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# Insurance Against Covariate Shocks

*The Role of Index-Based Insurance in Social Protection in Low-Income Countries of Africa*

*Harold Alderman  
Trina Haque*



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Africa Region Human Development Department



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# Abstract

Uninsured risk has far reaching consequences for rural growth as well as poverty reduction. A range of informal mechanisms to insure rural households against the impact of shocks, but they are a modest component of a risk layering strategy for well-off households and even less protective for low-income households. Formal insurance mechanisms (including conceptually similar credit access) have inherent market imperfections. State interventions to address these limitations have proven costly and generally are targeted poorly. Recent developments in microfinance as well as in insurance marketing have opened new possibilities for household risk reduction.

Index insurance, such as weather indexing, addresses other inherent problems in insurance by using an indicator that is not affected by individual behavior and may address monitoring costs and moral hazard. A number of innovations using index insurance are being tried currently in diverse settings ranging from India to Mongolia to Malawi. Marketing costs may limit the provision of such insurance to small farmers, but even in such cases microfinance institutes may serve as market intermediaries. Moreover, state and subnational governments can use insurance to achieve countercyclical funding of programs. In this vein, municipal governments in Mexico have used insurance to finance disaster contingency while the World Food Program has insured a portion of its emergency assistance to Ethiopia. Humanitarian organizations and NGOs may also seek insurance in this manner.





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# Introduction

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## Income Transfer versus Insurance Functions

Short-term economic shocks have long-term consequences for low-income households that are forced to reduce investment in child health and schooling or to sell productive assets in order to maintain consumption. The covariate nature of many of these shocks means that traditional mutual assistance or informal insurance mechanisms tend to break down. Governments may attempt to mitigate the shock with safety nets—often with donor assistance—but these programs are often stop-and-go and may fail to respond in a timely manner.

Despite extensive research on publicly supported safety nets in developing countries, far more is known about how to achieve their *income transfer* function than is understood about their *insurance* function, either following a natural disaster or in the downturn of an economic cycle. While many core principles of safety nets are shared over both objectives, they differ in three aspects. First, to serve an insurance function safety nets need to have a counter-cyclical budget so that they can be scaled up as need increases as well as scaled back subsequently, while an income transfer program targeting chronic need does not typically need to have this temporal “scalability” feature. Second, they need to be able to target on transitory need rather than more chronic correlates of poverty and, third, they need a flexible implementation strategy which permits speedy response (Alderman and Haque 2006).

## Indexing as a Social Protection Instrument

One means that these interlocking objectives can be advanced for a particular group of shocks—climatic shocks—is through insurance indexed to an objectively-measured indicator of weather such as rainfall or temperature. Publicly-provided insurance, however,

does not have a good track record. Seldom is such insurance provided without substantial subsidies, and rarely are these subsidies targeted or means tested (Hazell 1992). Recent innovations have reduced the inherent business reasoning for insurance to the point that it is unavailable or prohibitively costly for low-income populations (World Bank 2005b). Moreover, while most experience with insurance assumes that farmers or households are the main purchaser of insurance, recent developments have led to exploration of the role of the public sector as purchaser as well as provider of insurance.

## **Study Purpose and Structure**

This review looks at such recent developments from the perspective of how weather-based indexing and weather-based insurance can assist in the timely provision of safety nets in response to weather shocks in low-income countries, with a principal focus on Sub-Saharan Africa. This builds upon extensive work undertaken by the Commodity Risk Management Group of the World Bank as well as specific missions to Chad, Ethiopia, Malawi, and Tanzania undertaken by World Bank staff from the Human Development and Rural Development Groups. The next chapter of this paper lays out the rationale for indexed-based weather insurance as a component of a risk mitigation strategy. Chapter 3 presents examples of new approaches to index-based insurance outside the Africa region and is followed by a more detailed discussion of pilot efforts in Africa. Chapter 4 reviews cases in Africa. Chapter 5 considers future directions for weather indexed insurance in the region.

# Index-Based Insurance in Low-income Contexts

## *Potential and Limitations*

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It is generally agreed that individuals prefer to stabilize consumption. In the absence of formal insurance they often trade off a significant amount of potential income by adopting low-risk, low-return strategies. Given their desire to insure, what prevents households from actually doing so? This question needs to be addressed if one seeks to assess the role of publicly-supported insurance in a social protection strategy. In particular, it is necessary to review a few general features of insurance markets and the reason for market failures to consider the efficiency as well as the equity issues addressed in social protection.<sup>1</sup>

### **Why Insurance is Important**

Weather-related risks are a fundamental determinant of rural livelihood strategies and often an important reason why poor households remain poor. Weather-related risk limits the capacity of the chronic poor to escape poverty in two distinct manners. First, it affects their resource allocation by encouraging activities with lower risk but lower return. Second, weather events can be catastrophic, triggering famine, displacing families, and leading to the sudden loss of slowly built-up assets. In addition, such events transmit poverty across generations by inducing malnutrition and school drop out. Yet, in many environments, formal insurance is lacking and informal insurance proves particularly limited in the context of covariate shocks.

The literature on insurance notes the importance of *moral hazard*, under which the insured individual modifies his behavior in response to having insurance, and thus changes

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1. Das, Do, and Özler (2005) has a good presentation of these two themes.

the probability of an adverse outcome. The up side of changing behavioral incentives is the possibility that an individual who has chosen a low-risk, low-yield production strategy shifts to one with a higher expectation when they have access to insurance. Similarly, because poor households often cannot utilize insurance—or they find informal insurance substitutes inadequate—they decapitalize their assets in the face of income shocks. Access to insurance can prevent such decapitalization, thereby preserving productivity and potential to participate in economic growth. Indeed, both these implications provide an *efficiency rationale* for addressing market failures in the provision of insurance.

Evidence also indicates that poorer segments of society are typically less able to buy informal insurance than are wealthier segments in response to the same covariate shock, such as prolonged drought. Clearly they have fewer assets to sell or savings to draw down. Moreover, poorer households are engaged in mutual assistance networks to the extent possible but since these networks are usually resource constrained to begin with, the impact of these efforts is most often not adequate to meet the needs arising from a climatic or economic shock. Conversely, richer households tend to have both higher own-resources as well as access to more resource-rich networks in times of need. Consequently, lack of insurance, formal or informal, can worsen the income inequality within society, thus providing an *equity rationale* for addressing insurance market failures as well as the efficiency rationale noted above.

## Reasons for Undersupply of Insurance

Insurance may be undersupplied due to asymmetries of information. Insurers do not have the same information as their customers (or cannot obtain it economically). This not only increases the chance of fraudulent claims, it leads to *adverse selection* under which individuals with higher than average risk seek insurance and those with lower than average risks find it uneconomical. This raises overall costs, with increased drop out of the customers with lower risks.

Risks are often poorly known. For example, insurers may be unable to estimate the costs of rare events; a one-in-a-hundred event is hard to distinguish from a one-in-eighty event. Similarly, risks are hard to quantify in a changing climatic or economic environment. Thus, insurers may require a loading of premium rates to accommodate ambiguity. This is a different issue that the documented tendency of individuals to under estimate the probability of low frequency catastrophic events and thus to under invest.

Finally, since the more uncorrelated risks in a portfolio the lower the overall variance, private insurers may find it hard to develop a market for insurance of covariate risks that has a sufficiently large geographic base to enable adequate pooling of risks. Alternatively risks can be transferred to a secondary market through reinsurance. The more distant the reinsurer, however, the harder it will be for the company to monitor contracts. This difficulty may translate into higher premiums.

## Weather-Index Based Insurance

Some of these obstacles can be addressed by the use of weather-based indexes. Typically such an index has an insurance payout that is triggered by an easily-measured event such

as rainfall below a certain level. Alternatively, payouts can be indexed so that they increase proportional to a shortfall of rain. Similarly, the occurrence of frost or the number of days that the temperature is hot or cold, depending on the crop, can trigger a payment. Common features of effective indices are that they are easily measured, objective, transparent, independently verifiable, and available in a timely manner. Moreover, the probability distribution must be reliably estimated. This implies that there is a stable time series of information.

*Reduced monitoring costs.* These features reduce the costs of monitoring. Furthermore, because, by design, the behavior of an individual cannot affect the probability of an adverse event, the problem of moral hazard is limited. Likewise, the asymmetries of information that create adverse selection are reduced. Moreover, with a stable and transparent indicator, local knowledge is relatively unimportant in determining risk, making reinsurance easier. There is, therefore, a public good rationale for investing in information systems that meet the requirements for an index-based insurance.

*Fine-tuning payouts.* Applications of index-based insurance can occur at the *micro*, or farm, level. For example, farmers may purchase weather index insurance to cover expected loss of income from a specific crop or over a season. For the former case the index will need to construct a payout schedule that corresponds to a crop-specific risk. For example, some crops are most vulnerable to rainfall shortage at flowering; others to heat at seed or fruit set, still other risks of income loss are best proxied by the date of the onset of the rainy season and the need for a minimum amount of soil moisture for timely planting. Because the rainfall index is still a proxy for income loss, the mapping of the weather index for a crop-specific coverage can be made more precise than a general index—thereby reducing *basis risk*. That is, fine tuning the indicator can decrease the mismatch between the index and the actual losses incurred by individuals. Basis risk is generally reduced when within-spatial unit correlation of income shocks is greatest (a condition that also encourages households to seek spatial distribution of risk since it works against the functioning informal insurance through transfers between neighbors).<sup>2</sup>

While the index on which an insurance policy is calculated needs to conform to the expectation of losses, the relationship is statistical and need not be causal. It is not, necessary, for example, that an index calibrated to maize production be used only to insure maize producers. Indeed, it is not necessary for a policyholder to even have a crop; laborers and merchants whose incomes are indirectly linked to the production of their employers or their customers could, in principal, choose to purchase insurance at a level commensurate with the laborer's perceived exposure to a given weather shock.

*High administrative and marketing costs remain.* Improvement in the nature and specificity of contracts comes at an obvious cost in terms of information as well as increased costs in terms of marketing. Administration and marketing costs, however, remain relatively fixed and thus unit costs are lower for larger policies. In addition, low-income and uneducated producers may be risk averse in contracting for a relatively complex financial instrument or unable to marshal the cash to pay premiums at the appropriate time. Moreover, to the degree that low-income households have higher than average risks—as may be

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2. In general, smaller units—and more reporting stations—will have less basis risk because they tend to be more homogenous. However, small units may also have imprecise estimates of the costs of weather shortfalls due to small samples, and thus may incur errors that influence pricing of insurance.

the case, for example, if local climatic variability creates spatial poverty traps—then the population that is likely to be the target communities for insurance linked to social protection may have actuarially fair premiums for low-level risks that are comparatively costly.

*Risk-layering may be an option.* However, an expansion of insurance opportunities is seldom done in isolation from a set of social protection programs and other formal and informal options to smooth consumption. In general, households manage risk with a set of *ex-post* and *ex-ante* strategies, often retaining a degree of risk and seeking to shift other risks, depending both on the probability of the loss and the costs of insuring. A typical form of *risk layering* might have a farmer retaining risk for small shortfalls of rain and to transfer some risk to commercial providers for greater shortfalls. This market insurance layer, however, may not be available or may be too costly unless low probability, high cost events can be covered through reinsurance. If there is market failure at this layer, the cost and, indeed, the availability of insurance for more moderate shortfalls may be affected. A government can serve this role of reinsurer, assisting local providers in spreading risk over space. Indeed, when a government is itself an insurer this reduces any disincentives to provide infrastructure that can mitigate risk. However, in many circumstances an additional or alternative layer of risk protection is through international reinsurance. When the government provides one layer of catastrophic risk it may be able to “crowd in” a degree of private insurance.

*Managing marketing costs.* Some of these limitations of index insurance can be addressed by the way it is packaged. For example, one way to address the scale consideration is to reduce the costs of marketing by linking the sale of insurance to the purchase of agricultural inputs or credit. The sale of fertilizer, for example, can include a weather-indexed policy that covers the financial risk in the event of a weather-related crop failure. In general, such insurance could be optional, although it may be mandatory in the case of credit insurance. However, as purchased inputs are a small share of a farmer’s overall loss in the event of a drought, retail outlets for agricultural inputs may be able to market wider coverage to their customers.

This envisioned role is similar to one that is already taken up by Microfinance Institutions (MFIs) in diverse settings. MFIs can be either *intermediaries* for insurance to their clients (see Box 1) or *beneficiaries* of reinsurance. In the former role, MFIs often include a mandatory insurance on the assets purchased when a loan is taken out, for example, to insure

### Box 1. Micro Finance Institutions as Purveyors of Micro-Insurance

MFIs can also serve as intermediaries for insurance that is not directly linked to loans taken. This service takes advantage of the ability of MFIs to collect small amounts of payments on a regular basis and is in keeping with the transformation of some MFIs from lending institutions to providers of a broader range of financial services including savings accounts. That is, the marginal costs for collecting such payments when staff networks are already in place may be reduced due to economies of scope. Indeed, the lives of over 1.6 million individuals in Uganda were insured through MFIs in 2004. While this example is of a profit making product marketed through NGO-managed MFIs, it may serve an important social protection role since it addresses the vexing problem of the vulnerability of widows to asset loss. This example of a role for MFIs does not, however, address covariate risk. Nevertheless, MFIs have marketed weather index based crop insurance (discussed below) in a few countries.



against the loss of a cow. They may also require that clients either insure against external factors that interfere with a client's ability to repay on schedule or offer loan protection insurance to ensure that debts are not passed on to survivors.

MFIs can also purchase insurance to reinsure themselves against a covariate shock that disrupts their cash flow. This reduces the risk of bankruptcy. Reinsurance helps MFIs get around the dilemma that they often work best on a small scale (or at least start small) and hence are vulnerable to localized shocks. This is a *meso* or market-level application that may also be taken up by larger commercial banks as well as retail agents because the services demanded as well as the ability of customers to repay any loans or advances is linked to rainfall or temperature.

## Implications for Public Intervention

Thus, even if the use of weather-based indices can reduce costs and solve some of the information asymmetries that bedevil rural insurance, in the absence of subsidies, it is not clear that low-income producers would be able to afford insurance or even that the most risk adverse “trust” formal insurance.<sup>3</sup> There may, therefore, be a role for the government in expanding the demand for individual insurance both to address equity concerns and to address market imperfections.

Moreover, the demand for weather index insurance by a household reflects not only the perception of downside risk, but also the assessment that the government or a donor will provide *ex-post* assistance. Thus, if the uninsured neighbor of a household that dutifully paid flood insurance premiums for years receives assistance as great as or greater than the insured individual, it is likely that in the future demand for insurance will decrease.

Finally, there are also *macro* level applications in which a government or NGO purchases insurance in order to be able to scale up programs in the event of a weather-related shock that reduces their revenues or increases the need for their services or—as is often the case—both at the same time. The World Food Program (WFP) has recently purchased such insurance (see below). Subnational governments or even social funds could similarly smooth program financing with insurance. In such cases, given the availability of an index on which to calculate a premium and payout schedule, marketing costs are not an appreciable issue. However, the ability to scale up a relief or reconstruction program that is funded by such payouts is a concern.

Another approach to index-based insurance is a layered strategy involving domestic funding of relief and recover up to a predefined point and further assistance covered through insurance. Given a diverse enough climatic base a country may be able to *self insure* social protection or relief operations on the basis of a weather index. In effect, this would geographically target federal funds on an objective and transparent formula either for a defined transfer program or as a contingent block grant to different administrative units at provincial or district levels. Using a transparent formula for allocating assistance could reduce the

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3. A number of studies have inferred unmet demand for insurance. Similarly a study of contingent valuation for drought insurance in Morocco shows that weather indexed insurance is both feasible and that the poor are not less likely to choose to insure. Nevertheless, weather insurance, particularly catastrophic insurance, is often subsidized even in developed countries.

temptation to use relief programs to reward political supporters or the reluctance of a government to declare a disaster. The central government could, in addition, reinsure against a catastrophic loss that follows a widespread shock and thus avoid an open-ended liability of an indexed disaster fund. Alternatively, the government could issue a catastrophe bond—or cat bond—that provided higher-than-market yield to investors but under which a portion or all of the principle is forfeited when a catastrophic trigger is hit (World Bank 2005b).

As with individuals, in the event that an insurance payout crowds out other revenues or transfers, there would be a disincentive for macro-level insurance. For example, if federally-funded disaster relief is reduced for municipalities that have received an insurance payout and not for those that have no insurance, this would create a macro-level parallel to a problem that is often noted on the micro level. Indeed, after weather indexing insurance for Nicaragua had been priced in the global reinsurance market, the government declined to pursue the program, citing the availability of international assistance following Hurricane Mitch (1998) as an indication that alternatives were dependable (World Bank 2005b). Similarly, if a government perceives that the amount of disaster relief donors will provide will be reduced on a roughly one-to-one basis with insurance payouts (triggering “the Samaritan’s dilemma”), the demand for insurance will reflect the degree to which the government values the timeliness of payments and not the complete aversion to the risk of a budget shortfall. On the other hand, donors or international financial institutions may prefer to pay the regular insurance premiums rather than mobilize the high catastrophic relief assistance once the weather shock has actually materialized.

# Recent Global Innovations

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**I**n this chapter, we review a selection of recent innovations in weather-indexed insurance in low-income contexts from around the world: Mongolia, Mexico, and India. In Chapter 4 we continue the review of experiences, this time focusing on Africa.

## Mongolia Index-Based Livestock Insurance

As of 2005, Mongolia is piloting index-based livestock insurance to share risks between herders, the insurance industry, and government in three provinces of Mongolia with a US\$7.75 million credit from the World Bank (World Bank 2005a). The project combines self-insurance, market-based insurance, and social insurance. Herders retain small losses that do not affect the viability of their business (self-insurance), while larger losses are transferred to the private insurance industry (market insurance through a Base Insurance Product or BIP), and only the final layer of catastrophic losses is borne by the government (social insurance through a Disaster Response Product or DRP).

Herders pay a market premium rate for the former product which will pay out when local mortality rates exceed specified trigger percentages. While excess mortality is based on weather, because it reflects a complex combination of dry windy summers and cold, high snowfall winters, the insurance index is not linked to the weather event itself but to historical livestock mortality data which are available. The insurance would pay out to individual herders whenever the livestock mortality rate in the local region exceeds a specific threshold. Insurance payments therefore would not be directly linked to individual herders' livestock losses; instead payments would be based on local region-level mortality. This should avoid or reduce moral hazards and adverse selection as well as reduce costs.

Key to the approach is the availability of good data to develop the livestock mortality index, and through the National Statistics Office (NSO), Mongolia has a 33-year time series on adult animal mortality that is available for all regions and for the four major species of animals (cattle and yak, horse, sheep, and goat). The mortality index provides the basis for determining the specific mortality rates that would be used to trigger indemnity payments under the BIP and DRP.

*The Base Insurance Product.* The BIP would be a commercial risk product, sold and serviced by insurance companies. Herders would pay a market premium rate for this product. This product would pay out when the *sum* mortality rates exceed specified “trigger” percentages (in the range of 7 to 10 percent, depending on species and location). The maximum payment under the BIP would be when mortality rates reach a specified “exhaustion point” of between 25 and 30 percent, depending on the location. The trigger and exhaustion point percentages have been derived from the analysis of historical livestock mortality data. They have been chosen to balance the level of coverage and affordability by herders. These numbers will be subject to annual review and change, if necessary.

*The Disaster Response Product.* The DRP is a social safety net product financed and provided by Government which would begin payments at mortality rates exceeding the BIP exhaustion point—between 25 and 30 percent, depending on the location.

The central activity of the project would be the piloting of these index-based livestock insurance products in the three *aimags* of Bayankhongor, Uvs, and Khenti for three consecutive seasons (2006/7, 2007/8, and 2008/9). These three *aimags* were selected due to their geographical spread and the relatively low historical correlation of livestock mortality. Offering the insurance over three seasons and over three *aimags* provides a strong chance that the BIP would be triggered (in some locations) and a reasonable chance that the DRP would also be triggered.

Different alternatives were considered in reaching the decision as to whether to trigger livestock insurance based on individual herd performances, or if indexing is adopted then which index to use for the insurance products (see Box 2).

## Mexico FONDEN and FAPRACC

Since 1995, the government of Mexico has earmarked funds for relief and reconstruction through the National Fund for Natural Disasters (FONDEN). This fund has supported emergency relief operations and productive safety nets.

Since 2003, some of these functions have been supported through an Agricultural Natural Disaster Fund (FAPRACC) that targets assistance to small farmers in the event of weather-related shocks including frost and wind damage with costs shared between the federal and state governments on a 70/30 percent basis. The existing database for different targeted transfer programs such as Procampo allows this micro-level insurance to be linked to specific guidelines based on a comprehensive inventory of assets as well as to localized contingencies. Thus, the program targets to households on proxies for chronic poverty but the timing of payouts is determined by the occurrence of weather-related shocks.

FAPRACC has piloted weather index insurance to transfer risk exposure out of the federal and local government budgets and has begun the process of scaling up this macro hedg-

## Box 2. Considering Alternative Approaches to Livestock Risk Management

Preliminary analytical work and discussions focused on selecting the most appropriate type of insurance for local conditions. The aim was to identify an insurance product for catastrophic mortality events within a region, recognizing that smaller, more localized livestock mortality risks are better addressed through appropriate household-level risk management mechanisms. As such, three alternative approaches were considered:

- (i) *individual coverage to herders* has been unsuccessful in Mongolia due to moral hazard, adverse selection, high administration costs, and a largely immature private insurance market;
- (ii) *index-based weather insurance* is another option using weather indicators rather than livestock mortality as its basis. As with the livestock mortality approach, index-based weather insurance would require an index for determining risk and designing the insurance product. However, Mongolia does not have the historical weather data that is necessary to develop the appropriate weather index reflecting the complexity of the *dzud* events (the combination of summer rainfall levels, winter snowfall levels, temperature, and wind); and,
- (iii) *index-based mortality insurance* is simpler than weather-based insurance and is less prone to moral hazards and adverse selection and less costly than individual insurance. In addition, historical livestock mortality data is available for all local regions and livestock species.

Source: World Bank (2005a).

ing. Insurance contracts based on the probability of drought at local weather stations are issued by the state owned reinsurance company, AGROASEMEX, and reinsured internationally (AGROASEMEX 2006). The program was initially piloted in the state of Guanajuato in 2002 using only 5 of the state's 127 weather stations. The following year a contract for coverage of 107,000 hectares and \$3.9 million with a premium of \$0.4 million was written for that state using six stations. The 2004 cropping year saw a second state included in the coverage. With overall obligations in the event of payout at 18.6 million dollars AGROASEMEX also hired reinsurance coverage, sharing both the premiums and the risk on a proportional basis. Further scaling up to 18 states and 186 weather stations occurred in 2005. That year also included the first payout due to drought; total indemnities paid were \$10.5 million, virtually the same as the cost of premiums for the year but only 16 percent of the full value of coverage.

The expected coverage for the 2006 crop year is over \$130 million. This coverage will cost a total of \$17.3 million with individual state premiums varying. Similarly, triggers vary by state and triggers differ by crop. Shortfalls of rain at any one of three different stages of growth can trigger a payment, although only a single payment per crop and state is permitted. Payouts come within three weeks of the trigger being assessed.

The 2.3 million hectares to be covered in 2006 represents 28 percent of the unirrigated cultivated area. The main reason this glass is only one quarter full after a short period of three years for scaling up is due to limited rain metering infrastructure. Less than 300 of the 5,000 rainfall meters in the country were deemed suitable either because the time series of data with few gaps was insufficient or because the stations covered urban areas or airports. The average station covers only 8,000 hectares of land with the maximum at 20,000.

At this time the insurance contract is with the Federal and State governments. Expenditures by the states, however, reflect the previous social protection programs. For example, currently farmers receive support from the local governments without a contractual relationship. Farmers do not either pay or even register for eligibility although they receive payments based on assumed area under the different crops covered. AGROASEMEX indicates that they can not insure certain areas of the country for the crops covered since they estimate the expected value for some crops is at a loss. One plausible way that continued cultivation of these crops (or the continued overstocking of livestock they have also identified) can be explained is that current state offered compensation has distorted production incentives.

While, as mentioned, the method of payment to farmers reflects the extensive database assembled for other social protection endeavors, private insurers are unlikely to bear the administrative costs for this program and would probably seek other means of matching the weather event to the payout. However, at this time the interface of privately-marketed insurance and state transfers is unknown, as is the degree to which state funds obtained from insurance crowd out federal transfers. Similarly, the approach is too new to assess how farmers modify their investments in response to the increased availability of hedging instruments.

Future directions for the program include a repackaging for insurance at the farmer level, again with piloting and subsequent scaling up. AGROASEMEX would like to transfer their technology to the private sector. In addition, AGROASEMEX is exploring the possibility of insuring livestock using remote sensing of a vegetation index. Similarly, satellite technology will also be considered as a means to fill in areas not currently covered in the rainfall insurance for crops.

## **India: Supporting Commercially Provided Weather Indexed Insurance**

India has introduced weather indexed insurance through an MFI, BASIX, with branches in seven states. BASIX serves as the intermediary between two private insurance companies and smallholders, taking advantage of its network of local agents to keep administrative costs moderate. The product is new; beginning in one district and covering two crops in 2003, it scaled up to 36 locations and introduced non-crop specific livelihood protection contracts in 2005.

The marketing faces a dilemma. From the standpoint of product design, it responds to farmers' needs with a diverse range of products including separate rainfall windows at planting, vegetative growth, and harvesting stages. On the other hand, there is a recognized need to keep the product line simple given the unfamiliarity of the product. Given the short time of operation it is too soon to assess how farmer input allocations have responded; neither can the long-term demand be determined—always a tricky issue with irregular payouts.

In a different project, in Uttar Pradesh, the World Bank is finalizing a US\$180 million loan that includes a pilot drought safety net (US\$2.3 million) and a component of technical support to crop-specific insurance (US\$0.8 million). The former pilot is envisioned as a contributory drought safety net that should partially substitute for traditional drought emergency relief transfers with an insurance product that provides timely ex-ante payments. By paying an *ad valorem* subsidy only on the first hectare of privately provided coverage, the subsidy does not increase with the farm size. For most beneficiaries who already purchased insurance, the subsidy is likely to be inframarginal and thus not increase pur-

chases. As the pilot is not yet large enough to diversify over the entire state, never mind the breadth of India, the initial premium payments are likely to be more than what will sustain a larger program since the risk is more covariate than it would be with a larger spatial base. Nevertheless, the scale of the pilot is large enough to be informative of demand for insurance by a class of farmers believed to be outside of formal insurance at this time.

The smaller component of the loan will widen the range of products within crop-specific technical packages offered to farmers and improve the database by supporting new weather stations. The stations—which will measure wind velocity and moisture content as well as rainfall because the crop-specific insurance has a wider range of triggers—will be installed by a private company; the Bank's role in this venture includes knowledge dissemination as well as the provision of a subsidy on demonstration plots of 0.1 hectares for each participant. But as these will include horticultural products with substantial cash inputs, this subsidy may cover a substantial investment. Both components plan an evaluation over three years and subsequent scaling up.





# Forays into Insurance in Africa

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**T**his chapter reviews emerging experiences with weather-indexed insurance in low-income countries of Sub-Saharan Africa, focusing on Ethiopia, Malawi, Kenya, and Madagascar.

## **Ethiopia WFP and International Drought Insurance**

A study prepared in 2004 as case-study for this paper recommends four possible uses of weather-indexed insurance in the context of Ethiopia (see Box 3 and Skees, Jack, Goes, and Miriti 2004). In each case, the feasibility of the insurances depends, in part, on the quality of the data and the degree to which the indices can be localized.

Of these various options, it is the fourth one which has recently been taken up via a pilot program. Ethiopia is the setting for a pilot use of a drought insurance mechanism at the macro level. In 2006 the World Food Program (WFP) purchased a weather derivative to protect against drought in Ethiopia during the 2006 agricultural season from a European reinsurer, AXA Re. This contract, costing US\$930,000, provides for a maximum payout of US\$7.1 million in case of a severe drought in selected woredas (districts) in Ethiopia as measured by weather stations located in these areas. A total of 26 stations were used for the analysis of the probability of a payout and for the underlying weather index on which the derivative contract was based. These represent the best weather stations in Ethiopia in terms of having complete and long historical datasets, over half of the 44 stations in Ethiopia with historical data with few missing observations, and roughly a fifth of the 120 official stations in Ethiopia. The pastoral regions of the country were not included in the pilot index as there are very few weather stations in those regions with good historical data.

### Box 3. Potential Uses for Rainfall Insurance in Ethiopia

Four potential uses for rainfall insurance are developed in the Ethiopian context:

- ◆ Linking rainfall insurance to loans
- ◆ Linking rainfall insurance to input usage
- ◆ Stand alone rainfall insurance
- ◆ Tying rainfall insurance to international food aid

Rainfall insurance can be used to spur lending. In some cases, lending is hampered by the risk. One can envision a bundled lending arrangement whereby those obtaining loans would be purchasing a certain level of rainfall insurance. This could open the way for individuals to gain better access to credit. However, such a system raises many questions regarding how the benefits of the arrangement might influence production decisions. The details of how much debt might be forgiven under what circumstances would also be a critical element to consider when linking debt to rainfall insurance.

A better system may involve the purchase of the rainfall insurance directly by the bank or microfinance institution. This would allow the financial institution to hedge default risk that may arise in their portfolio of loans when there are widespread/correlated losses due to drought.

One can also envision linking rainfall insurance to input purchases such as fertilizer. The motivation for such an innovation ties back to concerns that poor farmers are reluctant to take the risk of investing in technology given the risk environment. One advantage of this approach is that it is easy to implement. When selling a bag of fertilizer one only need attach a coupon that can be redeemed if it does not rain in the area. Direct sales of rainfall insurance are also possible. Insurers in Ethiopia expressed a keen interest in this idea. While basis risk (having a loss and not getting paid) is a concern, it is likely that a severe drought contract would have value in getting cash to many individuals when there is a regional problem.

The three scenarios presented above are not mutually exclusive in that these delivery mechanisms could co-exist providing more options and flexibility. Keep in mind however, that the reach of input markets and financial institutions remains small. Increasing the access to these services in rural areas should be a priority for improving agricultural production and risk management.

Finally, one can envision using the country-wide information that is generated from a portfolio model, to motivate cash payments to various key parties when a major problem is emerging. Results of the analysis show that years with severe rainfall shortages are correlated to WFP's emergency assistance to Ethiopia, supporting the idea that a rainfall index could be used as an early trigger for drought relief. It is well known that 1984 was among the worst drought years in Ethiopia. The analysis performed in this report also demonstrates that 1984 was by far the worst year from 1961–1996. An insurance solution could get cash into the hands of traders and others much earlier than food aid arrives. Using insurance-like solutions to provide early assistance is an idea that merits further development for Ethiopia.

*Source:* Adapted from Skees, Jack, Goes, and Miriti (2004).

The objective of this pilot is to ascertain the feasibility of using such an insurance instrument to make emergency assistance timelier, since a payout would allow for assistance in November of any year in which assistance is needed, much sooner than generally possible with emergency appeals that require a government request (after rains have failed) followed by field assessments and donor response. The scale is such that the WFP envisions only about 60,000 households would be covered with cash-for-work programs in the event of a maximum payout. As this is a contingent payout, the possible relief operations are outside

of those programmed for the public works programs for chronically food insecure families that are supported in the Ethiopian government's Productive Safety Net Program. A rainfall deficit would trigger money to WFP and thereby the Government of Ethiopia—the actual payouts to Woredas and then beneficiaries are based on the drought contingency planning system Ethiopia has in place since 2002. Thus, in some respects while the pilot is an innovation on the financing mechanism the envisioned response in the communities differs little from past disaster response, with the notable exceptions in regard to timing and the fact that cash instead of food would be used for wages. The long-term sustainability of such a program likely depends on the willingness of WFP's donors to pay premiums on a scale necessary to meet likely program requirements at scale.

One of the objectives for the recent pilot is to engage in price discovery to determine what contract prices will prevail. A total of five leading reinsurance companies participated in the WFP tender for the weather derivative contract in Ethiopia. AXA Re put forward the most competitive bid and was therefore awarded the first humanitarian aid derivative contract.

Disaggregating the data on rainfall into cropping seasons as well as different agro-ecological zones provides information relevant to determine risk pooling opportunities. Moreover, such analysis indicates other potential uses for data, thus increased rationale for investment. For example, it is straightforward to show that the southern and eastern rims of Ethiopia are most vulnerable to correlated risk problems that are driven by drought. However, when livestock production is added to the portfolio of risk, the degree of these correlated risks does decline for the south. Moreover, severe droughts for the two cropping seasons in the south appear to be slightly negatively correlated. This implies that timely payments, when early rains fail, may have a particularly high payoff in financing subsequent planting.

### **Malawi: Using Rainfall Data for both Localized Crop Specific Insurance and for a National Index of Maize**

The World Bank has provided technical assistance into an index insurance pilot for groundnut farmers in Malawi who have found it difficult to obtain loans necessary to finance the planting of certified seeds. The pilot, launched for the 2005/6 crop season, links two financial institutions, an agricultural marketing firm, and the Insurance Association of Malawi with clubs of farmers. Under the arrangement, if drought triggers insurance payments the funds will go directly to the banks to settle the farmers' loans.

The index and payout schedule has a number of features that illustrate the fine tuning that might be applied to contracts for a specific crop. First, the payout is based on the deficit in cumulative rainfall as at specific dates at three stages in the growth cycle: the establishment of vegetative growth, flowering and pod formation, and maturity. Second, not only is there a trigger below which payouts begin, payments increase in proportion to the shortfall in cumulative rainfall. For example, payouts are triggered if there has been less than 60mm of rain 30 days after planting (Table 1). For each millimeter below this cutoff, the farmer (or, actually, the creditor) receives 28.5 Malawi kwacha. If rainfall is below 30mm, the crop is deemed to have been irrevocably harmed and the loan is fully repaid. The triggers at flowering and maturation also include levels at which maximum damage is assumed to have occurred. If the crop is not a total loss the payout is cumulative; that is, the payouts for shortfall of rain in each of the three periods are added together. A final noteworthy feature

**Table 1. Payout Schedule for Malawi Groundnut Insurance**

Growth Period	Number of Days in Growth Period	Rainfall Trigger (mm) Below Which Payout Begins	Rate of Payout per mm Below Trigger	Lower Limit for Payout (mm)
<b>Establishment of vegetative growth</b>	30	60	28.5	30
<b>Flowering and pod formation</b>	50	160	16.9	30
<b>Pod filling and maturation</b>	60	100	16.9	20

is the fact that these benchmark dates are based on a flexible calendar; the starting planting date is not based on a set calendar date but rather is determined when rainfall is at least 25mm in a ten-day period. If no ten-day period between November 11th and January 20th has 25mm of rainfall, the crop is assumed to have failed and the loan is repaid.

Tailored as this program is to local cropping conditions, it is also limited in that it covers only the cash inputs into a single crop. Farmers in this program do not insure against the loss of income or even any costs of hired labor that they may incur. Thus, in addition to this specific product, there is a need for a more general instrument.

In the case of Malawi, there are two alternative methodologies for the development of a general index-based drought insurance or emergency relief strategy. An index can be based on data from the relatively few weather stations with a long-term record and with few missing observations, or a basket can be compiled from a weighted average of a number of stations. The basket can consist of individual contracts taken from across the country with weights chosen to represent the expected maize production in the region represented by each weather station. This is a cheaper, more efficient and appropriate approach. Firstly, it gives a measure of the countrywide exposure of maize production to drought and hence serves as a nation-wide food security indicator. Secondly, the basket approach can reduce the risk of reliance on one weather station and hence the associated issues of moral hazard and basis risk. Including more stations in the basket not only gives better national coverage and hence representativeness of the index but also increases the attractiveness of the insurance in the international reinsurance markets (Hess and Syroka 2005).

There are 21 primary weather stations throughout Malawi and approximately 200 rain gauges. All 21 primary stations exhibit long historical records with very few missing data points. Using 13 of these stations, a Maize Rainfall Index has been defined as a weighted sum of cumulative rainfall during the 130-day growing period of maize, with individual weights assigned to specific phases of the crop's evolution, so that the index gives more weight to the more critical periods when maize is most vulnerable to rainfall variability.

One way to see how well this or a similar index performs is to look at the relationship of the index and production. For example, the correlation between the inter-annual variations in an index constructed using data from Lilongwe Airport weather station and the inter-annual variations in both the hybrid and local maize yields in the Lilongwe region is 56 percent and 50 percent respectively for the period 1990–2002. Although these correlations are not strong, the index is somewhat more useful when focused only on drought years;

when years with below average maize yield are taken into account (10 years in total) the correlation rises to 72 percent. This still implies that only 52 percent of the maize variability in low-yield years is explained by the index (Hess and Syroka 2005). Moreover, the correlation of yield and rainfall was lower in most other districts.

These findings serve as a partial illustration of the potential and limitation of rainfall indices. As risk layering would generally assume that a household would retain frequent, low-level risk—restricting consumption if necessary—even looking at the correlation of yields below the mean does not match the rainfall index to the most likely use. More practically, a measure of the suitability of an index would be the degree to which the index can predict the probability of yield shortfalls at some distance from the mean, that is, low-frequency, high-cost events. Alternative analyses or alternative indices, based for example on planting dates or soil moisture, may improve the correlation or may prove to have timely payouts that are more in keeping with social protection objectives.

The case study on Malawi conducted for this study, for example, analyzed the potential for linking a “social protection payout” to an index-based insurance. Using the relationship between the Malawi Maize Production Index (MMPI) and WFP drought deliveries, as opposed to national maize production, a recalibrated “prototype” insurance product was designed.<sup>4</sup> The information on past drought deliveries were used to estimate a maximum exposure to drought risk based on an estimated cost of past drought deliveries given today’s prices.

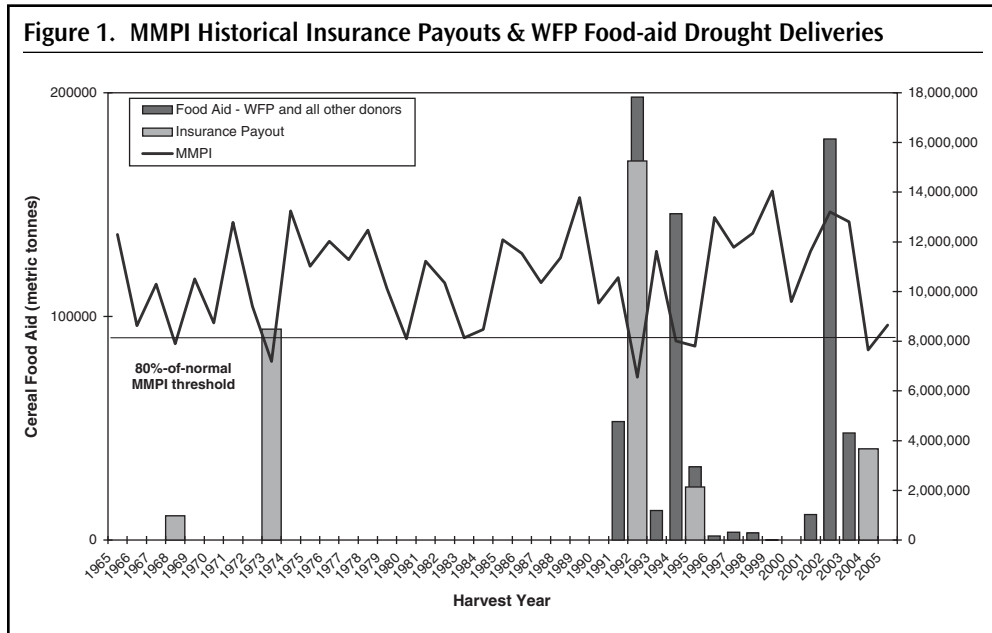
As can be seen in Figure 1 (see below), going back fifteen years the largest drought delivery by the WFP was in 1992 when it delivered close to 200,000 MT of cereals. Quantifying this by multiplying the tonnage by \$175 per MT (cost of maize) brought the maximum annual fiscal exposure in the last 40 years to US\$20 million given the historical weather data of 13 weather stations throughout the country (omitting the costs related to the physical delivery and distribution of maize). Thus, the index would have paid out five times in the last 30 years with three of those five payouts coming since 1990. These historical payouts can be used to determine the payout rate in US dollar terms, known as the tick size, for deviations in the MMPI for a maximum payout of \$20 million. Above 800mm of the rainfall index (equivalent to approximately 25 percent deviation from the 30-year mean), the insurance does not payout. As rainfall falls below this trigger, the insurance payouts are \$105,000 for each tick up to a limit of \$20 million.

Assuming improvement in designing indices, an important issue is to whom the payouts should go. On a national level, an insurance contract can provide the cash to import maize. This can be linked to call options trading on the South Africa commodity exchange (SAFEX) to reduce price uncertainty.<sup>5</sup> Insuring for the costs of imports, however, does not cover the main needs in the wake of a weather-related shock since the same shock that leads to an increased need for imports (or higher prices for grain) will generally reduce the incomes

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4. The team looked at the correlation between the MMPI and WFP deliveries of food aid specifically related to drought. This gave a (negative) correlation of around –54 percent. However, if you were to exclude 2002 from this index, when many attribute the extreme food aid needs to poor handling of the drought by government and an increase of vulnerability in the Malawian population in general, the correlation increased to –84 percent.

5. Malawi used such an option in 2005/6 marketing year saving between US\$60–90 per ton at a cost of US\$ 25 per ton for the premium on the contract. While this reduced price risk, it was not linked with insurance that covered the costs of the purchases.



Source: Bryla, Wiseman, and Tsoka (2005).

of the rural population. Thus, there is a need to tie insurance payouts received by the government to a distribution and targeting mechanism.

### Kenya Arid Lands Livestock

The World Bank (2003) also financed a form of drought-contingent social protection as part of the first and second phases of the Arid Lands Resource Management Project (US\$22 million and US\$60 million approved for phases 1 and 2 in 1996 and 2003 respectively). This project aims to develop and implement a community based drought management system that decentralizes monitoring and rapid response to the district and community levels in the 22 most drought-prone and food-insecure districts in Kenya. While the approach in this project has some common features with the other innovations surveyed here—in particular, it reduces monitoring of individual losses by using a community indicator—it differs in that it does not use a weather indicator. Instead, the community-based early warning system assesses drought risk through a monthly household and environmental survey conducted at the livelihood zone level. Subsequent decisions are taken by the district steering group made up of technical government and NGO representatives.

The decision on support is largely driven by the meat-to-grain price ratio. This is an objective, readily-observed measurement that reflects the real income of the pastoral population. Moreover, it is not easily manipulated by the potential beneficiaries, nor is it prone to moral hazard. Thus, it has many of the features that make a rainfall index desirable. In principle, this price index could be formulated into a transparent formal trigger point, and, furthermore, could be the basis for reinsurance, though this is apparently not the case.

One of the ways in which the second phase of the project aimed to improve drought preparedness was through enhancing the Early Warning System (EWS). Given increasing evidence of peri-urban and mixed livelihoods in arid districts and a variety of farm and wage labor in semi-arid districts, the coverage of the EWS was to be expanded beyond the focus on the meat-to-grain price ratio to include aspects of natural resources, migration, and conflict. Furthermore, District Drought Contingency Plans supported by the project would be triggered by the stages of drought signaled by the EWS.

An important feature of the program is that resource allocations are based on previously-prepared contingency plans. To ensure that drought contingency plans are better tied to the drought cycle and flexible enough for rapid response, a restricted portfolio of rapid interventions suited to each stage of a drought cycle was to be developed to be financed via contingency funds. Targeted responses include a transport subsidy that provides a floor for local prices of livestock and prevents a perverse situation in which declining prices lead to increased distress sales of animals. At the same time, efforts are made to strengthening water supplies in communities or at schools and health centers. If drought effects worsen, food aid is targeted through a community-based food aid distribution system. As communities recover from severe drought, restocking of destitute members of the community and other social safety net programs such as asset building through group credit schemes and other social programs are carried out.

At the time of project approval for the second phase in 2003, the proposal was to establish a Donor Contingency Funding Mechanism which was to be open to donors and others to make funding available on standby for activities in the contingency plans. The aim was to avoid the delays typically involved in *ex-post* emergency appeals, thereby improving the effectiveness of mitigation activities. The payouts from the fund would be triggered by information from the EWS. A fund in which resources sit prior to a realized event may be an expensive and somewhat risky option—relative to a formal insurance mechanism—given competing demands for these funds from other sources of need from within the country.

## Programs in the Planning Stage: Madagascar and Tanzania

Madagascar is in the early stage of designing a program to insure against the risks of both cyclones and drought. The current stage of the investigations is designed to assess meteorological data, existing agro-ecological zoning and cyclone models in the country, and to seek means to use such data to strengthen sub-national entities by providing financing mechanisms within existing or proposed programs for social protection and disaster response. The data may also be used to enhance the rural risk management framework by improving access to micro-level insurance policies and rural finance including that provided by MFIs.

Weather data in Tanzania appear to be relatively good.<sup>6</sup> The Meteorology Agency relies on 21 synoptic stations (one per region) and about 600 informal rainfall collectors (missions, hospitals, schools, and so forth). Though there are areas, in the South, where disasters come in the form of floods, inadequate rainfall is the chief source of weather risk in agriculture, affecting Central and Northeastern areas. The Agency offers services on a cost recovery

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6. There is a long tradition of data collection in Tanzania (formally since 1927). After being part of the Ministry of Transport and Communication for 22 years, the Agency became autonomous in 1999.

basis, and dataset are available on payment (for example, 30 years of monthly rainfall observations in ten collection points selected randomly).

At the present time Tanzania does not have a weather-indexed insurance product, although efforts are underway to develop a product for coffee farmers (akin to the groundnut farming insurance described for Malawi). In terms of potential implementers of an indexed insurance scheme, a combination of one of the domestic banks (CRDB) and MFIs might be an option. CRDB has ongoing technical support from DANIDA, experience deriving from implementation of a price protection pilot, and increasing its rural depth. In theory the National Microfinance Bank could be considered, but the fact that it is in the process of being privatized means it may be under stress for quite a while. Regarding the four main microfinance institutions (PRIDE, SEDA, FINCA, and FISEDA), the least likely to be interested is PRIDE, in light of its urban specialization, and the most likely is SEDA, because it is already working closely with the community based Savings and Credit Cooperatives (SACCOs, the alternative to the traditional Cooperative system), hence close to the final beneficiaries.



# Future Directions and Conclusions

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## Public Investment and Weather-Indexed Insurance Market Failures

Is there a potential to address market failures in household level insurance through public investment? The rationale for doing so comes, in part, from the evidence that there is unmet demand, reflecting, in part, the costs of monitoring and of transactions mentioned above. Similarly, in the relatively new field of index insurance there is still a fair potential that prospective clients can misestimate the risks of low frequency, high cost events or fail to anticipate the benefits of this particular type of insurance. In addition, possible clients will base their demand for insurance on their estimate of the probability of assistance from a government or from donors.

There is also ambiguity loading on the part of potential providers since they have limited information on which to base their estimates of risk. In addition, should a subsidy on insurance be found to be cost effective relative to the current expected government expenditures on relief and recovery, then the rationale for public support comes from the rationale for the expenditures already being undertaken; any cost effective improvement over existing investments can be justified in terms of the marginal savings of resources. By an analogous argument, the legitimate question of sustainability is ultimately tied to the sustainability of existing support and emergency measures. Insurance does not create new considerations in this regards, it mainly influences the timing of such costs.

In principle, subsidies on insurance premiums can address the implicit wedge between service provision and consumer demand created by asymmetric information, misestimates of event frequency failure and ambiguity loading. Moreover, subsidies can influence equity using the same targeting instruments that are advocated for other transfer programs. In practice, however, few countries—whether low, middle, or high income—have implemented progressive subsidies on insurance on a significant scale. Furthermore, to the degree that subsidies are on a limited amount of coverage or a fixed fee rather than a percentage of cost

of a premium, the subsidies may only be infra-marginal for a share of beneficiaries and, thus, not encourage the expansion of coverage. Adding to this dilemma is the fact that should subsidies induce greater coverage, this would most likely be greater the higher the risk of the environment and, if so, may distort behavior.

Balancing these legitimate concerns is the argument that increasing efficiency where other risk avoidance has led to substantial trade offs in terms of productivity, necessarily involves changes in behavior. Insurance should shift the burden of risk avoidance and encourage farmers to adopt activities with higher risk and higher expected payoffs. Additionally, as discussed, access to insurance should increase access to credit (indeed, it is often empirically difficult to distinguish credit constraints from risk avoidance). Thus, the concern is more a matter of *the degree to which* behavior is modified rather than *if* it changes.

Given the comparatively low rates of subsidies among the poorest small holders, a targeted subsidy such as the *ad valorem* subsidy being piloted in Uttar Pradesh, India is likely to be extra-marginal and, therefore, may increase the demand for insurance. Key issues for targeting may be choosing the indicator for the targeting (say land size) or the cap on the size of the coverage that will be provided. As with many other programs, there is no need that public financing of a service needs to imply the public provision of the service. Indeed, there are many reasons why public provision would crowd out the development of a private market. Thus, taking from examples of voucher programs that various governments have provided for agricultural inputs or for food consumption, subsidization may be most compatible with private service provision if it comes in the form of vouchers. Given the insurance providers are integrated into financial markets they may be more likely to accept a script that must be redeemed at a central location than many retail merchants might be. This will-igness would reduce the start up costs of a targeted voucher program.

In many cases, however, subsidies on premiums are not needed for the core of market-based weather-indexed insurance. In a direct analogy with micro finance (and, indeed, often using micro-finance programs as a delivery node) proponents of insurance claim that while subsidies on marginal rates invite elite capture, subsidies on transaction costs can broaden service utilization. In some of the pilots reviewed, the subsidies are implicit, with consultants or World Bank staff serving as a broker between insurance companies and banks or between these service providers and micro-finance institutions. A key to the long run sustainability of such programs is whether or not the product is profitable for the provider in the absence of external brokerage.

## Improving the Information Base in African Countries

Other than subsidies, one way that costs of service provision can be reduced is by improvements in the information needed for indexed-based insurance. Not only is the information needed on a reliable basis in order to have an objective and low-cost trigger, precise data is necessary to calculate the distribution of payouts; greater precision implies less ambiguity loading and, thus, lower premiums. Although private insurers have invested in weather stations in some countries, support to data systems is often acknowledged as a public good and one that is fairly free of rent seeking.

One private insurer indicated that they required the following to be able to contract rainfall indexed insurance: historic weather data, preferably covering at least 30 years and

with limited missing or out of range values; less than 1 percent observations missing; availability of nearby stations for “buddy checks”; consistency of observations (for example, manual stations are not automated in mid-series and the stations are not reoriented); protection against tampering; and an agreed method of settlement of disputes (Skees, Barnett, and Hartwell 2005). This is a daunting set of requirements at aggregate levels, never mind for a decentralized local index. Moreover, there is almost surely an overall negative correlation between the amount (and quality) of such data in different countries and the risk of life- or livelihood-threatening drought in those countries.

As the gestation for any useful time series is long, proponents of weather insurance are exploring other means of obtaining the data necessary to construct an index. One possibility is to use satellite rainfall estimates (RFE). These have a resolution of 0.1 degree latitude by 0.1 degree longitude (approximately 10 square kilometers). Data on rainfall as well as microwave based information on soil moisture and remote assessments of vegetation are available from 1996.<sup>7</sup> While RFE are unlikely to be preferred to data from weather stations, they may serve as a means of providing data where such stations are absent or too sparse or for cross checking and quality controlling data collected from real weather stations. RFE-based products on a national level clearly pick up the big events over large areas such as the current pastoralist drought in Kenya, Somalia, and Ethiopia. Nevertheless, there are a number of remaining problems with RFE. The topographical and tropical climate of Africa is particularly a challenge and there is not enough real-time station data coming from the underlying countries to adjust the RFEs for biases. Because getting on-the-ground station data is difficult, the process of verification is limited, although the data used for the Ethiopia and Malawi pilot programs are promising sources for correlation exercises.

Presuming the existing of an adequate index, additional steps are needed to package the information in a manner that is useful for a weather-index risk management instrument. A key step is to relate the timing of the risk exposure and the consequences for producers. For example, the rainfall data can be recorded for different stages of a crop and using a planting trigger to initiate the cumulative series. It is necessary, also, to determine the covariance of the distribution of these risks over the regions that plausibly will be covered and from this determine what is the maximum coverage that will be handled locally and what might be reinsured. Following this step, a contract that pays out when adverse weather occurs can be structured. Initially a fair amount of information, education and communication (IEC) is required in order that potential customers understand the product. Finally—and somewhat conditional on the success in the previous step—this contract likely needs to be marketed in international financial markets.

## Applying Weather-Indexing to Social Protection Programs

A range of alternatives to influence social protection objectives are feasible for any index insurance that is closely tied to the mitigation of drought (or flood) prior to any significant asset depletion. For example, vulnerable households, including laborers, might be targeted as eligible for payment of cash, food or vouchers, should insurance be triggered. This, in

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7. Data products produced by USAID’s Famine Early Warning Systems Network (FEWS NET) are posted on [earlywarning.usgs.gov](http://earlywarning.usgs.gov)

effect, resembles a fully-subsidized individual-level insurance (and differs from the case of Malawi's groundnut payouts mentioned above, because the groundnut payouts would go to the lender not the farmer).

Much of the above pertains to devising insurance instruments for individual contracts, whether subsidized or not. How different is the perspective of using insurance principles for social protection programs rather than for individual payouts?

*One critical difference stems from the degree of aggregation.* If insurance is used to fund safety nets then the unit that receives the payment would likely be a government agency or a community based organization. This sets up a two-tier payout procedure. The first tier payments would go to the local government or similar level of program management, and would be triggered by the weather index. This could be used to fund programs such as public works that are either self targeted through wage rates or targeted by proxies of need or other community level information on the potential beneficiaries.

The community programs, then, are less susceptible to basis risk than are individual payouts even though they are triggered by the same indices, likely using the same weather stations. Even though an individual can adjust the level of insurance purchased to match his or her subjective risk preferences effectively delinking the *level* of payments from the average correlation of rainfall and income loss, the timing and distribution of individual payouts follow the rainfall distribution. Thus, individuals may receive insurance when they have had little or no income loss or, conversely, fail to receive a payment when they had suffered a loss. Social protection programs that scale up program funding through weather-indexed insurance can use additional information to improve the match of payouts and loss. This potential is not automatically realized, however; it requires a targeting mechanism that utilizes information on income shocks and not just on chronic poverty.

A major obstacle to within-country reallocation of a contingency budget is that there are relatively few weather stations in many countries in Africa, as was noted above in Malawi. Other approaches include, as noted, weighted averages across the weather stations, satellite-based monitoring of ground coverage, or direct measurements of soil moisture. All are possibilities, but some might be harder to reinsure internationally. However, even the comparatively large basis risk inherent in having relatively few weather stations can be finessed in having a staged safety net program in which the early rainfall triggers some programs, and then more conventional vulnerability assessments as have been regularly conducted in several African countries (by, for example, WFP, UNICEF, and Save the Children) can subsequently fine-tune the targeting for late season safety net programs. This would reduce the chance that households seriously affected by a shock are left out of coverage.

*Targeting.* Community programs can also improve targeting of payments and needs by having a phased payout schedule. Social protection programs (as well as individual insurance contracts) can have multiple payouts over a weather cycle. A late onset of rain or an early break in rainfall might trigger a modest payment that will help fund replanting where feasible. Subsequent payouts could depend on aggregate loss. Index insurance might be used to trigger early payouts to fund public works and limit asset depletion. Later community needs assessments (with or without aggregate funding linked to weather indexed insurance) can be used to target direct relief and to ensure that basis risk and overall targeting errors do not leave a household unprotected.

While pre-screening has the advantage of conducting a time consuming targeting exercise prior to any emergency, the costs of such an activity are either incurred far more often

than needed, or they are conducted infrequently and risk going stale. Moreover, as indicated in a number of poverty assessments (for example, Malawi), proxy targeting is fairly imprecise in rural Africa

*Contingent financing for a scalable safety net.* An alternative potential approach, conceptually similar to the pilot scheme in Ethiopia with the WFP, is to link any payouts to scaling up of existing social protection programs, for example under the social investment funds in a number of countries (for example, the Malawi Social Action Fund [MASAF], the Tanzania Social Action Fund [TASAF], the Zambia Social Investment Fund [ZAMSIF]) or other public works programs. Such an approach assumes that a shelf of potential projects would be available, and that the implementing agency or local government can target services either on the basis of local knowledge (community based targeting) or by choosing a wage that facilitates self targeting. At this time, most Social Fund resources are allocated in accord with chronic poverty indicators but weather insurance could provide the information base for a contingent supplement for community grants. Both the technical planning of public works projects and the approaches to targeting are features of well-designed programs; insurance only changes the source and timing of funds. This is also the case with social funds. Indeed, some social funds in hurricane prone countries such as St. Lucia have prepared contingency manuals ahead of time although these are not yet funded through insurance payments.

It is also conceivable—indeed, desirable—that weather indexing can be used as part of a risk-layering strategy. A portion of high frequency, low severity events may be mitigated at the household level using savings and labor relocation, and a portion by the government using contingency budgeting from the central or (depending on the revenue basis of decentralization) local administrations. Relief following less frequent, large impact events can be funded through the reinsurance market internationally.

As formal insurance is only one component of a risk reduction strategy any insurance-based safety nets are likely to affect the use of other risk reducing instrument or be affected by these. For example, as with other forms of social protection, the availability of insurance will almost assuredly affect patterns of remittances. The net impact of an insurance payout on consumption and asset sales will be different than the gross payout by the amount that informal transfers change. Similarly, to the degree that a local or national government sees insurance as crowding out relief that would otherwise be forthcoming they may be reluctant to make the expenditures on premiums as was observed in Nicaragua. While this may be addressed if relief agencies agree to invest their relief budget in insurance, even if this is not the case, governments may find the certainty and timing of insurance payouts attractive for a range of risks.

## Potential Role of the World Bank in Insurance-Based Social Protection

Insurance at the national or even sub-national level is merely a means to make financing of programs more flexible. For a social protection program to serve an insurance function via safety nets it requires two features in addition to a countercyclical budget that enables a program to be scaled up as need increases as well as scaled back subsequently. First, the program also should be able to target transitory need rather than more chronic correlates of poverty. In addition, it needs a flexible implementation strategy such as a public works

program with a shelf of viable projects. Similarly, the potential for conditional cash transfers to address some individual risks such as unemployment on death of earners has been recognized (De Janvry, Sadoulet, Solomon, and Vakis 2006). A comparable possibility exists for scaling up conditional transfers on the basis of weather indices in some contexts. The Bank already has extensive experience in designing such *safety net programs to address chronic poverty* and may be able to adapt this experience to short-term crises as well.

The possibility of the *Bank financing information systems* such as those required to make a weather-indexed insurance feasible is similarly not novel. However, given the research that is still needed, the externalities of the public goods suggest that the costs for designing such a system for any given country might include a grant element. Moreover, as with other aspects of research, the potential returns to investment in information carry greater-than-average uncertainty even if the expected rate of return might be relatively high.

Analogously, the World Bank can play an important role in addressing a systematic approach in the implementation of a sound insurance system by investing in the design of an appropriate regulatory environment, strengthening the institutional capacity to overlook the system. Nicaragua provides such an example; US\$200,000 of a competitiveness loan will be used for developing a modern regulatory environment for insurance transactions.

Similarly, there is little difficulty in including an *information and dissemination campaign* that informs potential beneficiaries of the role of insurance as part of a larger project. This is one means by which privately provided insurance is promoted with in the agricultural support project in Uttar Pradesh.

While it is arguable whether Bank staff and consultants should be designing and brokering commercial insurance beyond a demonstration stage, such considerations have a different appearance from the perspective of social protection. From this standpoint, the World Bank might include *the design of a weather-indexed trigger for social protection within standard technical support* for project development or policy design. Regarding the financing of this contingency, it is worthwhile to consider:

- Whether a part of IDA Grants be triggered on the basis of weather indexing?
- Can Bank projects include components to finance insurance premiums?
- Can the Bank convene a consortium of donors to finance drought insurance in a country, for example, in Ethiopia?
- Can the Bank *accept* insurance premiums from a client country and directly provide weather-indexed insurance?

In actuality it appears that the answer to the first three questions is affirmative, while for the fourth it is not. The World Bank Insurance Unit (FESOPD) has been involved for several years in the management of catastrophic risks. Moreover, in 1999 the World Bank set up an earthquake insurance pool in Turkey (TCIP) and provided a US\$100 million contingent loan facility. This contingent loan has recently been increased to US\$180 million. Similarly, the pilot index-based livestock insurance program in Mongolia indicates that contingent loans are feasible (see Box 4). Certainly, contingent loans have non-standard disbursement schedules that will require modification of monitoring approaches, but the loans to Turkey and Mongolia can help establish the necessary procedures.

Regarding the fourth possibility, could the World Bank serve directly as an insurer—accepting country insurance premiums—in order to provide contingent funding based on

#### Box 4. Mongolia—Contingent Debt Facility in an IDA Index-Based Insurance Project

IDA credit proceeds under the Mongolia Index-Based Livestock Insurance project provide for a Contingent Debt Facility (CDF) of US\$ 5 million (out of a total IDA Credit of US\$ 7.75 million). The CDF would be used to fund any indemnity payments under the Disaster Response Product (see earlier discussion in chapter 3 of the paper) and to meet any cumulative shortfall in the Basic Insurance Product (BIP) Reserve for the BIP. Funds from the CDF will be disbursed through direct payments from the Bank to the Payment Account agreed to between the Bank and the Borrower, from which payments would be made to livestock herders. A country risk financing strategy would also be devised to give the Government and the domestic insurance industry the time to become self-supporting by building adequate reserves across time and/or seeking international reinsurance.

a weather index which funds drought responses for severe events? In this way, contingent debt could be viewed as a call option on the capital issued by the client and would allow clients to pay a fixed amount yearly (interest) in order to be able to access funds if the event occurs, based on predefined criteria such as the weather index (Bryla, Wiseman, and Tsoka 2005). The distinction of this model with the Mongolia contingent debt facility appears to be that in the Mongolia case the primary providers of the insurance are the private insurance companies, whereas the Government and the Bank are serving a reinsurer function rather than insurer. Within the current institutional framework at the World Bank the use of this type of contingent debt is limited. World Bank policy prohibits the provision of different interest rates to different countries. As a result, if a contingent loan was given it would be impossible to charge an interest rate that matched the true risk or probability of the event.

The Malawi case study notes that in general international reinsurers seek to diversify their risk portfolio into uncorrelated risk. The weather market does have some reservations about developing country clients, particularly where the client country controls the weather reporting network, but has expressed interest in the contract with the participation of a third party, such as a *donor as counterparty to the transaction*, if the donor or government agrees to keep a tranche of the risk. The World Bank—or indeed any donor agency—could help fill this function.

But then, what should be included in the *monitoring and evaluation systems* for such loans? Conditional on a payout, one aspect of the program effectiveness would be the degree to which the payments go to poorest households, either as direct payments or through programs such as public works and social funds. The standard criteria of exclusion and inclusion based on static indicators of poverty might be relevant for assessing targeting of any subsidies on insurance premiums. However, assessing the targeting of contingent payouts might need to determine the relation of such payments to the income shock received.

Ultimately, however, if insurance is justified in terms of improved economic efficiency, evaluation of the insurance component of safety nets should be in terms of asset protection and growth—and in terms of allocative efficiency. The former is hard to measure since the data necessary to assess reduced variability of consumption or changes in asset accumulation are difficult to acquire in the course of a project cycle. However, the latter

can improve even in the absence of a shock large enough to trigger a payout, because the presence of insurance is likely to encourage increased input use and increased innovation. This may be mediated by improved access to credit although labor and precautionary savings can adjust even if some lenders are slow to acknowledge the implications of the expansion of insurance coverage.

Such evaluation will be particularly important in that, globally, the use of weather index insurance in social protection program is still in an early stage of development. While privately-provided, unsubsidized weather index insurance will be forged and tested by standard commercial pressures, the involvement of governments and donors in broadening the role of insurance for program financing or in brokering wider use at the farm level involves additional expenditures as well as carries expectations of additional public benefits. How much of this potential is realized and at what cost will ultimately determine the degree to which the initial pilots discussed in this paper will prompt further public investment.



# Key Challenges to Commercialize Weather Index-Based Insurance in Low-Income Countries

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The following challenges must be addressed if index insurance markets are to be successful<sup>8</sup>:

*Basis Risk.* It is possible for index insurance policyholders to experience a loss and yet not receive an indemnity. Likewise, they may receive an indemnity when they have not experienced a loss. The frequency of these occurrences depends on the extent to which the insured's losses are positively correlated with the index. Without sufficient correlation, basis risk becomes too severe, and index insurance is not an effective risk management tool. Careful design of index insurance policy parameters (coverage period, trigger, measurement site, and so forth) can help reduce basis risk.

*Security and dissemination of measurements.* The viability of index insurance depends critically on the underlying index being objectively and accurately measured. The index measurements must then be made widely available in a timely manner. Whether provided by governments or other third party sources, index measurements must be widely disseminated and secure from tampering.

*Precise actuarial modeling.* Insurers will not sell index insurance products unless they can understand the statistical properties of the underlying index. This requires both sufficient historical data on the index, and actuarial models that use these data to predict the likelihood of various index measures.

*Education.* Index insurance policies are typically much simpler than traditional farm-level insurance policies. However, since the policies are significantly different than traditional insurance policies, some education is generally required to help potential users assess whether or not index insurance instruments can provide them with effective risk management. Insurers and/or government agencies can help by providing training

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8. Adapted from World Bank 2005b.

strategies and materials not only for farmers, but also for other potential users such as bankers and agribusinesses.

*Marketing.* A marketing plan must be developed that addresses how, when, and where index insurance policies are to be sold. Also, the government and other involved institutions, must consider whether to allow secondary markets in index insurance instruments and, if so, how to facilitate and regulate those markets.

*Reinsurance.* In most developing country economies, insurance companies do not have the financial resources to offer index insurance without adequate and affordable reinsurance. Effective arrangements must therefore be forged between local insurers, international reinsurers, local governments, and possibly international development organizations.

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Uninsured risk has far-reaching consequences for rural growth as well as poverty reduction. A range of informal mechanisms to insure rural households against the impact of shocks, but they are a modest component of a risk layering strategy for well-off households and even less protective for low-income households. Formal insurance mechanisms have inherent market imperfections. State interventions to address these limitations have proven costly and generally are targeted poorly. Recent developments in microfinance as well as in insurance marketing have opened new possibilities for household risk reduction.

Index insurance, such as weather indexing, addresses other inherent problems in insurance by using an indicator that is not affected by individual behavior and may address monitoring costs and moral hazard. A number of innovations using index insurance are being tried currently in diverse settings ranging from India to Mongolia to Malawi. Marketing costs may limit the provision of such insurance to small farmers, but even in such cases microfinance institutes may serve as market intermediaries. Moreover, state and subnational governments can use insurance to achieve countercyclical funding of programs. In this vein, municipal governments in Mexico have used insurance to finance disaster contingency while the World Food Program has insured a portion of its emergency assistance to Ethiopia. Humanitarian organizations and NGOs may also seek insurance in this manner.

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