INDEX INSURANCE FOR WEATHER RISK IN LOWER-INCOME COUNTRIES

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[1] Using experience gained from a number of projects developing agricultural insurance, GlobalAgRisk, Inc., has produced this primer to guide development practitioners working on similar projects. However, it is not possible in a general document such as this to address the circumstances of any particular project or country. Therefore, this primer is not intended to provide, and should not be relied upon as providing, advice with respect to any specific project. No one should take any action with respect to guidance provided in this primer without making an assessment and without seeking appropriate professional advice. The primer is provided on the basis that users assume full responsibility for any decisions made, or actions taken, with respect to any matters considered in this primer, and GlobalAgRisk nor DAI do not accept any responsibility for such decisions or actions.

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INTRODUCTION[2]

This primer focuses on innovation in weather insurance designed to fit the special circumstances of lower-income countries where rural and agricultural financial markets are largely underdeveloped. Weather insurance is important to the long-term economic development of lower-income countries as a means of spurring rural finance and agricultural and rural development. Weather insurance can also help alleviate chronic poverty. The lack of access to weather insurance can cause rural and farm households in lower-income countries to consume their assets to survive an extreme weather event, or their assets may be destroyed, throwing these households into a cycle of poverty with no means of recovery. To be clear, the lack of weather insurance may be only one of several constraints that are slowing progress in economic development and rural financial markets in lower-income countries.

As critical as viable insurance markets are for economic stability and development in lower-income countries, creating these markets is a difficult undertaking. Looking to models from higher-income countries provides unsatisfactory answers. For example, agricultural insurance in higher-income countries is typically heavily subsidized. Lower-income countries cannot afford such heavy subsidies, particularly because a much larger percentage of the population is usually engaged in agriculture. Equally challenging, farm households in lower-income countries typically operate much smaller farm units, compounding the difficulty of providing rural financial services.

Other financial services, such as savings and loans, are also more accessible to small households in higher-income countries, allowing them to take more risk such as adopting new technologies and other activities to develop their businesses. This is the path to economic growth. Without strong financial services, countries are limited in their growth: limited formal rural financial markets can hinder development and the ability of the rural poor to climb out of poverty. Given the dominance of agriculturally dependent populations in lower-income countries and the typical pattern of a larger percentage of the poor living in rural areas, it is appropriate that national policy work toward building stronger rural financial services. This primer focuses on a new approach to weather insurance—index insurance—that can help develop and strengthen rural financial services. The intent is to provide the reader with the needed information to determine the potential viability of using index insurance for weather risk.

GETTING STARTED—DEFINING TERMS AND CONCEPTS

In this document, the term **weather insurance** is used for any type of insurance that is meant to pay for losses due to extreme weather events. Weather insurance here refers to most forms of agricultural insurance; flood insurance; property and casualty insurance that pays for losses from hurricanes, earthquakes, or other natural disasters; index insurance for weather risks; and so on.

TRADITIONAL INSURANCE

Traditional insurance is a financial mechanism in the form of a contract or policy between two parties (the insurer and the insured) that aims to reduce the uncertainty of loss, or risk, by pooling small payments from a large number of insured so that the burden of losses among a few is distributed over many. Generally, each policyholder pays a contribution to an indemnity fund administered by the

[2] For ease of reading, references are not included in the text. The reader is referred to the Further Reading section to find material that will support and supplement much of the information provided in this primer.

insurer and used to pay for losses experienced by the policyholders. This contribution, or premium, is assessed by the insurer to be commensurate with the risk and cost of providing the service.

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. For example, 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.

Weather risk is often **correlated risk**—many people in an area are affected by a single event and all are likely to suffer loss. In many cases, the more severe the event, the wider is the geographic impact. For example, drought or excess rainfall can create widespread damage across entire communities and regions. Such correlated weather risk can be a major constraint to the development of the **formal rural and agricultural financial markets** because a widespread, severe weather event may result in excessive loan defaults across the affected area.

Rural households often utilize various informal strategies for coping with risk, such as mutual aid networks and semi-formal microfinance activity, but these informal arrangements can suffer from many of the same challenges that make it difficult to develop formal financial markets. In particular, informal strategies often break down when correlated catastrophic losses occur. It is difficult to help your neighbor when you are also suffering from the same event.

Reducing the economic impact of severe weather events can be an important step in supporting agricultural growth, poverty alleviation, and development of rural finance. In many cases, formal risk mitigation instruments can help spur these activities. The challenge is to overcome the constraints and market failures that limit the development of insurance and financial markets in lower-income countries. It is important to note that catastrophic weather is by no means the only constraint. Lack of infrastructure, undeveloped financial markets, weak regulatory and judicial systems, adverse price fluctuations, and distorting government interventions are common obstacles that must also be addressed to further rural finance and rural development. Risk management can address one constraint, but it cannot succeed without tending to other obstacles as well.

This primer examines one innovation in risk mitigation—index insurance for weather risk. To establish the context and justification for insurance interventions, the primer first explores the nature of risk and, specifically, the impact of weather risk on agricultural enterprises and rural households. A brief review of the traditional agricultural insurance mechanisms used in higher- and middle-income countries—and the limitations to using those mechanisms in lower-income countries—sets the stage for discussion of index insurance. The primer then explores how index insurance works, the constraints and preconditions to developing these products, and the role of government and donors in supporting development of index insurance. A guide for development professionals is provided to develop a feasibility study and pilot activity for index insurance. The primer closes with a discussion of the applications for index insurance and a look to the future.

For simplicity, the products discussed in this primer 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.

SECTION 1: EFFECTS OF WEATHER RISK IN LOWER-INCOME COUNTRIES

In agriculture-dependent economies, weather is a significant factor for economic well-being. Particularly in areas of rain-fed 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 or national income. Where there are no mechanisms in place to protect against large losses from extreme weather events, household income and economic activities are likely to be depressed. This section describes how 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 household behavior and economic activity. To avoid or minimize exposure to weather risk:

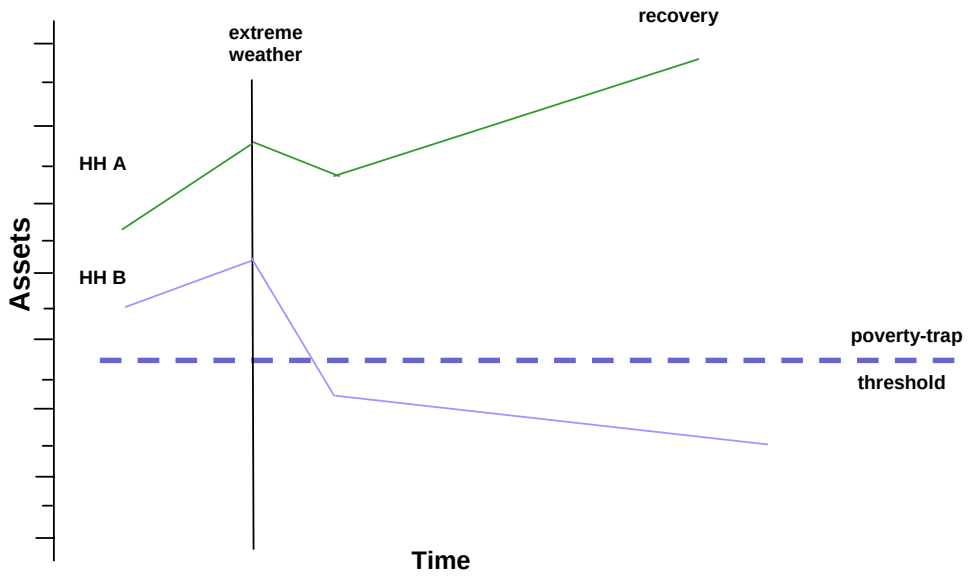
- Agricultural households will choose low-risk, low-return activities;
- Financial institutions may restrict lending to farm households; and
- Investment in the rural sector may be deterred.

These strategies may be effective at reducing risk exposure to some extent; however, the tradeoff, or cost, is that opportunities for growth are hindered.

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

Figure 1 shows the asset positions for two hypothetical households A and B. Initially, both households are experiencing 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.

FIGURE 1: ECONOMIC IMPACT OF A NATURAL DISASTER ON HOUSEHOLDS WITH DIFFERENT ASSET POSITIONS



Source: Carter, Little, Mogues, and Negatu (2005)

Total business risk is divided into operational risks and financial risks. Operational risks relate to the variation of operational income due to variation in yields or agricultural prices. Financial risks relate to the possible fluctuations in the firm's financial commitments as a result of the firm's debt position and variations in interest rates. Usually, a firm is interested in maintaining a constant level of total risks. Therefore, the higher the operational risk, the lower the financial risk a firm may be willing to undertake. Extreme weather events create quite high operational risk for farm households.

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.

Recognizing the potential for losses from weather events beyond their control, households that are highly vulnerable to shocks often manage risk by engaging in activities characterized by low risk but also low 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. 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. Yet these low-risk, low-return strategies are not entirely effective at reducing exposure to extreme weather risk. For example, in 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. However, if a loss event is serious and widespread, affecting many households in the same area—like a 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 money lenders 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 strategies may not be effective or feasible. 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.

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. Insurance is a way to reduce operational risk, making it possible to take more financial risk to finance new technologies, education, or infrastructure.

SECTION 2: IMPORTANCE OF WEATHER INSURANCE FOR LOWER-INCOME COUNTRIES

While 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, there are seldom viable formal alternatives. This section explains 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. The benefits of being able to transfer risk into a global market are also discussed. 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.

WEATHER INSURANCE CAN SPUR RURAL FINANCIAL MARKETS

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 are 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 in Section 1.

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, the correlated losses of the individuals have the potential to create a significant default on the portfolio of microloans. For example, in the northern regions of Peru, El Niño events, such as the one that occurred in 1998, can cause major flooding. Following the last such event, default rates on microfinance loans increased from a rate of 8 percent to nearly 18 percent in the 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 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.

WEATHER INSURANCE CAN SUPPORT DEVELOPMENT 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 government and donor organizations. Weather insurance for quick response for emergency assistance can have an immediate impact on reducing vulnerability to weather risk by:

- 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 structured 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:

- 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 government funds can be used for other social purposes during a natural disaster.

Despite the strong need for weather insurance, developing these markets is challenging. It is important to review traditional approaches to insuring agricultural weather risks as the basis for understanding why a new approach should be considered by lower-income countries. A key component to the approach is to develop weather insurance that can be delivered at less cost and can contribute to long-term economic development.

SECTION 3: TRADITIONAL WEATHER INSURANCE FOR MITIGATING AGRICULTURAL WEATHER RISKS

While Section 2 made a strong case for developing weather insurance in lower-income countries, that development process must be carefully considered. The starting point is to consider how traditional weather insurance is provided. Three types of weather risk insurance are dominant: 1) agricultural insurance; 2) flood insurance; and 3) property and casualty insurance for natural disasters such as hurricanes and earthquakes. Although many of the challenges discussed in this section could be extended to all types of weather insurance that pay for individual losses, the focus here is on agricultural insurance, and more particularly, on multiple peril crop insurance.

TWO DOMINANT TYPES OF TRADITIONAL AGRICULTURAL 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 crop insurance: 1) named peril, and 2) 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. This asymmetric information creates the twin problems of adverse selection and moral hazard.

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. It requires careful planning to ensure 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.

CALCULATING THE COST OF TRADITIONAL WEATHER INSURANCE FOR AGRICULTURAL WEATHER RISK

At this stage, it is useful to consider all of the costs that must be considered when establishing premiums for weather insurance such as multiple peril crop insurance. These costs can then be discussed in the context of the challenges associated with offering traditional agricultural insurance to small households in lower-income countries. The breakdown of the costs to be considered is as follows:

Price of insurance = Cost of the pure risk
+ Cost of information to control adverse selection
+ Cost of monitoring to control moral hazard
+ Cost of loss adjustment
+ Cost of delivery
+ Cost of ambiguity of risk
+ Cost of ready access to capital to pay for all losses

THE COST OF THE PURE RISK is the beginning point for pricing any insurance contract. Insurance specialists, known as **actuaries**, price insurance. Actuaries begin by making calculations of the underlying risk given the insurance contract design. At times, this is referred to as the "pure risk." Data are the key element to making these calculations. For example, if an insurance company was offering an individual farmer insurance against yield shortfalls below a certain percentage of the farmer's expected yield, the actuary would want a long history of the farm yields. Given this history, the actuary would develop an estimate of the expected payments over a long period using special procedures—simply, to capture the needed premium to offset the long-time average of all indemnities that would be paid out.

THE INFORMATION COST TO CONTROL ADVERSE SELECTION can be significant. Again, data are essential to ensuring that individuals are properly classified and obtaining the needed information is costly.

THE MONITORING COST TO CONTROL MORAL HAZARD adds to the cost of insurance as well. If the insurance was for multiple risks, it would be important to know that the farmer is using standard management practices. Any type of weather insurance that is being offered where the insured can influence the outcome will require some type of monitoring system.

THE LOSS ADJUSTMENT COST is important with traditional insurance. Loss adjustment generally involves procedures to determine the actual loss sustained by the insured. Loss adjustment can be costly and imprecise. For insurance against losses from a weather risk, there are even more problems that tie directly to the nature of the event—many people are likely to suffer a loss at the same time. Determining a large number of individual losses can put a serious strain on the resources

of any insurance company. Estimating losses for crops can also be quite difficult, in particular if the crop insurance covers multiple perils.

DELIVERY COSTS also add to the cost of insurance. It is expensive to send sales agents to the countryside to attempt to convince individuals to purchase a weather insurance product. This is particularly true in countries where individuals have little experience with any form of insurance. It may take multiple visits to convince the individual to buy the insurance.

THE COST OF AMBIGUITY OF RISK must also be considered for extreme weather risk events. Even if major loss events have not occurred in recent memory, insurers are aware that such events are possible. They attempt to determine the maximum probable loss that they could incur with any given insurance policy.

THE COST OF READY ACCESS TO CAPITAL TO PAY FOR ALL LOSSES adds yet another cost to weather insurance products. Given that the extreme event can occur in the very first year of the insurance offering, the insurer must have the capacity to pay for losses that may exceed premiums by several times. They do this by accessing international markets that insure the insurance companies. This type of insurance is called **reinsurance**.

The **problem of small units** compounds nearly all of the costs outlined above. Most of the costs presented above do not vary greatly with the size of the insurance policy. Thus, for small insurance policies, such as one would expect with rural households in lower-income countries, these costs are quite large relative to the amount insured. *The problem of small units makes it almost impossible for insurers to offer traditional agricultural insurance in lower-income countries that are dominated by large numbers of small farms.* Due to the structure of agriculture in lower-income countries, commercial insurers may feel that the investment to develop and administer an insurance product will be higher than the potential income from a relatively small market volume and the costs associated with administering the product.

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: 1) a direct premium subsidy, 2) subsidy in the delivery costs, and 3) 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 delivery 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 do not invest significantly in trying to control adverse selection and moral hazard.

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. 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, 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.

SECTION 4:
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 listed in Section 3. As will be more clearly developed below, index insurance is designed for that explicit purpose.

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 of interest (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, divided by the threshold minus the limit. [3]

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

= (100 – actual value)/(100 – 50)

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

= (100 – actual)/(100 – 50) x $50,000

Table 1 shows indemnity payments due under the contract for different scenarios. The amount 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 (second case in Table 1)

= (100 – 80)/(100 – 50) x $50,000 =

= (20)/(50) x $50,000 =

= (0.40) x $50,000 = $20,000

TABLE 1: PAYMENTS DUE UNDER DIFFERENT RAINFALL LEVEL SCENARIOS

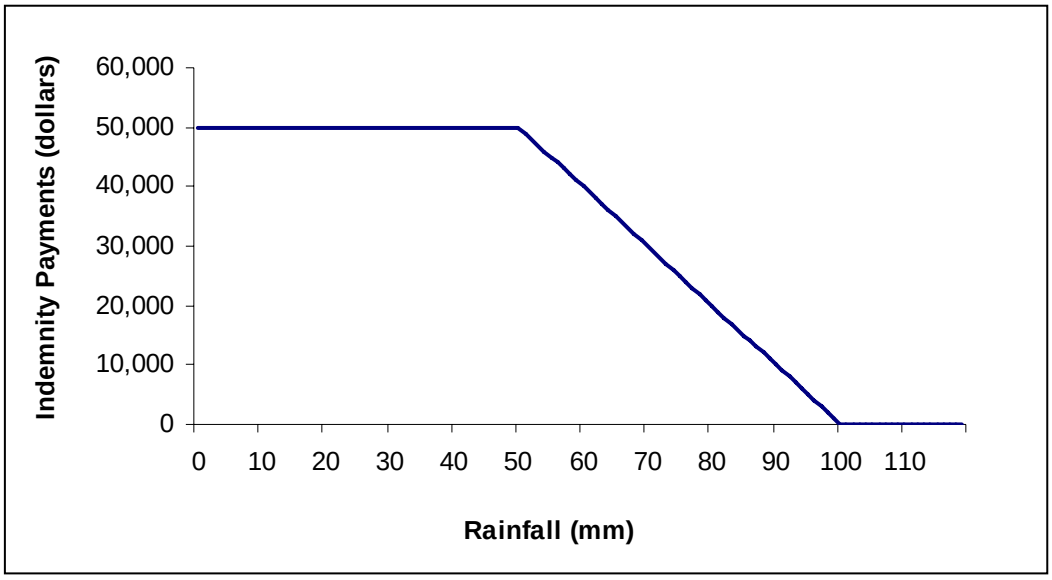
TOTAL RAINFALL	INDEMNITY PAYMENT DUE
110 mm	None. The threshold has not been reached.
80 mm	$20,000.
50 mm	$50,000.
40 mm	$50,000. The limit of 50 mm has been exceeded.

Figure 2 illustrates the payout structure for the hypothetical contract presented above. The payout rate is proportional, meaning that for each additional mm of deficit rainfall between the threshold and the limit, an equal increment of indemnity is due.

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.

[3] For index insurance against *excess* rainfall, or whenever the index insurance payments are covering losses from higher-than-normal index values (for example, high temperatures, strong winds), the payment rate would be calculated as (actual value – threshold)/(limit – threshold).

FIGURE 2: PAYOUT STRUCTURE FOR A HYPOTHETICAL RAINFALL INDEX INSURANCE CONTRACT



ADVANTAGES OF INDEX INSURANCE

When comparing index insurance to traditional farm-level agricultural insurance, it is useful to recall the equation from Section 3 that highlights the various components 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 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 that informational asymmetries can be exploited or that the most risky individuals will be the primary purchasers of the insurance.

LOW ADMINISTRATIVE COST. Indemnity payments are based solely on the 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 factor 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 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 sections on feasibility study, product design, and pilot development further discuss 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 could receive an indemnity even when he/she has not suffered a loss. 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, basis risk 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 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 it is 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.

SECTION 5: 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. 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 to 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

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.

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. By doing so, a regulator can facilitate 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. If losses for the insurance companies and the domestic reinsurance 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 setting 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 still provide incentives to domestic insurers to operate in a proper fashion.

SECTION 6: PRECONDITIONS FOR AND RESTRICTIONS TO INDEX INSURANCE

Before moving forward with detailed feasibility work and a possible pilot program, the development practitioner should be in a position to make informed judgments regarding the potential value of weather index insurance. How might weather index insurance work in a particular country? Is there a major weather event that occurs on average once every 7 to 10 years and causes significant losses for the community? Identifying the weather events that concern the community the most, and why, may reveal new information to help focus thinking for the next set of questions about the preconditions for implementing weather index insurance.

As Section 5 makes clear, among the first preconditions for any efforts to develop index insurance is a strong enabling environment. When considering the potential for weather index insurance, the practitioner should consider a preliminary visit with the government's insurance regulator and other government policy makers. While the complete enabling environment for regulation does not need to be in place for a pilot project to proceed, it is important to gauge the government's interest and facilitation of the conditions listed in Section 5 and the regulator's willingness to make revisions in the regulatory structure that may be necessary to facilitate the development of index insurance.

TECHNICAL PREREQUISITES FOR WEATHER INDEX INSURANCE

Some of the elements necessary for weather index insurance, such as an appropriate regulatory environment, can be developed or enhanced during a pilot phase. However, some technical preconditions are necessary for the use of these instruments to be considered feasible. If some of these preconditions are not met, it may be unwise to advance to pilot development.

WEATHER EVENT MUST CREATE CORRELATED LOSSES

One of the fundamental preconditions for index insurance is that the targeted weather event causes a similar pattern of losses over a relatively broad geographic area. Index insurance will not work well for weather events such as hail or tornadoes that cause isolated and random loss in different geographic regions. It also cannot be used where many microclimates exist within a relatively small geographic area. Index insurance relies on a measurable variable that indicates the occurrence of an event that is likely to cause large losses for many households. If moral hazard and adverse selection can be overcome, traditional insurance may be better suited for independent—uncorrelated—risks.

INDEX MUST BE A GOOD PROXY FOR LOSSES

If index insurance is to provide effective risk protection, the underlying index must be closely aligned with losses experienced by policyholders in a particular geographic area. The focus here is on the relationship between the underlying index, for example, shortfalls in rain, and actual losses incurred by policyholders, for example, reduced crop yields.

EVENT MUST BE OBSERVABLE AND EASILY MEASURED

The event that creates the losses must be measured by reliable and secure systems that can be used to develop the index and make the payments. The measures to record the events must be transparent, objective, and reliable for the index insurance to work properly.

MEASUREMENT OF WEATHER VARIABLE SHOULD INVOLVE A THIRD PARTY

It is best for the weather variable to be measured by a an independent entity or agency that has no financial stake in the outcome of the event, for example, secure weather data from the national meteorological agency, objective and scientifically developed data from other national and international agencies, satellite data from certified companies, and so on).

RELIABLE, HISTORIC DATA MUST EXIST TO PRICE THE RISK

Developing the statistics needed to price weather index insurance requires a long time-series of data with few missing observations—30 years or more is ideal.

STAKEHOLDERS MUST BE COMMITTED

For all of the difficulties listed above, it is complex to develop an index insurance scheme in any country for the first time. The users, government agencies, (re)insurance companies, donors, and all others involved in the development of index insurance must be very committed to the work they are doing and willing to invest time in undertaking well-planned feasibility, development, and evaluation.

STABLE POLITICAL AND ECONOMIC ENVIRONMENT IS REQUIRED

Because of the time required to investigate, develop, and test index insurance, and because the risks suitable for index insurance are not frequent events, it is important that the country have political and economic stability to support the long-term commitment and planning that is needed. Instability could cause a pilot program to collapse or to be misdirected according to changing political priorities.

WHAT TYPES OF RISKS CANNOT BE MANAGED BY INDEX INSURANCE?

Index insurance is a promising tool for supporting agricultural and financial sector development. However, interventions to develop index insurance should not be attempted where the preconditions listed above are not met. Moreover, index insurance is not suitable for all types of risk. The following are some types of risks that cannot be managed using index insurance.

FREQUENT RISKS

If a severe event occurs regularly, the probability of loss will be high and, thus, the cost of index insurance (the premium charged by the insurer) will be high. Frequent risks require other strategies for mitigation and management. For example, appropriate farming systems and risk-coping strategies must be adopted to fit into a consistently harsh environment (for example, extremely arid regions).

INDEPENDENT RISKS

Independent risks cannot be managed using index insurance because the index will not be a good proxy for the uncorrelated losses experienced by individual policyholders across space and time.

RISKS THAT CAN BE INFLUENCED BY HUMAN BEHAVIOR

Index insurance requires that the policyholder not be able to influence the value of the underlying index. Otherwise, moral hazard problems will occur. This is one reason why index insurance is often based on weather variables. It would be much more difficult to create index insurance for something like a contagious livestock disease since human actions can play a large role in containing or exacerbating the spread of those diseases.

SECTION 7: FEASIBILITY STUDY FOR INDEX INSURANCE

If the preconditions for index insurance are met and the risk to be covered is appropriate, the next step is to conduct a full feasibility study. A feasibility study requires a more thorough analysis of the probability and impact of the risk, the capacity of existing institutions, and the potential demand for index insurance. A feasibility study should be conducted by a professional who is qualified to examine the host of issues that are listed in this section. Depending on the country, a useful feasibility study can be conducted with a few weeks of intense activity. Understanding the assessment components of a feasibility study can aid in preparing the scope for such a study.

ECONOMIC RISK ASSESSMENT

A risk assessment identifies the major risks affecting rural households to evaluate the economic impacts of those risks and ascertain whether the risks can be effectively transferred using index insurance. The following are some of the primary questions to address in the risk assessment:

ARE THERE ONE OR MORE EXTREME WEATHER EVENTS THAT ARE KNOWN TO DIRECTLY UNDERMINE THE WELFARE OF RURAL HOUSEHOLDS OR TO IMPEDE THE DELIVERY OF CRITICAL SERVICES TO RURAL AREAS?

Events likely to meet this condition include well-defined extreme weather events such as droughts, excessive rainfalls, floods, freezes, excessive temperatures, deficit sunlight, and hurricanes.

HOW WIDESPREAD ARE THE ECONOMIC IMPACTS OF THIS WEATHER EVENT?

For weather index insurance to be cost-effective, the extreme event must affect a geographic region that encompasses significant economic activity. This condition effectively excludes from consideration events that are localized in their impact in any one occurrence, such as hail or tornadoes. This condition also effectively excludes weather events that occur non-uniformly over space due to significant microclimatic variation, which is not uncommon in mountainous regions.

WHAT IS THE NATURE OF THE ECONOMIC IMPACTS OF THIS WEATHER EVENT?

Does the extreme event destroy private property such as homes, crops, livestock, irrigation facilities, storage structures, or other capital equipment? Does it destroy public infrastructures on which rural households depend, such as roads, bridges, railroad systems, public irrigation systems, and water reservoirs? Thorough documentation of the economic impacts of the extreme event is not required for the feasibility study; however, some statistical or strong anecdotal evidence of widespread economic damages should be provided to justify proceeding to the pilot program.

HOW FREQUENT IS THE WEATHER EVENT?

For index insurance to be cost-effective, the extreme event must occur frequently enough to be recognized by individuals as a significant risk. However, the event should not occur too frequently,

because then the premium rates would be prohibitively high. As a rule of thumb, the event, on average, should occur at least once every 15 years, but not more than once every seven years.

INDEX AND DATA ASSESSMENT

If index insurance is to be successfully implemented, an appropriate index must be identified and adequate historical data on the index must be available. In identifying whether an appropriate index exists, the following questions should be considered:

DOES A VARIABLE (INDEX) EXIST THAT IS HIGHLY CORRELATED TO THE LOSSES CAUSED BY THE EXTREME EVENT?

Potential variables that could serve as an index include standard weather variables compiled by the meteorological service, such as rainfall and temperature; satellite or radar imagery for flood or vegetative cover, and El Niño Southern Oscillation (ENSO) indexes; government-compiled statistics directly related to losses, such as regional crop yield, livestock mortality, and epidemiological statistics; and other environmental variables such as river flow and reservoir levels.

HOW MANY YEARS OF RELIABLE DATA ARE AVAILABLE FOR THE CANDIDATE INDEX AND HOW DISPERSED ARE THE GEOGRAPHIC LOCATIONS AT WHICH THEY ARE MEASURED?

An insurer must have reliable data from which to establish premiums for index insurance. Ideally, insurers prefer at least 30 years of data that conform to international standards. Insurers may be willing to work with fewer data provided that supplementary data exist, such as measurements from other nearby geographic locations.

CAN THE INDEX BE MEASURED OBJECTIVELY USING CONSISTENT, SECURE, AND TRANSPARENT METHODS?

To sell index insurance, an insurer must have confidence that the underlying index will be measured securely, consistently, and in accordance with internationally accepted protocols; for example, an index compiled and published by a disinterested international organization that reports based on data from government meteorological stations. Meteorological variables compiled locally and on site, however, may not be useful as indexes if the agency responsible for compilation and publication of the statistics is deemed by the insurer to be susceptible to corruption or if the measurement stations are not secure or do not conform to international standards (such as those established by the World Meteorological Organization).

INSTITUTIONAL ASSESSMENT

An assessment of existing institutions and mechanisms for managing risk is necessary to understand where improvements may be needed. The institutional assessment examines the current roles of the government, private sector (insurance and banking), and donor organizations in risk management. The existing mechanisms may influence the design of the index insurance, because a new product may need to account for or complement existing mechanisms and strategies. The responsibilities and experiences of existing institutions will also influence the design of the index insurance in terms of financing, delivery mechanisms, regulations, and so forth. The following questions should be considered for the institutional assessment:

HOW ARE RISKS CURRENTLY BEING HANDLED BY FINANCIAL, INSURANCE, OR GOVERNMENT INSTITUTIONS? WHAT WEAKNESSES, IF ANY, EXIST IN THE ABILITY OF THESE INSTITUTIONS TO PROVIDE RISK MANAGEMENT SERVICES TO RURAL HOUSEHOLDS?

The cost of extreme weather events is likely already being internalized somewhere in the country's political and economic systems. In particular, it is important to understand how existing government programs may be absorbing these costs. In many lower-income countries, state-supported banks change the terms of an outstanding loan for those affected by a natural disaster. Such policies have numerous negative consequences: they are fiscally costly and they do nothing to improve incentives for improved risk management practices. In addition, these types of programs and policies are generally not transparent and are difficult to uncover when working in lower-income countries. Discovering and understanding these programs and policies is extremely important because they can potentially crowd out any real demand for index insurance.

DOES THE COUNTRY HAVE A WELL-ESTABLISHED LEGAL AND REGULATORY FRAMEWORK FOR ITS BANKS, INSURERS, AND SECURITY EXCHANGES, AND WHICH REGULATORY AGENCY IS LIKELY TO HAVE AUTHORITY OVER THE INDEX INSURANCE?

As with any insurance product, index insurance must conform to the laws and regulatory requirements of the country. Sometimes this is not easy with index insurance, since index insurance contracts are relatively novel instruments that can be considered to be either insurance products or derivative securities. Lack of clarity regarding the regulatory status of index insurance creates a business risk for insurers and reinsurers, potentially undermining their interest in participating in a pilot demonstration project. As part of the feasibility study, a prototype version of the index insurance contract should be presented to various regulatory agencies for preliminary review, in an effort to anticipate possible regulatory issues associated with the sale of the contract. Early indications regarding which regulatory agency will have oversight over the index insurance contract and the recent experience of the agency with similar financial products, if any, should help fashion strategies for the design of a successful pilot demonstration program.

DO BANKS, MICROFINANCE INSTITUTIONS, AND/OR INSURERS OPERATE SUCCESSFULLY IN THE TARGET REGIONS AND COULD THEY SERVE AS FINANCIAL INTERMEDIARIES FOR THE SALE OF THE INDEX INSURANCE CONTRACT?

The insurer that writes the index insurance is highly unlikely to want to market or distribute the product directly to individuals—this is not the insurer's strength. The insurer will likely wish to establish a partnership with a local financial intermediary that is capable of aggregating individual risks and providing local services. This could be a local insurer with an established marketing base and experience dealing with the country's regulatory agencies, and, ideally, international reinsurers. This could also be any form of a rural lending institution, or a collection of such institutions, that implicitly act as insurers for individuals or that otherwise bear the consequences of catastrophic weather events, say by experiencing widespread defaults. Although it is not essential that a commitment of a local partner be secured during the feasibility study, identifying possible partners and testing their general interest in cooperating is prudent.

DEMAND ASSESSMENT

For index insurance to be viable, the targeted group must show some willingness to pay for the insurance. During the feasibility stage, demand assessment can be evaluated through research as well as discussion groups with potential users. This should also involve concept testing to obtain feedback on the product design. Is the time period the preferred one? Are the thresholds the ones of most concern? What misunderstandings emerge that may help focus the educational efforts?

WHO IS LIKELY TO BENEFIT FROM INDEX INSURANCE AND WHAT ARE THEIR GENERAL FINANCIAL AND ECONOMIC CHARACTERISTICS?

To assess the potential success of index insurance, a potential target sector must be identified and its financial and economic characteristics understood. In particular, the practitioner should know the typical size of the farm/rural household; typical sources of income (on-farm versus off-farm income) and how these sources are affected by catastrophic weather events; and the level of use of credit (possibly through microfinance institutions). Clearly, the potential benefits of index insurance increase if household income is relatively low and highly exposed to the extreme weather event indexed by the index insurance.

HOW DO THE POTENTIAL BENEFICIARIES OF INDEX INSURANCE CURRENTLY MANAGE INCOME RISK FROM CATASTROPHIC EVENTS, AND, IN PARTICULAR, DO PROGRAMS OR FINANCIAL PRODUCTS CURRENTLY EXIST THAT MAY COMPETE WITH OR COMPLEMENT INDEX INSURANCE?

To assess the potential success of index insurance, one must evaluate existing mechanisms and institutions for risk management and identify weaknesses or gaps. Some programs, such as disaster assistance programs, could be enhanced by the introduction of index insurance. Others may interfere with attempts to introduce index insurance. Examples of competing products and programs include other insurance products offered by private insurers or the government, implicit insurance coverage offered by banks in the form of easy debt forgiveness policies, public programs operating in nearby areas by the U.S. Agency for International Development (USAID) or other international agencies, and established government practices of free disaster assistance in times of extreme weather events.

DO THE POTENTIAL BENEFICIARIES OF INDEX INSURANCE HAVE EXPERIENCE USING FORMAL FINANCIAL SERVICES?

Are the potential beneficiaries of index insurance receptive to the idea of hedging or risk sharing using formal financial contracts? Do they have experience with formal financial services, including savings deposits or consumer or business loans? Do cultural norms undermine the use of financial risk-sharing arrangements? Clearly, chances of success for the index insurance pilot program are higher if the potential beneficiaries of index insurance have experience with formal financial transactions.

WHAT ABOUT RISK TOLERANCE AND WILLINGNESS TO PAY AMONG POTENTIAL USERS?

Under some conditions, focus groups or field surveys may be used to gauge risk tolerance and willingness to pay. Such activity should be conducted only if the potential users have some prior knowledge of insurance products. In many cases, no such knowledge exists and the best way to determine demand is with a pilot project that actually offers index insurance in the marketplace.

SECTION 8: PILOT-TESTING OF INDEX INSURANCE

If the feasibility study suggests that index insurance is possible, the next step involves designing a pilot test. Developing a pilot program has many advantages. One can experiment on a limited basis and learn much more about the potential for index insurance. Additionally, the pilot can be undertaken with fewer resources and in such a fashion that adjustments can be made using a true "learn-by-doing" activity. It is important to understand that it takes time to develop and test innovative financial products. It also takes time to refine product design and allow participation in the market to develop. Thus, it is unlikely that the direct benefits of a pilot test of index insurance will be realized in the short run. Nonetheless, there can be significant indirect benefits that may motivate moving forward. Examples of these indirect benefits include building the capacity of many stakeholders, developing rural insurance markets for products other than index insurance, ascertaining the explicit costs of weather risk, and gaining more transparency by discovering how the costs of weather risk are currently internalized in the economy.

THE INSURANCE CYCLE

The insurance cycle on an insurance product is typically about 18 months for an annual crop. The product design, rate making, and contracts must all be prepared well before actual sales of the insurance product begins. Thus, it takes good planning and execution to develop a pilot test. Depending on the production cycle of the crop or livestock being insured, a new sales season can actually begin before payments are made for the previous contract. Therefore, any adjustments will have a lag time of at least one sales season as one is learning about problems with the insurance product after the next sales season has started.

Five critical phases of a pilot test must be considered:

- Phase 1 Pilot Design (to begin many months to several years before sales begin)
- Phase 2 Promotion and Public Awareness (throughout)
- Phase 3 Sales Season (must close before information on weather forecast is available)
- Phase 4 Loss Settlement (at the end of the first season)
- Phase 5 Monitoring and Evaluation (M&E) (throughout)

This section focuses on Phase 1, Pilot Design, because this is the most critical aspect of a pilot test. A good design will plan for all five phases. Who actually does the work for the different phases is highly dependent on the development of the insurance sector within the country. For example, insurance and financial markets in India are more advanced than those in many lower-income countries. In the pilot project for India, therefore, while outside professionals were involved, much of the pilot design and implementation was conducted by private sector firms in India (for example, ICICI-Lombard and BASIX). It was also possible to implement a weather insurance pilot very quickly (in roughly six months' time from the initial discussions). By contrast, insurance markets in

Mongolia are not nearly as advanced as those in India and local insurance companies had little access to international capital. Thus, the Mongolian project took a few years to develop and was supported by a variety of donors. The pilot design required significant involvement from outside professionals. Additionally, the project was also designed with the government and the World Bank organizing the financing to pay for the most extreme risks. Still, the project is designed to transition to the global market over time. The Mongolian project is being implemented by a unit that is tied to the Ministry of Finance with participation from three insurance companies in Mongolia. India and Mongolia likely represent the two extremes of how much time and outside expertise is needed to design a pilot project.

CONSIDERATIONS FOR DESIGNING A PILOT PROJECT

A pilot project can be a challenging endeavor, but very useful because, with relatively low cost and investment, potential problems and, more importantly, potential applications of the scheme not previously considered can be discovered. The activities and suggested best practices that follow will be required either by private firms that are most engaged in the development or by government agencies. Even if development of the index insurance is pursued mostly by private companies, many of the items discussed in Section 5 regarding the role of government and donors will still apply. Finally, there is no particular order for the items that follow—each must be considered from the outset. It is particularly important to ensure that dialogue with the regulatory authorities takes place from the beginning of the endeavor.

USE COMMERCIAL PRACTICES

An overriding principle for pilot design involves the use of commercial practices. From the outset, careful consideration must be given to developing products that can be sustainable in the difficult setting of a lower-income country. The development literature is full of examples of how the poor suffer more than others due to natural disaster risk. While it is common to hear that the poor will not pay for risk transfer, it should not be forgotten that the poor likely already are “paying” for these risks in one fashion or another. When asset-poor households make decisions to stay with low-risk–low-return production practices, they are effectively paying what an economist may characterize as “an insurance premium,” in effect, “self-insurance.” When the poor must go to costly and inefficient sources for loans after a crop failure or a natural disaster, they are also, in effect, paying for their risk exposure.

BUILD DATA AND INFORMATION SYSTEMS

It is best to consider building data and information systems that are accessible to as many stakeholders as possible. A first priority should be obtaining detailed weather data for a long time-series and putting them into an easily accessible format. It is also important to document the data and organize them by geographic location. Data on crop yields and information on production practices for each crop are also useful. Understanding the crops and their agronomic cycle and vulnerabilities to various weather events will become critical to designing index insurance for crop-yield losses.

IDENTIFY THE TARGET MARKET

The feasibility study should have provided a clear picture of the potential target market. As discussed previously, there may be a number of potential users of weather index insurance. While the farm household may be the initial target market, it is important to keep the policy dialogue open to other potential users such as commodity processors, agricultural exporters, or other enterprises vulnerable to weather risk. Any group that has an insurable interest and that could benefit from purchasing the index insurance should be considered.

CONSIDER APPROPRIATE DELIVERY SYSTEMS

What existing systems are appropriate for delivering index insurance? In many cases, rural credit providers such as banks or microfinance institutions may provide the lowest-cost delivery system. Loan officers can sell index insurance by simply adding the cost of the product to the loan. However, such an approach should still be transparent. India has had a government crop insurance program where the insurance is built into the loan. However, in many cases, the farmer is not informed about any aspect of the insurance. Such an approach does not foster a good market environment.

CREATE A POLICY DIALOGUE WITH STAKEHOLDERS

An important aspect of any innovation is education among stakeholders. Numerous stakeholders must be educated about the value of using index insurance. This is time-consuming and requires both sharing new ideas and shaping those ideas based upon feedback from the stakeholders. While some basic principles are transferable, again, it is critical that ideas be tailored to local conditions.

DESIGN AND PRICE INDEX INSURANCE

Index insurance should be relatively simple and easily understood. There are numerous ways to design these products. The design and the data available will drive the pricing of the insurance products. The risk must be priced based on insurance principles. Developing proper pricing of insurance products requires professional input. Improperly priced products can cause adverse selection, as discussed earlier.

SET APPROPRIATE DATES FOR SALES CLOSING

For any index insurance, it would be a major mistake to allow sales to go beyond the time when individuals have information about the weather events that are being insured. For example, in Peru, indicators that an El Niño may happen begin to emerge about nine months before losses start to occur. Thus, the sales closing must come before this type of knowledge is available. When these types of events are predictable, it may be useful to have a multi-year insurance contract that would extend into two to three years of protection for well-defined events. Generally, these events will be occurrences that cover a specific time within the year as well.

ESTABLISH AN APPROPRIATE SCOPE FOR THE PILOT

Determining the appropriate scope for a pilot is always a balancing act. Those who underwrite and market index insurance during the pilot will incur start-up costs. They will want to spread those costs over enough policies so that the cost per policy is not excessive. This suggests that the pilot test should not be too small. It may also be important to spread the risk geographically. In Mongolia, the pilot is being implemented in three provinces that are geographically separate to give some risk offsets (generally, when there are losses in one state, another, distant state has no losses). Also, if a pilot is to attract national or international reinsurers, it cannot be too small. Yet, caution should be taken in not making the project so large that it cannot be easily modified as needed. It should be clear that, without some measurable progress, the pilot will not be continued or expanded. Establishing proper monitoring and evaluation (M&E) procedures (see below) will set a framework for this.

DISCUSS THE PILOT WITH REGULATORY AUTHORITIES

Failure to engage the regulator early on could be very costly—it may result in product design work having to be redone. In most cases where index insurance is being used, it has been classified as an insurance product. However, because index insurance is a relatively new concept, the legal and regulatory systems of many countries do not expressly recognize it. Its status depends on an

interpretation of the relevant laws, particularly laws on insurance and securities, and, in common law countries, an interpretation of decided cases, all of which may differ from country to country. In most jurisdictions, an insurance contract must satisfy certain essential criteria, such as providing an indemnity, or compensation, for actual losses incurred. If data and analysis can demonstrate that the index is a good proxy for the actual loss suffered by the policyholder, it will often be possible to argue that the index contract is an insurance contract. However, regulators may have little or no experience with index insurance and there is still limited international precedent. Thus, regulators in different jurisdictions may take different views of the same product. In the initial meetings with the regulator, the aim should be to

- Explain what the pilot is seeking to achieve and the benefits of index insurance if the pilot is successful;
- Explain how index insurance fits with internationally accepted regulatory standards and how it fits into the local context;
- Seek the regulator's preliminary views as to the appropriate classification of the product;
- Discover whether the regulator has any particular concerns that could be addressed in the design of the product; and
- Discover whether the regulator is likely to impose regulatory obligations that would seriously affect the operation of the pilot or the feasibility of the product.

DRAFT SAMPLE INSURANCE POLICIES

An insurance policy is a legal contract, and entering into insurance policies as an insurer is always a regulated activity. Although specific contract or product approval is not always required, given that index insurance will be a new product for many regulators, it is likely that the contract will be required to be submitted to the regulator and, in many cases, regulatory approval will be required. Coordination with the appropriate regulator (or regulators, if more than one) is therefore a critical step in pilot development. Regulators often have discretion in the classification of financial services products. Therefore, even if a contract is written as an insurance contract, the regulator may reclassify it as a non-insurance contract, or vice versa. How the product is classified by the regulator will influence product design, how the product can be used, and to whom and by whom it can be sold. However, the regulator should be provided with the proposed design of the insurance product and a sample insurance policy to ensure that the regulator can make an accurate assessment.

DETERMINE WHO CAN SELL THE INDEX INSURANCE

As part of the product design, consideration must be given to whether the index insurance will be provided by an insurer or other institution, or by an international institution, for example, an international insurer or reinsurer. This decision has legal and regulatory implications. International institutions may need approval from the regulator to sell index insurance and this approval may be difficult to obtain. Even if approval is given, it may be subject to conditions that would make the product unprofitable to sell, such as the establishment of a local office or subsidiary or the maintenance of an in-country deposit of funds. If an international insurer or reinsurer is to be used, the regulator may require it to have a certain minimum rating.

DEFINE THE INSTITUTIONAL STRUCTURE FOR THE PILOT

Some lower-income countries have very few regulations regarding the sale of insurance products. The bureau charged with regulating the insurance industry may not have the resources or experience to fully implement existing insurance regulations. If the pilot is successful and the index insurance is to

be sold nationwide, the government may need to consider making changes to the insurance legal and regulatory frameworks **over time.**

In the meantime, consideration should be given to designing the pilot to incorporate a regulatory dimension. For example, contracts could be put in place that impose market conduct requirements on insurers. There could be a contractual requirement that sales agents must be certified for the pilot and mechanisms could be established to protect policyholders' premiums where financial reserving regulations are not in place or inadequate, and there is a risk that the insurer will not have adequate financing to cover large losses.

OBTAIN LEGAL AND REGULATORY ADVICE

Clearly, many legal and regulatory issues must be considered in the design of an index insurance plan, and regulatory frameworks differ from country to country. It is therefore impossible to give generalized legal and regulatory advice in a primer such as this, or even to attempt to anticipate all of the legal and regulatory issues that may arise. Practitioners should obtain expert legal and regulatory advice as soon as possible in the feasibility stage or early in the design process. Given that index insurance is relatively new and uncommon, the experience of local lawyers will often be limited. Thus, consideration should be given to obtaining the expertise of international legal and regulatory experts who have experience implementing index insurance in other jurisdictions.

SUPPORT PROMOTION AND PUBLIC AWARENESS

Investments in promotion and public awareness will be critical for the success of a pilot on index insurance. In many countries, people may have little familiarity with any type of insurance. They will likely have no knowledge of the advantages and limitations of index insurance. Basic education on both insurance and index insurance are needed, in addition to promotion of the specific products being sold.

ESTABLISH A MONITORING AND EVALUATION (M&E) PROTOCOL

A pilot project must involve an M&E protocol. It is important to set performance criteria and contain expectations and to set clear development objectives. M&E can be used to make necessary adjustments during pilot implementation. If possible, a baseline survey can be highly useful for testing the impact of the pilot. However, index insurance is different from many other financial products. It would be a mistake to use short-term payment history or loss experience as an indicator of success. Since index insurance generally is used for infrequent yet severe risks, it is altogether possible to have very few payments over a short pilot test or, if an extreme event does occur, it is possible to have large losses for the insurance company offering the index insurance. The focus of M&E should be on more fundamental issues such as whether the access to rural credit is improving and whether the terms of credit are improving.

SECTION 9: APPLICATIONS OF INDEX INSURANCE

This section presents some 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 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.

MONGOLIA. The Mongolian pilot project, supported by the World Bank, offers insurance to herders to protect against high livestock losses due to severe winters. Private insurance companies sold index insurance for livestock to 2,400 herders in 2006, the first pilot year. This exceeded expectations—nearly 10 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 severe winter weather. Importantly, the Mongolia 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. Two of the primary rural lenders that are making microloans 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. The intended outcome of launching this index insurance 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 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 FAPACC. 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 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. 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 Program (WFP) have developed a rainfall index insurance contract to prefinance some share of the WFP emergency operations in Ethiopia. The index insurance, purchased through a global reinsurer, AxaRe, will 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 is 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 to simply depend 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 government 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, nongovernmental organizations, 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 primer, development of index insurance products requires careful dialogue with government policy makers 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 these large weather risks are currently being paid for by society 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 primer has provided the needed information to encourage consideration of this important innovation.

USEFUL WEB LINKS AND LINKS TO OTHER REFERENCE MATERIAL

http://www.itf-commrisk.org/index.htm

http://www.globalagrisk.com

http://www.guaranteedweather.com/casestudies.php

http://www.wrma.org/wrma/index.php?option=com_frontpage&Itemid=1

http://www.artemis.bm/html/weather/personnel.htm

http://www.basis.wisc.edu/live/basbrief28.pdf

http://siteresources.worldbank.org/INTARD/Resources/Managing_Ag_Risk_FINAL.pdf

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