in the development of index insurance products, a careful feasibility study that examines weather risks and how society is currently paying for these large weather risks is an important activity. Finally, index insurance products can also serve as the first step in developing more advanced weather insurance products and improving access to broader rural financial services in lower income countries. It is hoped that this article has provided the needed information to encourage consideration of this potentially important innovation.

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